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REVIEWS

A Roadmap for Educational Research in Pharmacy

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Educational research must play a critical role in informing practice and policy within pharmacy education. Understanding the educational environment and its impact on students, faculty members, and other stakeholders is imperative for improving outcomes and preparing pharmacy students to meet the needs of 21st century health care. To aid in the design and implementation of meaningful educational research within colleges and schools of pharmacy, this roadmap addresses philosophy and educational language; guidelines for the conduct of educational research; research design, including 4 approaches to defining, collecting, and analyzing educational data; measurement issues; ethical considerations; resources and tools; and the value of educational research in guiding curricular transformation.

Keywords: educational research, quantitative research, qualitative research, research design, curricular transformation

INTRODUCTION

Educational research has undergone significant growth in recent years amid increasing demands for accountability, data-informed decision making, and evidence-based quality improvement. While governing bodies like the Accreditation Council for Pharmacy Education assess the effectiveness of current practices in pharmacy education,[1,2] curricular changes and pedagogical innovations are permeating colleges and schools of pharmacy.[3-7] Amid the many challenges and changes facing health professions and higher education, educators are uniquely positioned not only to re-engineer learning and curricula within colleges and schools of pharmacy, but to engage in educational research that goes beyond informing course redesign and truly guides the transformation of learning and curricula. Thoughtful consideration should be given to the ability of educational research to inform, empower, and transform faculty members and the academy as pharmacy educators strive to understand and improve curricula and educational outcomes in pharmacy.

While some debate surrounds its definition, educational research generally refers to the systematic and critical investigation of any aspect of education that advances knowledge and benefits society by allowing people to live fuller lives.[8] It draws from a wide range of philosophies, constructs, and disciplines, equipping researchers to engage a diverse array of methodologies and approaches in their studies.

Educational research differs distinctly from assessment and evaluation, although the latter 2 terms are often used interchangeably. Assessment, which provides ongoing feedback for targeted improvement, guides good practice.[9] In contrast, evaluation guides good decision-making by facilitating judgments based on performance quality.[10] Although these approaches are closely related and often complementary, educational research requires a systematic approach that results in knowledge that can guide theory, contribute to conceptual frameworks, and inform future research.[8] Results from assessments and evaluations can inform study design, inspire research questions, and provide support for educational research, but they do not meet the standards of rigor required for educational research (Table 1).[8-10]

Educational research also differs from the scholarship of teaching and learning (SoTL). Defined as the systematic study of teaching and learning, SoTL involves answering questions about activities designed to promote student learning and improve teaching practices, and disseminating findings publicly.[11] SoTL focuses on practice-driven inquiries that are led by investigators (faculty members and teachers) with a vested interest in the issues under investigation and the critical experience necessary to assess change and understand subsequent findings.[12]

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Table 1. Comparison of Assessment and Evaluation to Educational Research

	Assessment and Evaluation[9,10]	Educational Research[8]
Purpose	To guide good practice and decision making; to determine if goals are being met; identify strengths and weakness; facilitate planning; determine effectiveness of treatment; evaluate programs.	To guide, contribute to, and develop theories; to generalize "about how phenomena are related."
Conceptual framework	Relies on practice to frame the study and inform results; the outcomes measure experiences and inform change. Theory typically not used.	Relies on theory to frame the study and inform results; the outcomes create new or extend current theory.
Audience	Administrators, accreditors, faculty, practitioners, and granting agencies, among others.	Scientific community, other educational researchers, and practitioners.
Conductors	Practitioners, accreditors, program evaluators, and administrators.	Scientific community, including university professors and researchers, among others.
Use of results	Results are used to inform change, such as program improvement (including teaching and learning), or to meet accreditation guidelines. Results can be used to judge performance quality.	Results are used to publish in peer-reviewed journals; results inform, develop, and extend theory; inform future research and practices.

