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Skills Development and Academic Productivity of Scholars in the NIH Mixed Methods Research Training Program for the Health Sciences

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Abstract

The Mixed Methods Research Training Program (MMRTP) for the Health Sciences is a mentoring-based program to train faculty in mixed methods research. We administered a Mixed Methods Skills Self-Assessment instrument with domains of “research questions,” “design/approach,” “sampling,” “analysis,” and “dissemination.” For each item (i.e., skill), we requested three ratings on a 5-point Likert-format scale drawn from an educational competency ratings scale: “My ability to define/explain,” “My ability to apply to practical problems,” and “Extent to which I need to improve my skill.” To assess productivity, we administered a survey with questions related to grants funded, grants submitted, publications, presentations, instances of serving as an institutional resource for mixed methods, and other comments. The results showed that 29 scholars in the first two cohorts represented a diverse set of disciplines and research topics. Although scholars expressed a strong interest in learning mixed methods skills, they came into the program with limited professional experiences with mixed methods. Scholars reported statistically significantly increased confidence in ability to define or explain concepts and in ability to apply the concepts to practical problems. Only practical applications of case studies and ethical principles of research did not show statistically significant improvement after the retreat. Scholars reported substantial productivity in mixed methods and described leadership in mixed methods at their institutions. Participation in an interactive program statistically significantly improved the confidence of scholars. The MMRTP holds promise to bridge the gap between complex research questions in the health sciences and investigators suitably trained in mixed methods.

Keywords

Faculty development; mixed methods; research; outcomes assessment; professional development; research productivity; research training

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Ethical Approval

The program was reviewed by the Institutional Review Board of Johns Hopkins University and was deemed exempt as educational research on August 2, 2014 (IRB No: 00005739).

Health services researchers are increasingly using mixed methods approaches without substantive training in rigorous scientific techniques. As a result, findings from mixed methods investigations do not advance the potential for integration of qualitative and quantitative data, present confusing and inadequate results, and ultimately diminish the potential of their scientific impact on communities, public health agencies, and patients (Creswell, Klassen, Plano Clark, & Smith, 2011). Indeed, investigators today—often being asked to participate on collaborative teams using mixed methods—have little access to training opportunities, advice from health researchers skilled in this methodology, and ongoing mentoring needed to conduct rigorous and systematic investigations. Nevertheless, an increase in proposals submitted to the U.S. National Institutes of Health (NIH) using mixed methods reflects the growing awareness of the importance of this approach in addressing population and behavioral health (Coyle et al., 2016; Plano Clark, 2010). The NIH is the largest source of government grants for health research in the U.S. and funds \$32 billion in research per year (NIH, 2017).

In the Mixed Methods Research Training Program (MMRTP), we build on the expanding interest in mixed methods across the health sciences in fields such as nursing (Morse & Niehaus, 2009), medicine (Bristowe, Selman, & Murtagh, 2015; Palinkas, 2014), social work (Watkins & Gioia, 2015), mental health (Barg et al., 2006; Wittink, Barg, & Gallo, 2006), cardiovascular health (Curry, Nembhard, & Bradley, 2009), palliative care (Farquhar, Ewing, & Booth, 2011), public health (Curry, Shield, & Wetle, 2006), intervention development (Bass et al., 2013; Gallo & Lee, 2016; Nastasi et al., 2007), implementation science (Bradley et al., 2009; Greenhalgh et al., 2010), health policy (Brannen & Moss, 2012), global health (Petros, 2012), and health disparities (Apesoa-Varano & Hinton, 2013; Stewart, Makwarimba, Barnfather, Letourneau, & Neufeld, 2008). The program is timely in that NIH (through the Office of Behavioral and Social Science Research) issued *best practices* recommendations on a website in 2011 (Creswell et al., 2011), followed with NIH-sponsored workshops on mixed methods (Implementation and Dissemination Science (Creswell & Wisdom, 2012)), and conference sessions on mixed methods in prevention science (Creswell, 2012). The MMRTP is a natural extension of the activities of NIH to improve the quality of mixed methods applications.

