

Using mixed methods research in medical education: basic guidelines for researchers

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CONTEXT Mixed methods research involves the collection, analysis and integration of both qualitative and quantitative data in a single study. The benefits of a mixed methods approach are particularly evident when studying new questions or complex initiatives and interactions, which is often the case in medical education research. Basic guidelines for when to use mixed methods research and how to design a mixed methods study in medical education research are not readily available.

METHODS The purpose of this paper is to remedy that situation by providing an overview

of mixed methods research, research design models relevant for medical education research, examples of each research design model in medical education research, and basic guidelines for medical education researchers interested in mixed methods research.

CONCLUSIONS Mixed methods may prove superior in increasing the integrity and applicability of findings when studying new or complex initiatives and interactions in medical education research. They deserve an increased presence and recognition in medical education research.

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 INTRODUCTION

Medical education research finds itself at the intersection of two approaches. It is subject to increasing calls for evidence-based medical education,^{1–4} which often relies on controlled experiments or comparison groups. However, this emphasis on evidence-based practice threatens ‘to reduce research questions to the pragmatics of technical efficiency and effectiveness. It will not encourage research which explores the wider social, philosophical or ethical issues’ inherent in educational and policy decisions.⁵ Commentaries on the future direction of medical education research leave little doubt that both qualitative and quantitative approaches are needed to expand knowledge and understanding of educational process and content, and of impacts.^{6–9}

Medical education research regularly involves exploration of complex initiatives and interactions among multiple players,^{10–12} such as those involved in measuring the translation of knowledge, attitudes and skills displayed in the provision of patient care.¹³ As such, medical education research provides the ideal milieu in which to conduct mixed methods research, which is, namely, the collection, analysis and integration of both qualitative and quantitative data in a single study.¹⁴ The benefits of a mixed methods approach are particularly evident when studying new questions and initiatives or complex initiatives and interactions in natural, as opposed to experimental, settings.^{15,16} This approach aims to broaden and triangulate research findings^{17–21} in a way that sheds more light on these findings.^{15,22}

Mixed methods approaches should feel familiar to individuals practising medicine as most patient care includes collecting and analysing both qualitative (patient history) and quantitative (physical examination and diagnostic tests) data, and resources on conducting quantitative, qualitative and mixed methods research abound.^{15,17,23–33} Unfortunately, for those who want to learn more about mixed methods research in medical education, there is no readily available set of basic guidelines. The purpose of this paper is to remedy that situation by providing a starting point for investigators interested in, but unfamiliar with, mixed methods research and approaches.

 BACKGROUND

Although mixed methods research has been used in the social and behavioural sciences^{34–37} for more

than a century,^{38,39} its use in education and medicine has been hampered by epistemological debates between the qualitative and quantitative traditions.^{40–45} During the past decade, mixed methods research has been rigorously promoted as a distinct methodology.¹⁵ Relating and integrating qualitative and quantitative data in the research process is key to distinguishing mixed methods research.¹⁴ This distinction has been supported by a proliferation of in-depth texts designed to guide researchers in the application of mixed methods,^{14,21,26,46} a new journal,⁴⁷ and funding opportunities.^{15,48} Greene and her colleagues¹⁹ have defined five particular categories of purpose for the use of mixed methods in research studies:

- development: to inform the development of one method from another, using the methods sequentially for the purposes of increasing construct validity;
- complementing: to explore areas of overlap and uniqueness within a phenomenon through the use of different methods for the purposes of enhancing, elaborating, illustrating or clarifying results, and to aid in the description or application of research findings;
- triangulation: to cross-check and corroborate results by the use of different types of data;
- expansion: to increase the range or scope of inquiry by appropriately matching the methodology to various components of the question of interest, and
- initiation: to specifically discover inconsistencies and new perspectives that may be uncovered as a result of employing both qualitative and quantitative methods.

These purposes are not mutually exclusive and may be combined in any given study.