This approach has provided significant insight into student learning and effective educational practices; however, the scope of educational research can extend well beyond teaching and learning. Educational leadership, enrollment modeling, student activism, economic impact, admissions practices, student debt, faculty equity, and organizational effects are among the numerous topics that can be examined with educational research. Educational research may also focus on populations outside of the local setting or on topics external to the investigator's vested interests.

A growing body of literature demonstrates the use of educational research in pharmacy and health professions education. Journals such as the *American Journal of Pharmaceutical Education* frequently publish empirical studies investigating various facets of pharmacy education, including student outcomes, faculty development, and instructional design. Similarly, *Academic Medicine, Journal of Nursing Education,* and *Medical Education* publish research on a wide range of educational issues that include innovative approaches to traditional and clinical teaching, faculty development, and curricular design. Colleges and schools of pharmacy are uniquely positioned to examine critical research questions within education that are not only of importance in pharmacy education, but are of increasing importance and interest to larger audiences within health professions and higher education. This includes topics such as the flipped classroom, science education, layered learning, clinical training, mentoring, faculty development, student development, and interprofessional education. To aid in the design and implementation of meaningful educational research within colleges and schools of pharmacy, this roadmap addresses philosophy and educational language, guidelines for the conduct of educational research, research design, ethical considerations, resources and tools, and the value of educational research in guiding curricular transformation.

PHILOSOPHY AND EDUCATIONAL LANGUAGE

Depicting an accurate reflection of educational experiences and the context in which learning takes place lies at the heart of educational research. Issues of access, perception, data interpretation, lack of control, timeliness, and extrapolation can impact an investigator's ability to capture and disseminate findings that describe what is happening within an educational environment. Understanding the boundaries associated with educational research can empower investigators to address potential limitations within the design of a study.

Two distinct paradigms drive the design and implementation of educational research: positivism and constructivism.[13,14] Positivism suggests that a single reality or truth exists across time and contexts, and that this truth exists independently of the researcher. Relationships can be understood through the objective study of variables isolated through sampling procedures and generalized to the population by the researcher with a certain level of confidence. In other words, reality exists independent of the human mind and relationships between variables can be established as scientific laws. In contrast, constructivism argues that groups construct knowledge for one another and that there are as many realities as there are social constructions. Truth is ever-changing, depending on context, and relationships can only be understood by

examining the role of factors like culture, gender, attitudes, external structures, and beliefs on reality construction. Study participants are selected based on specific characteristics of interest and are interactively linked with the researcher. Generalization beyond the population is not the researcher's responsibility.[13] Researchers may relate more to 1 paradigm than the other, but both paradigms can contribute greatly to one's understanding of education.

Embedded within the underlying and often competing philosophies of educational research are challenges associated with the language of education. Constructivism has driven adoption of the term "participants" over "subjects" to capture the active role human beings play in constructing social meanings within educational research. Descriptions and metaphors of educational activities may embody social and cultural values that can influence the conceptualization and interpretation of research based on the lens of the researcher, the participant, and the reader. The operationalization (ie, defining the measurement of a construct or variable that cannot be measured directly) and measurement of educational constructs like teaching and learning often suffer from the reduction of a complex concept into something that is measurable. As a result, researchers must clearly define terminology and explicitly describe the measurement and application of terms in the context of any pertinent value system.

GUIDELINES FOR CONDUCTING EDUCATIONAL RESEARCH

Historically, educational research methods have closely resembled the scientific method, which uses well-defined hypotheses and analysis techniques.[8] Process descriptions vary slightly from text to text[8, 14-16] but most follow this basic outline:

(1) Identify and clarify a problem. Select a topic and review the literature to identify gaps where research can contribute. Be mindful of available resources and identify a topic that meets standards for usefulness, timeliness, and ethical integrity. Prior to beginning any study, a problem statement should be written to provide a clear and succinct purpose for the research.

(2) Link the study to relevant theory. Theory drives educational research. It should inform the design and implementation of the study, along with providing context to the problem being investigated. Examples of common theoretical frameworks are shown in Table 2.