Mixed methods research is the collection and analysis of both quantitative and qualitative data and the integration of the two forms of research (Creswell, 2015). The goal of mixed methods is to provide a more complete understanding than either approach alone could provide. Broad applications of mixed methods in the health sciences include incorporation into intervention development and trials (Gallo & Lee, 2016), assessing patient reactions to a program implemented in a community health setting (Curry & Nunez-Smith, 2015), and explaining the link of behavioral and social factors to specific health outcomes (Weller & Barnes, 2014). Mixed methods hold promise to advance the strategic goals of several NIH institutes to develop interventions that are culturally relevant, to translate interventions into practice, and to carry out research that leads to improved patient- and community-centered care. Research focus areas such as reducing health disparities, increasing the reach and acceptability of interventions, and enhancing the patient-centeredness of care are common to the strategic plans of several institutes, calling for the integration of behavioral and social science research with clinical investigation. Following the Institute of Medicine's systems

approach, investigators can focus on the “whole picture and not just a single element,” typical of solely quantitatively or qualitatively driven investigations (Institute of Medicine, 2012, p. 21). Mixed methods contribute to implementation research by providing information about what core components are adopted, including by whom (quantitative methods) and why (qualitative methods), to develop interventions adapted to the practice environment that enhance sustainability.

The need for mixed methods application to complex public health and clinical challenges is evident in the increasing number of mixed methods proposals to NIH, the Patient Centered Outcomes Research Institute (PCORI), and foundations (Plano Clark, 2010). Undertaking mixed methods research, however, can be daunting. A pressing question remains as to how to best train faculty-level scholars to meet the need for trained health services investigators. Although resources and guidance exist for providing mixed methods training to individuals in graduate-level courses (Christ, 2009; Earley, 2007; Frels, Onwuegbuzie, Leech, & Collins, 2012; Poth, 2014), the MM RTP specifically targets faculty-level investigators in medicine and the health sciences writing grant proposals to NIH.

The Mixed Methods Research Training Program

The MM RTP aims to provide a state-of-the-art methodology training program to enhance the mixed methods skills of NIH investigators, in response to RFA-OD-13-009, “Short Courses on Innovative Methodologies in the Behavioral and Social Sciences (R25).” The overarching program goal is for scholars to submit a research grant for external funding to the NIH or similar funding body, such as the Agency for Healthcare Research and Quality or PCORI. Several specific MM RTP outcomes support that goal. Those outcomes are for scholars to increase their:

- use of rigorous mixed methods research in the health sciences,
- publications employing mixed methods,
- presentation of mixed methods health research at conferences,
- research collaborations, and
- service as a resource and leader in mixed methods at participating institutions (Guetterman, Creswell, Deutsch, & Gallo, 2016).

The MM RTP is a mentoring-based program to train faculty or equivalent scholars, each of whom is assigned to a mentor to provide overall guidance and a consultant who has expertise related to the scholar’s content-focus along with experience in mixed methods research, modeled after the successful National Institute of Mental Health (NIMH) Advanced Research Institute (Bruce et al., 2011). Consistent with the focus on a specific project in faculty development programs (Gusic et al., 2010), the scholar’s own research proposal serves as a platform for learning mixed methods. The goal of the yearlong program is for scholars to develop their project into a fundable application. Concomitantly, the scholars learn mixed methods research methodology through the mentored experience and through presentations provided through webinars and an in-person two-and-a-half-day retreat.

Two cohorts have participated in the MM RTP. As of the preparation of this manuscript, the first cohort entered the program two years ago and the second entered one year ago. We administered a self-rated mixed methods skills assessment questionnaire (Guetterman et al., 2017) to participating scholars before and after the retreat. Mixed methods skills were rated under six domains; namely, “Research question,” “Design/approach,” “Sampling,” “Data collection,” “Analysis,” and “Dissemination.” To assess academic productivity related to mixed methods, we sent a follow-up survey to scholars from both cohorts (i.e., at one year and two years since entry) to ask about grants, publications, and presentations involving mixed methods. In this report, we describe the professional experiences of the scholars in mixed methods and their assessment of needed skills improvement, and evaluate changes in the ability of the scholars to define and apply mixed methods concepts. We provide data on academic productivity of the first- and second-year scholars, separately for mixed methods and non-mixed methods, for grants, publications, and presentations. This report fills a gap in the literature in providing an empirical report of a mixed methods training program intended to improve the skills of faculty in medicine and the health sciences.