 APPLICATION OF MIXED METHODS IN MEDICAL EDUCATION RESEARCH

Although mixed methods research in medical education has grown significantly in the last decade,⁴⁹ specific research design models have not been defined. Current textbooks describe designs ranging from four models with 10 variants¹⁵ to over 20 typologies of mixed methods research designs.⁵⁰ In a review of mixed methods studies in medical and nursing education research carried out over the past 20 years, Schifferdecker⁴⁹ identified four overarching design models that were used consistently. We use

these four models – instrument development, explanatory, triangulation and longitudinal transformation – to define and illustrate mixed methods research designs in medical education.

In our focus on these four designs, we do not suggest that they are the only ones available and appropriate for use in medical education or that they will always be the best designs to use. However, they cover a number of the variants in mixed methods approaches, have been used successfully in medical education studies⁴⁹ and fulfil a wide range of purposes and options for conducting mixed methods research. For these reasons, we consider them to represent an excellent starting point from which to define and illustrate mixed methods research in medical education.

Instrument development model

Instrument development is a model in which qualitative data are collected for the purpose of developing a quantitative instrument, such as a questionnaire or checklist, for observation. The resulting instrument is grounded in the views, experiences and language of the participants, rather than relying solely on the perspective of the researchers.

Sherratt and Jones⁵¹ used this model to develop a needs assessment for continuing medical education (CME) training in working with patients who misuse narcotics. They began by conducting semi-structured interviews with individuals in different clinical roles to assess areas of concern when seeing patients misusing narcotics. They used themes identified through analysis of the interviews to develop a questionnaire, which was sent to health care workers in more than 30 practices and pharmacies. Responses to the questionnaire suggested that the topics included were relevant concerns, as more than 80% of general practitioners and nurses were interested in training on those topics. The researchers could have developed a questionnaire without the interviews or they could have used the qualitative data only to select topics for the CME course. However, by using an instrument design approach, they were able to identify the range of possible relevant topics to address (interviews) and to verify which were of primary interest to their target audience (questionnaire).

Questionnaires are not the only instruments that can be designed from qualitative data. Other tools and techniques possible include observational checklists, used extensively in objective structured clinical examinations (OSCEs),⁵² and pile sort exercises,⁵³ a method

where individuals sort pictures or words into piles, which produces similarity data across respondents. Analyses of these data can reveal how an area of interest (e.g. patient-centred care) is defined, conceptualised or agreed upon across different individuals.

One cautionary note for instrument development from qualitative data concerns the desire on the part of an investigator to develop an instrument that covers every aspect of the topic revealed during qualitative analysis. As with any instrument, investigators must balance the overall question and purpose of the instrument with the time required by respondents to complete it.

Explanatory model

The explanatory design is one in which results or questions arising from quantitative data are explored qualitatively, producing data that are used to complement or clarify the original findings.

Kennedy and colleagues⁵⁴ wanted to explore the gap between knowledge and behaviours among residents when providing clinical care. They used the identification of autism and referral steps as the basis of their investigation. Firstly, the residents participated in a training session on autism. They completed pre/post questionnaires, which showed adequate and improved knowledge of autism. A few weeks later, the residents were videotaped during an OSCE-like scenario in which they observed a child who was potentially autistic via a video and then discussed a management plan with the child's parent (standardised). A pre-set checklist of expected behaviours (quantitative) was used to code residents' videotaped scenarios and identify those residents whose behaviours did not match their knowledge (gap). Afterwards, the residents were interviewed while viewing videotapes of their encounters in order to capture their interpretations of their reasoning and behaviours. Interviews with residents who displayed a gap were then coded to identify potential reasons for their behaviours.

This study used a combination of two quantitative approaches, a questionnaire and an OSCE-based checklist of behaviours, to identify a gap between knowledge and behaviours, but went further by exploring reasons for this gap. A questionnaire could have been developed to capture potential reasons for the gap, but semi-structured interviews allowed for wider exploration of the possible reasons.