(3) State a research question(s) and/or hypothesis. Research questions are typically open-ended and broad enough to allow extension of the research following the study. A hypothesis provides additional detail about the research question and indicates what the researcher expects to discover. Similar to scientific research, multiple research questions and hypotheses may be acceptable depending on the nature of the study.

(4) Select a research design. Researchers need to determine an appropriate method for collecting, analyzing, and reporting the data. Does one want to understand a specific population or to study a larger population to make more generalizable conclusions? There are different approaches available depending on the nature of the problem, as described in the Research Design section below.

(5) Identify measures. The data collected to answer a research question can often take many forms. Special attention should be given to the design, selection, and/or construction of valid data collection instrument(s) to ensure that they are aligned with research question(s) and research design. One must be mindful of the need to engage a statistician

Table 2. Theoretical Frameworks Commonly Used in Educational Research

Academics and Student Learning	Organizational Effects	Student Development	Other
Holland theory of career Choice[21]	Leadership framework[26]	Theory of experiential learning[32]	Intergroup contact theory[37]
Academic disciplines[22]	Higher education[27]	Theory of identity development[33]	Model of institutional departure[19]
Adult education and andragogy[23]	Model for assessing change[28]	Piaget theory of cognitive development[17]	Polkinghorne practice theory[38]
Kirkpatrick learning evaluation model[24]	Causal model of student persistence[29]	Theory of stages of moral development[34]	Attribution theory[39]
Gardner's theory of multiple intelligences[25]	Organizational structure and student attrition[30]	Schlossberg transition theory[35]	Social cognitive theory/ self efficacy[40]
Bloom taxonomy (cognitive domain)[20]	Transactional distance theory[31]	Cognitive theory of student development[36]	Theory of involvement[18]

or researcher with the skills necessary to analyze the data collected; collaborating with these specialists during the planning stage of the study may strengthen the design and implementation of the research.

(6) Obtain Institutional Review Board (IRB) approval. Educational research involving human participants falls under the Federal Policy for the Protection of Human Subjects.[41] Approval or exemption from an IRB should be obtained prior to any data collection.

(7) Collect and analyze the data. Approaches to collecting and analyzing data are determined, in part, by the methodology used.

(8) Report, discuss, and disseminate the findings. Present a clear statement of the findings and form conclusions based on the results of the study. Expand upon the findings with a discussion that is framed by current theory and presented to advance current educational knowledge. Disseminate and share this knowledge with the appropriate audiences to advance the academy and educational system.

RESEARCH DESIGN

When planning, investigators must seek to answer researchable questions. The type of research approach selected is contingent upon these questions. The most common approaches to defining, collecting, and analyzing educational data are: quantitative research, born out of positivism; qualitative research, born out of constructivism; mixed methods research, which bridges the "schism between quantitative and qualitative research;"[42] and action research, which is commonly used by teachers or administrators to inform decision making at the local level [43] (Table 3). Because a wide range of disciplines and contexts can influence the inspiration, design, and implementation of a study, careful consideration should be given to which of these approaches best suits the study.

Quantitative Research

Quantitative research investigates phenomena using statistical, computational, or mathematical methods. Quantitative data are numeric in nature, represented by counts and measurements that are believed to describe a single, generalizable reality. Data sources for quantitative studies may include surveys, structured interviews, observations, performance indicators and assessments, institutional information, and national databases.[8] Sampling techniques can also vary in quantitative research. In an experimental design, random sampling means that every member of the population has an equal chance of being selected. This type of sampling is not always feasible or desirable in educational research, prompting many researchers to implement quasi-experimental designs. In quasi-experimental research design, sampling is not random and participants may represent a convenience sample or self-select into the sample. Sampling should be given careful consideration because it can directly impact data analysis and interpretation of the results.[8,14]

Quantitative data can be analyzed with statistical techniques. Selecting an appropriate statistical test for social science data is not trivial; hundreds of procedures exist, some of which are preferred by specific disciplines, and their applicability varies based on characteristics such as sample size and data type. The statistical tests and analyses conducted are as complex and rigorous as those applied to scientific research. Statistical techniques in educational research can range from relatively simple tests like correlations to complex analyses like hierarchical linear modeling. Common statistical packages used in analyzing social science data include SAS (SAS Institute Inc, Cary, NC), SPSS (IBM Corp, Armonk, NY), STATA (StataCorp LP, College Station, TX), and R (R Foundation).