Method

Participants

Twenty-nine scholars participated in the first and second cohort of the MM RTP. All are faculty-level researchers in the health sciences. All but one is based in the United States. Eight are MDs, and 21 hold other doctorates (e.g., PhD, ScD, DrPH). The scholars are from a variety of disciplines in the health sciences; namely, pediatrics, psychiatry, general medicine, oncology, human development, nursing, music therapy, nutrition, psychology, and social work. The program evaluation procedures were reviewed by the Institutional Review Board of Johns Hopkins University and were deemed exempt as educational research.

Retreat and Webinar Content

In addition to mentoring activities, two main program components are webinars and a retreat. We held one webinar prior to each retreat to provide an introduction to mixed methods research, with the goal of imparting foundational knowledge and ensuring a common language. The webinar was largely based on content put forth in the *NIH Best Practices of Mixed Methods Research in the Health Sciences* (Creswell et al., 2011), covering an introduction to mixed methods, designs, scientific rigor, becoming a resource at one’s institution, and what to expect at the retreat.

Approximately one month later, scholars participated in a two-and-a-half-day retreat (at Johns Hopkins University Bloomberg School of Public Health for Cohort 1 and at the Harvard School of Public Health for Cohort 2). The intent of a retreat was to provide an active workshop blending lectures and interactive workgroups led by a mentor. In addition to scholars, program faculty (JG, CD, JC) who serve as investigators and mentors for the MM RTP, consultants, and the program’s evaluator (TG) participated in retreats. Retreats covered the following topics within the context of mixed methods research: reasons to use mixed methods, procedural diagrams, study aims, use of theory, integration strategies, qualitative and quantitative primers, interdisciplinary teams, becoming a resource at one’s

institution, sampling strategies, NIH and PCORI funding, evaluation, and manuscript and proposal writing. In interactive workshops, scholars were sorted into three small groups with an assigned mentor and a consultant. Each scholar gave a presentation of her/his project and received feedback on her/his grant proposal in the small group.

Measurement Strategy

We distributed a Scholar Mixed Methods Skills Self-Assessment instrument (see Appendix A) designed for this program (Guetterman et al., 2017). We collected the baseline data upon entry to the program, approximately four months prior to the retreat and collected the post-retreat assessment two weeks after the retreat. The instrument consisted of three sections: (a) professional experiences with mixed methods, including background, software, and resource familiarity; (b) a quantitative, qualitative, and mixed methods skills self-assessment; and (c) open-ended questions about other skills and scholar goals for the MM RTP. In this investigation, we focus on the components of the skills assessment related to mixed methods.

The domains of the skills scale were “research questions,” “design/approach,” “sampling,” “analysis,” and “dissemination.” For each item (i.e., skill), we requested three ratings drawn from an educational competency ratings scale (Harnisch & Shope, 2007): “My ability to define/explain,” “My ability to apply to practical problems,” and “Extent to which I need to improve my skill.” Response options for each item were on a 5-point Likert-type scale anchored by “Not at all” (coded ‘1’) and “To a great extent” (coded ‘5’). Five points were used to ensure a mid-point and to minimize respondent burden from discriminating among response options (DeVellis, 2012).