One general consideration when using the explanatory model concerns the need to decide how

individuals will be selected for the qualitative portion of the study. In the above example, all participants were interviewed, but only a subset of the interviews were analysed based on the quantitative results (i.e. those in which a gap was found). Although there are instances in which the individuals participating in the quantitative phase of a study may not be available for the qualitative phase (e.g. Year 4 medical students), it is generally recommended that individuals selected for the qualitative phase should be drawn from those used in the quantitative phase in order to best represent their experiences or views.¹⁵

Triangulation model

Triangulation, the most widely used design in mixed methods research,¹⁵ is a model in which qualitative and quantitative data are collected simultaneously. Data collection generally occurs in a relatively short period of time and involves a single population (e.g. medical students). Data are integrated in the final analyses.

Papp and colleagues⁵⁵ wanted to examine professional and personal effects of sleep loss and fatigue on residents. Residents from five institutions participated in focus groups on experiences with sleep loss, fatigue and coping strategies, and then completed a questionnaire which included a standardised measure of sleepiness. Data were analysed separately and then integrated to provide an overview of the existence of sleep loss and fatigue (quantitative results), and the professional and personal effects of sleep loss and fatigue (qualitative results). By choosing a triangulation design, the researchers were able to both substantiate the hypothesis that residents are sleep-deprived and also to describe the areas of professional and personal effects associated with this deprivation.

One potential challenge in both the triangulation and explanatory designs refers to the discovery of contradictions between the qualitative and quantitative findings.¹⁵ Although such findings are seemingly disconcerting, these situations allow for opportunities to develop new research questions or theories, and to collect additional data for clarification and exploration. Padgett⁵⁶ has suggested that if additional time or resources are not available to further the study, results should be presented together and directions for future research defined.

Longitudinal transformation

A model that combines many of the characteristics, benefits and potential challenges of the models

previously described is the longitudinal transformation model. This model collects data at multiple points (longitudinal), generally from more than one population (e.g. residents and attending doctors), and uses multiple methods (such as coding of e-mail communications, pre/post questionnaires and examination scores). The data are analysed and integrated throughout the project and often build on one another.

Coady and colleagues⁵⁷ wanted to define a core set of musculoskeletal skills for medical students. They began by conducting focus groups with doctors from multiple specialties and in-depth interviews with doctor experts to inform the design and content of a questionnaire (instrument development). The questionnaire was sent to a large number of clinicians representing different specialties. Results were summarised and used to develop a modified group-nominative technique for a six-member, multi-specialty group to finalise the core set of musculoskeletal skills. The nominal group technique is a consensus planning tool that helps a group to prioritise issues or come to consensus on some topic, such as clinical guidelines.⁵⁸ In this group-nominative process, members of the group were given focus group and questionnaire summary results to review. They were then asked to vote on whether items in the list of skills were core, not core or undecided, and to present their reasons and decisions to the group (a form of the explanatory design model). Modification of some of the skills took place and a second round of voting ensued, leading to consensus on a 50-item set of core examination skills for medical students. By using a longitudinal transformation design, the investigators were able to define the universe of possible core skills in depth (qualitative), narrow the relative importance of these skills through a larger group (quantitative), and provide both sets of data to experts from multiple fields in order to refine the final set of core skills (qualitative and quantitative combined). Additional examples of longitudinal transformation studies in medical education can be found in the nursing literature.^{59,60}

Important considerations in the longitudinal transformation design concern when and how data are collected, analysed and compared or integrated. In some cases, information to develop one piece of the study is dependent on analysis of another dataset, such as the development of a questionnaire from qualitative data. In other cases, data collection at one stage might bias data collected at a later stage (e.g. conducting focus groups before administration of a

post-intervention assessment). As with any study, potential bias should be identified prior to data collection and steps taken to eliminate or reduce it. Creswell and Plano Clark¹⁵ describe some possible approaches, such as distributing qualitative data collection equally between control and treatment arms in a trial or collecting unobtrusive qualitative data, such as diaries kept by all participants.

The research design models and studies described above illustrate the range of research questions and topics that can be addressed using mixed methods research designs. In each case, the researchers could have chosen a solely qualitative or quantitative approach to address their research question. However, the combination of approaches allowed them to enhance the relevance, depth, applicability and triangulation of their research findings.