In pharmacy education, a common approach to quantitative research is the use of survey instruments. For example, Owen and colleagues surveyed pharmacy students to identify factors associated with interest in international study.[44] Similarly, McLaughlin and colleagues examined pharmacy student engagement, performance, and perception of the flipped classroom using survey instruments and academic performance indicators.[45]

Qualitative Research

Qualitative research draws from data sources that are descriptive in nature, such as interviews, focus groups, observations, documents, blogs, and pictures. Although the data are not numbers, they should still be systematically collected and analyzed to provide rich, contextual information for answering research questions. The goal of qualitative research centers on understanding a specific target population. Common sampling techniques include: stratified, which draws from particular subgroups within the population; snowball, which uses referrals to identify participants; convenience, which draws from people who are easy to access; and random, which gives every member of the population an equal chance of being selected.[46] Random sampling is rare in qualitative research because sampling is typically purposeful.[8,15]

Because this approach tends to draw heavily on participant involvement, it is important to consider how the information needed to answer the research question will be identified, collected, and reported. For example, asking

Table 3. Comparison of Research Approaches in Education[8,14]

	Quantitative Research	Qualitative Research	Mixed Methods Research	Action Research
Purpose	To demonstrate relationships and describe populations; test predictions and theories; seeks generalizable results	To understand a specific population	To fully understand an issue and/or population from a quantitative and qualitative perspective	To understand and solve a current problem specific to the investigator
Conceptual Framework	Uses literature and existing theory to frame the study	Uses literature and existing theory to frame the study	Uses literature and existing theory to frame the study	Usually does not use a conceptual framework or theory; does refer to literature
Sample	Normally representative of the population; large	Purposeful; small in size	See qualitative and Quantitative sampling methods	Convenience sample (what is specifically affecting the investigator)
Research Design	Structured; dataset contains multiple observations & cases; collects data from surveys, measures, etc.	Data collected from observations, interviews, and documents	Uses a mix of qualitative and quantitative research methods	Can use qualitative and quantitative research design
Data Analysis	Statistical and numerical analyses	Coding and document analysis	Blend of qualitative and quantitative data analysis methods; triangulation	Depends on research design
Reporting Results	Results are generalizable and interpreted through theory (or used to create theory); published in academic, peer-reviewed journals	Results are interpreted through theory and help readers understand a specific population; published in academic, peer-reviewed journals	See "Reporting Results" for quantitative and qualitative research	Results may be publishable, but typically not generalizable; results help solve problems, make decisions, or improve practices

a student if a professor is knowledgeable about course material tells us only if the student *perceived* the professor as knowledgeable because the student likely does not have enough expertise to know if the professor is actually knowledgeable. In addition, qualitative research designs, such as case study, ethnography, narrative, and phenomenological, can answer different questions and provide varying perspectives on a given topic.[44]

Qualitative research provides a depth and richness to data that is often missing in quantitative research. This approach reduces the distance between the researcher and participant and provides insight into contexts, values, opinions, concepts, and behaviors. Examples of qualitative research in pharmacy education include the work of Warholak and colleagues, who used semi-structured interviews to examine the science of safety in pharmacy curricula.[47] In addition, Suda and colleagues used focus groups to examine perceptions of effective study strategies and materials in pharmacy education.[48] When done correctly, qualitative research can make meaningful contributions to educational theory and conceptual frameworks that help shape one's understanding of educational environments.