We assessed academic productivity with closed-ended questions about grants, publications, presentations, and open-ended questions about serving as an institutional resource for mixed methods and other comments about the program. All questions prompted scholars to respond about their activities since beginning the MM RTP. The first set of questions asked scholars for the number and types (e.g., NIH mechanisms, other federal, foundation, and internal) of grants submitted and funded, the number and types (e.g., empirical or methodological) of publications, and the number of presentations made since first beginning the MM RTP. To allow for comparison, questions separated research involving mixed methods from research not involving mixed methods. The next section of the survey asked scholars to describe any experiences they have had serving as a resource for mixed methods at their institution since beginning the MM RTP. We asked whether they have recommended the program to others, and to reflect on the overall impact of the program on their research and career.

Data Analysis

We compared skill ratings using a repeated-measures design. We first obtained descriptive statistics of professional experiences to better understand the background of each scholar. We then examined descriptive statistics for each skill and response domain. To examine the change in scholar mixed methods skill ratings from before the program to after the retreat, we conducted a paired samples *t* test. We set statistical significance at $\alpha < .05$ as a guide to inference. We calculated Cohen’s *d* as a guide to the magnitude of differences (Cohen,

1988). In general, Cohen's d of 0.4 to 0.7 would be considered a moderate effect size, and greater than 0.7 large. We considered a moderate effect size to represent a meaningful difference in mixed methods skills. Next, we examined descriptive statistics for the survey of academic output, comparing reported academic productivity for mixed methods versus non-mixed methods. SPSS Version 22 was employed for all quantitative analyses. The open-ended responses did not generate the depth of interview data, yet participants were insightful and most shared several sentences per question. We conducted a thematic text analysis (Kuckartz, 2014) of their responses by coding the text and grouping into overall themes that emerged. MAXQDA facilitated the qualitative analysis.

Results

Background of Scholars

Most scholars ($n = 23$, 79%) reported that their primary training was quantitative rather than qualitative or mixed methods (Table 1). Similarly, most scholars indicated they were "experienced" with quantitative software but were "not familiar" with qualitative software. In their open-ended comments, all but one described "hands on experience in qualitative research," including the use of interviews, focus groups, and document analysis in their research. Scholars' background reflected that they were new to mixed methods research. Only two scholars (7%) noted having used or cited a mixed methods textbook, but six (21%) reported using or citing the *NIH Best Practices for Mixed Methods Research in the Health Sciences* (Creswell et al., 2011).

Experience of Scholars

The experience of scholars varied but indicated at least some exposure to mixed methods research (Table 1). The most common experiences were writing a mixed methods application for funding, presenting, and publishing mixed methods papers. Least common experiences were advising others and participating in a mixed methods workgroup. Only three of the scholars had taken a mixed methods course, and two wrote a dissertation involving mixed methods.

Self-identified Needs for Skills in Mixed Methods

Upon entry into the MM RTP, scholars self-identified the quantitative, qualitative, and mixed methods skills they needed to improve using the self-assessment instrument (Table 2). In general, scholars more strongly endorsed their need for qualitative skills than quantitative skills. Examples of qualitative skill needs were narrative inquiry, qualitative sampling (e.g., purposive sampling), interviewing, all aspects of analysis, and dissemination. Scholars did report needing to improve several quantitative skills, including establishing the validity evidence of measures and conducting advanced analysis (e.g., structural equation modeling).

Two items in particular were unanimously endorsed as needing to improve to a great extent: developing diagrams of the mixed methods design and mixed methods analysis combining qualitative and quantitative data in a single table or graph, such as through a joint matrix. Self-identified needs less highly rated were advanced mixed methods designs (e.g., case studies and program evaluation designs).

Change in Self-ratings of Skills after the Retreat

We examined changes in ratings of the scholars before and after the retreat for defining or explaining concepts in mixed methods research (Table 3). For all items, the scholars reported statistically significant improvement in ratings of ability to define or explain concepts in mixed methods research. Cohen's *d* test generally indicates large effect sizes. Scholars reported improvement in their perceived ability to apply mixed methods to practical problems (Table 4). With two exceptions (case studies, ethical principles of consent and recruitment) improvements were statistically significant.