As discussed, specific considerations and challenges arise in mixed methods designs just as they do in purely qualitative and quantitative approaches. More general challenges for conducting mixed methods research relate to:

- 1 the availability of resources with which to conduct the research, including time, money and personnel with strengths in both qualitative and quantitative methods;
- 2 access to tools and programs with which to store and arrange data to promote comparison or integration of qualitative and quantitative data, and
- 3 the difficulties encountered in publishing mixed methods studies, given word limits and the amount of data such studies present.

To aid medical education researchers in considering mixed methods approaches and addressing some of the potential challenges and questions, we provide the following general guidelines for developing mixed methods studies.

GUIDELINES FOR MIXED METHODS RESEARCH STUDIES IN MEDICAL EDUCATION

The most important task in any research is to clearly define the research question and hypothesis to be investigated. In the case of mixed methods studies, multidisciplinary teams with expertise in qualitative, quantitative and mixed methods approaches are invaluable, both for defining the question or hypothesis and for selecting the research design model and methods to use. As Stange and Zyzanski¹⁶

noted, when ‘the only tool researchers have is a hammer, they tend to see every problem as a nail’. Thus, mixed methods perspectives can aid in the determination of the best tools possible for answering the question or hypothesis, and may lead to the decision that a purely qualitative or quantitative approach is appropriate. If researchers with qualitative or mixed methods expertise are difficult to locate, departments such as those of anthropology, nursing, sociology and education are potential resources, as are colleagues who conduct research in community-based settings. When a mixed methods approach is chosen, there are a number of major steps to be taken for designing, analysing and publishing studies:

- Identify the study design as mixed methods and choose the appropriate research design.^{14,15,61} This increases the recognition and easy identification of mixed methods studies in medical education research and connects this literature to the larger mixed methods research paradigm.
- Decide on the prominence of each data type in data collection, analysis and results (i.e. whether the study is quantitative-dominant, qualitative-dominant, or whether both types are given equal status).^{39,62,63} The more detailed investigators are in defining the prominence of each data type, the more they will be able to plan for the resources and personnel needed.
- Develop sampling strategies for data collection that provide adequate data for the research questions asked and that adhere to guidelines within the methods chosen. These strategies should address common considerations when designing quantitative or qualitative studies, such as ensuring adequate power to develop inferences or conducting sufficient interviews to establish reliability.^{61,64,65}
- Decide how and when data are collected, analysed and integrated or compared. In the first three models, the order and process is fairly straightforward. Qualitative and quantitative data are collected and analysed sequentially in the instrument development and explanatory models and concurrently in the triangulation model. The longitudinal transformation model requires careful planning to identify potential biases and to consider when different datasets need to be collected, analysed and integrated. Realistic analyses of the time required for each project phase are important. On a cautionary note, researchers unfamiliar with qualitative approaches can easily underestimate the resources and time required. For example, the

conducting of one 90-minute focus group requires time for recruiting participants, developing the focus group guide, conducting the session, transcription and analysis. The total time required can lie in the range of 25–40 hours.

- Explore tools (e.g. software programs) or methods to integrate qualitative and quantitative data analyses.^{66–68} A number of programs are available to assist with this process.
- Review mixed methods research articles to generate ideas for reporting and displaying data, and develop a strategy for publishing mixed methods research results (e.g. consider reporting quantitative and qualitative results in separate papers in order to stay within word limits, but submit the papers as a pair to the same journal).⁶⁹

Researchers interested in exploring mixed methods in greater depth will also benefit by consulting more exhaustive research guides that focus on this approach.^{15,26}

CONCLUSIONS

Mixed methods research may offer a number of benefits over purely qualitative or quantitative approaches. This paper provides an overview of mixed methods research and guidelines for use in medical education research. Some unique methodological challenges remain, such as the learning of effective strategies and tools for integrating qualitative and quantitative data analysis,⁷⁰ but options are available and growing. Researchers must also carefully consider the resources and expertise required to carry out both qualitative and quantitative data collection and analyses. Nevertheless, when studying new questions or complex initiatives in natural settings, as is often the case in medical education research, mixed methods approaches may prove superior in increasing the integrity and applicability of the findings.

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