Mixed Methods Research

Mixed methods research, which has gained momentum in recent years, uses both quantitative and qualitative data in a single study.[14] While some researchers avoid this approach, others embrace it for its ability to enable more sophisticated and multifunctional research designs. By integrating both qualitative and quantitative research, the deficiencies of 1 approach can be offset by the advantages of another.[49] Mixed methods research can also enable methodological triangulation, which is the process of cross-examining results from 2 or more methods to validate findings. With proper foresight and design, a study using methodological triangulation can yield stronger and more robust findings.[49] A common example of mixed methods research in pharmacy education involves the use of qualitative data from focus groups or interviews to triangulate or provide further insight into findings from surveys, data models, or questionnaires.[50,51]

Action Research

Action research has been defined as inquiry conducted by teachers, faculty members, administrators, or others with a vested interest in the teaching and learning process for the purpose of gathering data about teaching, learning, and operations.[43] Action research targets specific problems at the local level with the intent to improve functions or outcomes. It is an approach to improving education through localized change by encouraging teachers to be aware of their own practice, to be critical of that practice, and to be prepared to change it.[14] A common example of action research is evaluating student perceptions of pedagogical approaches as demonstrated by Zolezzi's evaluation of an online psychiatric pharmacy course,[52] and the assessment of an educational tool for teaching medication history by Sando and colleagues.[53]

Most published action research studies are descriptive and restricted to a single classroom, program, or school,[43] which limits generalizability and reduces validity. Because action research is viewed as a practical research methodology that enables teachers to investigate their own teaching and their students' learning, there is often a tendency to use less rigorous approaches to these studies. Action research study results can provide valuable insight into local educational environments, but the approach should be well thought out and systematic with sound study design and implementation used.[43]

Measurement Issues

Reliability, validity, bias, and generalizability all play an important role in study design, implementation, and interpretation. Reliability is the extent to which a variable (or group of variables) consistently measures what it is designed to measure. A common approach to determining reliability is test-retest, which can indicate consistency in responses from an individual at 2 separate points in time. Most major statistical programs include reliability modules that can assess item-specific and overall measures of reliability using indicators such as the Cronbach alpha.[54]

Validity is the extent to which a measure correctly represents the construct of interest. Numerous types of validity exist and should be considered when designing or using a scaled instrument like a survey. Convergent validity, for example, assesses the degree to which 2 measures of the same construct are correlated while discriminant validity assesses the degree to which 2 conceptually similar constructs are distinct.[54] Threats to validity, including chance and confounders, can compromise study findings and should be understood and accounted for within the context of any study design.

From conception to completion, educational researchers must make every effort to limit bias (or acknowledge bias in the case of qualitative research) in a study. Some argue that it is impossible to eliminate bias because each researcher views the world uniquely based on experience and knowledge. However, bias can be limited. In qualitative research, investigators can use multiple analysts to improve inter-rater reliability and avoid adjectives that may inadvertently inject their own opinions into the findings. Additional sources of bias in educational research include social desirability bias, which is

the tendency for participants to respond in a way that they believe others will look favorably upon, and recall bias, which is the tendency for participants to draw responses from memories that may be skewed or inaccurate.

Given the prevalence of research in pharmacy education that uses survey instruments,[55] the importance of reliability and validity in survey research cannot be overstated. The design, wording, form, length, and order of items, along with the delivery mode and timing of a survey, can all affect participant responses. Developing, administering, and analyzing a survey instrument requires extensive planning and should account for numerous threats to reliability and validity. Survey research should be designed to optimize response rates and limit response bias and nonresponse error.[55]

Whether studies should be designed for generalizability is central to the debate between quantitative and qualitative research. When random sampling is used, quantitative findings can be generalized to larger populations of interest, but the methods themselves are limited to quantifiable constructs. Regardless of the methods used, findings should be interpreted and framed within their context because they may not be applicable in every time or place.