Academic Output of Scholars

We considered grants, publications, and presentations as indicators of academic productivity (Table 5). A total of 28 of the 29 scholars responded to the survey about their activities since entering the MM RTP (we exclude one scholar from outside the United States for whom the productivity criteria might be less comparable). Scholars reported substantially more grants and publications involving mixed methods than non-mixed methods grants and publications.

Grants involving mixed methods.—Twenty (71%) of the scholars have submitted at least one grant involving mixed methods since entering the program, and 14 have submitted more than one. One scholar received funding for an NIH K series grant and another four have submitted K grants, which are NIH career development awards designed to provide training for early career researchers in addition to funding for a substantial research project. One scholar is a co-investigator on a funded R01 project (an R01 is usually a large investigator-initiated research project). Five have submitted R01s for funding as principal investigator and another three are involved as co-investigators or in other roles. Regarding other NIH mechanisms (e.g., R21 exploratory/developmental research, R03 pilot study), two scholars have received funding as a principal investigator and another five have submitted as a principal investigator. Six have received foundation funding for mixed methods research, and seven have submitted for funding to foundations (including several who made multiple submissions), all as principal investigator. Eight scholars have received internal funding for mixed methods research, and 11 have submitted grants internally involving mixed methods. As noted in Table 5, most of the grants funded and submitted since entering the MM RTP have involved mixed methods.

Publications and presentations.—Of the 21 respondents who had articles accepted or published, 11 wrote mixed methods articles, including one who had both methodological and empirical mixed methods articles. Six have written multiple mixed methods publications, including three book chapters and two methodological articles. Among the scholars responding, 19 (68%) presented mixed methods research at a national or international conference and 20 presented at a local or institutional meeting. In total, 23 (82%) gave some type of mixed methods presentation since beginning the MM RTP, and 15 scholars gave more than one mixed methods talk.

Serving as a Resource and Program Impact

Three thematic areas emerged regarding scholars' experiences: (a) serving as a resource, (b) advocating for mixed methods, and (c) continuing mixed methods research. In all, 22 of 28

scholars described extensive work serving as a mixed methods resource at their institution. Serving as a resource was described as working with early career faculty interested in mixed methods, mentoring students and postdoctoral researchers in mixed methods, and giving invited lectures in their institutions. Several scholars reported acting as an advocate for mixed methods in their departments and institutions; for example, a scholar wrote, “I have advocated for a mixed methods course in my department.” As further evidence of program impact, nearly all scholars described sharing their experiences and recommended the program to others in their department and research communities—for example, “I encouraged three of my colleagues in the [Department] to apply to the program for the last application cycle.” Finally, scholars described their ongoing work with mixed methods. Scholars continue to develop research projects and commented on the ongoing support from their MM RTP mentors and consultants, such as reviewing summary statements of grant reviews with mentors in preparation for resubmission. Several commented on their professional growth. As one scholar noted, “My on-campus mentors regularly mention how much growth they’ve seen in my work because of this program.” Finally, the interests in mixed methods seemed to persist in scholars, many of whom described upcoming lectures and workshops they plan to give involving mixed methods. Some have begun to bridge from their professional communities to the methodological community of mixed methods as several scholars commented on presenting at the Mixed Methods International Research Association’s conference in Durham, England, in 2016.

Discussion

We found that scholars participating in an interactive program to improve mixed methods skills reported statistically significantly increased confidence in their ability to define or explain concepts and in their ability to apply the concepts to practical problems. Scholars describe substantial academic productivity with regard to mixed methods proposals, publications, and presentations. Although scholars expressed a strong interest in many mixed methods topics, they came into the program with limited professional experiences with mixed methods. Few of the scholars had previously taken a mixed methods course or wrote a dissertation involving mixed methods, further supporting the need for faculty-level scholars to receive advanced training in mixed methods that they did not receive during graduate education. Only practical applications of case studies and ethical principles of research did not show statistically significant improvement in self-ratings after the retreat. Given the disciplinary diversity of the program scholars, the results of the self-rated improvement in mixed methods skills, and the considerable productivity in the realm of mixed methods, were encouraging.