ETHICAL CONSIDERATIONS

Conducting ethical research requires careful consideration at each step of a study. There has been some confusion about the use of IRBs in health professions educational research.[56] Federal regulations define research as a systematic investigation and define human subjects as living individual(s) about whom an investigator conducting research obtains data through intervention or interaction with the individual or obtains identifiable private information. Paragraph 46.101(b)(1) of 45 CFR 46 singles out certain kinds of educational research as exempt: "Research conducted in established or commonly accepted educational settings involving normal educational practices such as (i) research on regular and special educational instructional strategies, or (ii) research on the effectiveness of or the comparison among instructional techniques, curricula or classroom management methods."[57] Although this provision applies to a large portion of educational research, this does not preclude the investigator from submitting an IRB application. Investigators must submit an IRB application requesting exempt status prior to the start of any research project involving human participants. At many institutions, exempt research can bypass full committee review; however, IRBs are unlikely to allow researchers to decide for themselves whether their research meets the standards for exemption from the 45 CFR 46 regulations.

The IRB serves as an independent party whose primary concern is to protect the rights and welfare of human participants involved in research. If an exemption is granted, it is still the researcher's responsibility to ensure that risks are minimal, participant identities are protected, and informed consent is obtained appropriately. Furthermore, IRB exemption may be denied if there is potential harm to the participant, which may exist within power structures or social norms. The complex and often dependent relationship between faculty members and students represents a common power structure in educational research that can jeopardize the ethical integrity of a study. While providing incentives to participants may be deemed appropriate by an IRB for some study designs, their use may be considered coercive in others. Another ethical aspect of study design is the appropriateness of withholding an educational opportunity for some students while offering it to others within a random control study design. Any risks associated with abuse of power or other potentially harmful consequences of participation should be explicitly addressed within the IRB application.

RESOURCES AND TOOLS

Conducting rigorous educational research requires thorough consideration of the resources necessary to design and implement a meaningful study. Accessing both classic and contemporary literature is extremely important to educational research. Employees of higher education institutions typically have extensive access to literature resources such as journal articles, books, and websites that are often not available through a public search engine. These institutional libraries have invested resources into subscriptions (online and in print), and consumers should take advantage of what is available. While PubMed provides extensive access to literature relevant to the pharmaceutical and health sciences, it is limited in its ability to identify educational research. Numerous computer databases and search engines like googlescholar.com should be used to identify and access educational literature across domains and disciplines. In education, the most robust electronic database is the Educational Resource Information Center (ERIC). This database indexes the *Current Index to Journals in Education,* which provides access to abstracts and full citations for articles published in over 800 journals, and *Resources in Education,* which provides information for unpublished reports, monographs, studies, and papers. The electronic database PsycINFO can provide additional literature in behavioral sciences and mental health from a database comprised of more than 3 million records.

Obtaining publically available data from government agencies, professional organizations, research centers, and advocacy groups may also provide information

that can inform and shape an educational research study. The National Center for Education Statistics is the primary federal entity for collecting educational data. The center routinely releases data and results from numerous surveys, including the Integrated Postsecondary Educational Data System, National Study of Postsecondary Faculty, and Beginning Postsecondary Students Longitudinal Study. These data sets may have some utility in designing educational research in pharmacy as well.

Assembling a team of individuals with a range of expertise related to the topic and research can provide value to the design and conduct of any research project. Educational research often demands a wide range of skills and collaboration, which can serve to strengthen the study, stimulate creativity, extend research networks, and enhance project dissemination. Creating an effective research team should be deliberate and strategic, incorporating individuals who can specifically contribute to the research initiative. This may require moving beyond a localized group like the instructional team or administrative office to include colleagues from within or beyond an institution who possess unique and relevant knowledge and skills. A statistician, survey developer, content specialist, or qualitative researcher could provide insight into study design, data analysis, and interpretation of the results. Identifying individuals who can contribute to a study team upfront can help to ensure a well thought out design and research plan. The collective vision and contributions of a team can serve to strengthen all aspects of the study from inception of the research question to data analysis and manuscript preparation.

Financial resources (ie, funding) may be needed to facilitate or conduct the proposed research. When deciding whether to pursue funding, researchers need to consider the scope of the project and the need for funding. Funding opportunities in the area of education are available and many more are emerging. Additional information is available on the websites of the Foundation Center (http://foundationcenter.org/efw/), the US Department of Education (http://www.ed.gov/), the Josiah Macy Jr. Foundation (http://www.macyfoundation.org/), and the Institute of Education Sciences (http://ies.ed.gov/funding/) for more information.