Before discussing the implications of the skills development for mixed methods in health research, the limitations of our study should be considered. First, we were not able to have a comparison group of investigators who did not participate in the program. Nevertheless, after participation in the MM RTP, scholars, who came into the program with limited professional experience in mixed methods, exhibited a high degree of engagement with mixed methods at the same time that they are reporting increased skills as a result of the program. The MM RTP has created a cadre of scholars who have taken on the role of leaders in mixed methods at their institutions. Second, the pre- and post-evaluations of ability to

explain or define concepts, or to apply the concepts to practical problems, were based on self-reports. We have attempted to supplement self-ratings with indicators of academic productivity such as proposals, publications, and presentations that suggest the scholars can influence the fields they work in employing mixed methods. Third, our new program has had experience with only two cohorts totaling 29 scholars. Nevertheless, the program deserves attention because the national need is so great for investigators prepared with training in mixed methods to address complex behavioral health problems, community- and patient-centered research, and implementation research.

Scholars are striving to incorporate both quantitative and qualitative data in mixed methods designs and analysis across the translation continuum, from effectiveness to implementation. Integration methods were an area of educational need identified by scholars. Joint displays are one way qualitative and quantitative data can be juxtaposed so that substantive inferences can be drawn across the methods employed (Fetters, Curry, & Creswell, 2013; Guetterman, Fetters, & Creswell, 2015). Joint displays typically consist of a matrix of qualitative data (themes) by quantitative data (numerical data, levels, or statistics such as means) that provide an overview of how the data obtained using qualitative and quantitative methods are related (Guetterman et al., 2015). All the scholars identified the need to improve “to a great extent” on “combining qualitative and quantitative data,” and improvement on self-rated assessment scores on ability to explain and apply this skill was observed after the retreat. In contrast, scholars did not report substantial gains in the practical aspects of employing case studies or in ethical principles in mixed methods research. Questions identified by scholars in some cases (e.g., employing mixed methods in behavioral intervention development) reflect the need for methodological development given the current state of mixed methods research applied to medicine and the health sciences.

The implications of the MM RTP for medicine and public health are timely, given the challenges posed by the behavioral and social factors affecting health outcomes in medical conditions such as diabetes and heart disease. Mixed methods hold promise to advance the strategic goals of several institutes to develop interventions that are culturally relevant, to translate interventions into practice, and to carry out research that leads to improved patient- and community-centered care. Themes such as reducing health disparities, increasing the reach and acceptability of interventions, and enhancing the patient-centeredness of care are common to the strategic plans of several institutes calling for the integration of behavioral and social science research with investigation of clinically relevant questions (<http://report.nih.gov/strategicplans/>). For example, strategic plans of the National Heart, Lung, Blood Institute (NHLBI) (Goal 3, to translate research into practice); the National Institute of Mental Health (NIMH) (Strategic Objective 3, to incorporate diverse needs and circumstances of people with mental illnesses), and the National Institute on Aging (NIA) (Research Goal E, to develop interventions to improve culturally appropriate health care delivery), all emphasize the need for understanding the sociocultural context of the patient, family, and providers to achieve mission goals.

Statistical methods may be employed to study adherence patterns or to estimate treatment effects in the face of non-adherence to treatment regimens, but to account for preferences, to consider alternative concepts of disorder and etiology, and to incorporate community

perspectives into how an intervention or service is configured—issues that affect conditions as varied as use of cancer screening strategies, glaucoma detection and treatment, lifestyle changes in diet and physical activity, and accepting treatment for mental disorders—investigators are recognizing that mixed methods can be a powerful tool. Although quantitative approaches can characterize and measure patient outcomes, use of mixed methods can enhance quantitative analyses to identify unmeasured factors that might be associated with poor response to interventions (Kravitz, Duan, & Braslow, 2004), or factors that account for people who do not “fit the model,” that is, outliers (Kawachi & Berkman, 2003), or provide clues to how interventions can incorporate the diverse needs and circumstances of people (personalized interventions) (Curry et al., 2006). Mixed methods increase the ability to address research questions about what puts people at risk in the first place (“at risk for risk”) (Glass & McAtee, 2006). The complexity of the problems faced by medicine and public health needs the perspectives of multiple disciplines (National Academy of Sciences, National Academy of Engineering, & Institute of Medicine, 2004; Singer & Ryff, 2001).

Scholars bring varied skills in general research design, in quantitative and qualitative methods, and in their understanding of mixed methods research. Some individuals have little training in rigorous, systematic research procedures. The goal of the MM RTP is to provide specific, targeted experiences for health researchers who have deficits in their skill training and who require the close attention of a skilled mentor in mixed methods and a consultant in mixed methods in their content area to improve their skills. An intended outcome of the program is for scholars to become resource persons and leaders for mixed methods at their institutions. Indeed, the survey results confirmed that scholars entered the program with few experiences mentoring others in mixed methods. The pre-post skills improvement indicates they are poised to enter into this role, and the scholars report experiences after the program that indicate they are taking on leadership and mentoring roles. The design of the MM RTP creates a network of scholars, mentors, and consultants to mentor scholars and create a community of leaders in mixed methods (DeCastro, Sambuco, Ubel, Stewart, & Jagsi, 2013). The interdisciplinary nature of the program should facilitate transfer of methods development across disciplines in the health sciences, critical to the clinical research enterprise (Teo, 2009).

The MM RTP fulfills a national need for a mentoring program for mixed methods in health sciences (Robinson, Schwartz, DiMeglio, Ahluwalia, & Gabrilove, 2016). In recent years, and especially in light of the best practices recommendations (Creswell et al., 2011), many health researchers are requesting workshops on mixed methods. The areas of interest span mental health, disparities research, humanitarian research, global health, health services research, implementation and translational science, and many others. NIH awarded projects for R and K grants that employ mixed methods are on the increase (Coyle et al., 2016; Plano Clark, 2010). Although the best practices (Creswell et al., 2011) provided an introduction to mixed methods, and specifically discussed how to develop a proposal and review an application that employs mixed methods, the natural next step to the guidelines is to provide training in the specific procedures that investigators might use. The promising results reported here are grounded in an evidence-based training program. Improvement in the confidence of investigators from a wide range of disciplines to apply mixed methods to

medical applications can help advance patient-centered, translational, and implementation research.

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Appendix A:: Self-Rated Mixed Methods Skills Assessment

We intend to develop and administer an instrument to self-assess methods skills in mixed methods. The Mixed Methods Research Training Program will involve activities whose purpose is to assess the progress of participants, evaluate the program, and develop measures of skills development in mixed methods. We are required by NIH to conduct an evaluation of the program, and by accepting a position as a Scholar, students are consenting to participate in this evaluation. This skills self-assessment consists of three sections:

Section 1 asks about your professional experiences with mixed methods;

Section 2 asks you to judge your ability to define or explain concepts, apply knowledge, and give advice in specific domains related to quantitative methods, qualitative methods, and mixed methods, plus what you want to learn; and,

Section 3 provides you with an opportunity to provide feedback about the skills self-assessment and your goals.

Section 1:

Your Professional Experiences with Mixed Methods

	Yes	No	Comments
Background in Research Methods			
I am primarily trained in qualitative research.			
I am primarily trained in quantitative research.			
I am primarily trained in mixed methods.			
Professional Experiences in Mixed Methods			
I wrote a mixed methods application that received funding.			
I wrote an application that did not receive funding.			
I participate in a mixed methods work group.			
I have presented mixed methods research at a local or institutional meeting.			
I have presented mixed methods research at a national meeting.			
I have taken a course in mixed methods. I have published a paper using mixed methods.			
I wrote a dissertation involving mixed methods.			
I mentor or advise others in mixed methods research.			
I have reviewed mixed methods applications on an NIH study section.			

	Yes	No	Comments
I have reviewed mixed methods applications for a foundation or other organization.			
I have reviewed mixed methods manuscripts as a peer reviewer for a journal.			