THE VALUE OF EDUCATIONAL RESEARCH IN GUIDING CURRICULAR TRANSFORMATION

In recent years, knowledge about health and medicine has grown significantly, the healthcare system has become increasingly complex, and educational innovations in technology and pedagogy have grown rapidly. Calls for reform within health professions and pharmacy education highlight ongoing concerns about the ability of current curricula to prepare students for the evolving healthcare needs of society.[1-4] Reform proposals have highlighted the need to rethink various aspects of the educational system, including curriculum content, pedagogical approaches, and student learning outcomes.[7,58] While numerous colleges and schools of pharmacy are taking action to revise their curricula,[7] pharmacy educators should look beyond the classroom and beyond isolated components of the existing curricula and rethink the entire educational process.

Fully understanding how to optimize educational outcomes requires a holistic and comprehensive approach to education as a system. The 2010 report from the Carnegie Foundation for the Advancement of Teaching highlights the disjointed nature of health professions education, citing "poor connections" between formal knowledge and experiential learning, and failure to develop habits of inquiry and innovation in learners.[59] Key articles in pharmacy education emphasize the importance of evaluating the impact of new learning environments on all aspects of the educational environment, including professional socialization of the students as they progress across the curriculum.[1,60,61] Efforts should focus on rethinking the competencies and abilities of pharmacists, promoting active learning in the classroom, challenging students to think critically and synthesize broadly to solve problems, engaging students earlier in patient care, and developing curricula in a more evidence-based manner.[1,60,61] Rethinking pharmacy curricula as complex systems with core components that require thoughtful integration and evaluation is likely to yield tremendous impact on student learning and the education and training of future health professions leaders.[62] This, in turn, creates an opportunity to thoughtfully design educational research studies and use the findings to inform and guide curricular transformation.

Measuring outcomes associated with changes to curricula and curricular delivery should be carefully planned, implemented prospectively, and disseminated appropriately.[60] As pharmacy curricula prepare students for patient-centered care, population-based care, and systems management, opportunities exist to evaluate the development of student learning as well as the impact and role of learners on patient care. Importantly, efforts must be made to use this evidence to refine student learning and pharmacy curricula, as well as shape the delivery of health care.[61] Educational research can play a vital role in providing evidence to schools and educators as innovations permeate numerous components of pharmacy education.[7] Taken together, the results from systematic and rigorous educational research studies can provide compelling support for implementing change that positively impacts the

ability of future pharmacists to address the health care needs of society.

Calls for reform, coupled with the changing landscape of healthcare delivery and pharmacy education, point to the need for a real transformation and a complete reengineering of the approach to educating pharmacy students. Educational research provides an opportunity not only to address the immediate and apparent questions facing schools and stakeholders, but creates an opportunity to design longitudinal studies that capture the long-term impact of education on desired outcomes. Pharmacy educators are uniquely positioned to engage in educational research that extends beyond informing course redesign and truly guides the transformation of health professions education. Thoughtful consideration should be given to the design and implementation of educational research as pharmacy educators examine student outcomes and disseminate new curricular and pedagogical innovations that enhance student learning.

CONCLUSIONS

Amid the calls for reform within health professions education and the increased accountability placed on institutions of higher learning for the quality of education provided, the role of educational research in informing practice and policy is of paramount importance. Educational theory and research can provide valuable insight into the complex teaching and learning environments embedded within colleges and schools of pharmacy. The creation, dissemination, and application of new knowledge can inform the practice of teaching and intellectual pursuits to advance the education of pharmacy students. The authors intend for this roadmap to stimulate and facilitate the conduct of rigorous and systematic educational research within pharmacy, and that educational research will be used to evaluate and guide curricular transformation efforts for years to come. This knowledge must be shared and disseminated widely to improve the education and training of pharmacy students and contribute meaningfully to informing the changing landscape of higher education.

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