	Not at all familiar	Familiar	Experienced
Please rate your familiarity with the following software...			
SPSS			
SAS			
STATA			
R			
MPlus			
NVIVO			
MaxQDA			
Atlas			
HyperRESEARCH			
dedoose			
List other software you use below, if you like...			
	Not at all familiar	Read some	Used or cited

Please rate your familiarity with the following resources...
<i>The NIH best practices for mixed methods in the health sciences</i>
<i>A concise introduction to mixed methods research</i> (Creswell, 2014)
<i>Designing and conducting mixed methods research</i> (Creswell & Plano Clark, 2010)
<i>SAGE handbook of mixed methods in social & behavioral research</i> (Tashakkori & Teddlie, 2010)
<i>Mixed methods in health sciences research: A practical primer</i> (Curry & Nunez Smith, 2015)
<i>Mixed methods research for nursing and health sciences</i> (Andrew & Halcomb, 2009)
List other resources you've used, if you like...

Section 2: Skills Self-Assessment

This section asks you to make ratings of specific research skills along three dimensions:

1. your ability to **define or explain** the concept or procedure;
2. your ability to **apply the concept or procedure to practical problems** in your discipline; and,
3. your evaluation of what your **learning needs** are in the next year.

QUANTITATIVE	My ability to define/ explain					My ability to apply to practical problems					Extent to which I need to improve my skill				
	Not at all (1)				To a great extent (5)	Not at all (1)				To a great extent (5)	Not at all (1)				To a great extent (5)
Research question															
Formulate question, aims and hypotheses	1	2	3	4	5	1	2	3	4	5	1	2	3	4	5
State the assumptions of statistical procedures	1	2	3	4	5	1	2	3	4	5	1	2	3	4	5
Use of theory or conceptual framework to be tested															
Design/approach															
Designs involving randomization (e.g., trials)	1	2	3	4	5	1	2	3	4	5	1	2	3	4	5
Observational studies (e.g., cohort, case-control)	1	2	3	4	5	1	2	3	4	5	1	2	3	4	5
Sampling															
Sampling strategies (e.g., random sampling)	1	2	3	4	5	1	2	3	4	5	1	2	3	4	5
Ethical principles of consent and recruitment	1	2	3	4	5	1	2	3	4	5	1	2	3	4	5
Data collection															
Principles of survey methods	1	2	3	4	5	1	2	3	4	5	1	2	3	4	5
Validity of measures	1	2	3	4	5	1	2	3	4	5	1	2	3	4	5
Reliability of measures	1	2	3	4	5	1	2	3	4	5	1	2	3	4	5
Threats to internal validity of the study	1	2	3	4	5	1	2	3	4	5	1	2	3	4	5
Threats to external validity of the study	1	2	3	4	5	1	2	3	4	5	1	2	3	4	5
Analysis															
Descriptive statistics (e.g., comparing means)	1	2	3	4	5	1	2	3	4	5	1	2	3	4	5
Linear regression	1	2	3	4	5	1	2	3	4	5	1	2	3	4	5
Logistic regression	1	2	3	4	5	1	2	3	4	5	1	2	3	4	5
Survival analysis	1	2	3	4	5	1	2	3	4	5	1	2	3	4	5
Factor analysis	1	2	3	4	5	1	2	3	4	5	1	2	3	4	5
Structural equation models	1	2	3	4	5	1	2	3	4	5	1	2	3	4	5
Dissemination															
Writing results involving quantitative methods	1	2	3	4	5	1	2	3	4	5	1	2	3	4	5
Communicate quantitative results to non-academic audiences	1	2	3	4	5	1	2	3	4	5	1	2	3	4	5
QUANTITATIVE	My ability to define/ explain					My ability to apply to practical problems					Extent to which I need to improve my skill				
	Not at all (1)				To a great	Not at all (1)				To a great	Not at all (1)				To a great

QUANTITATIVE	My ability to define/ explain					My ability to apply to practical problems					Extent to which I need to improve my skill				
	Not at all (1)					Not at all (1)					Not at all (1)				
	To a great extent (5)					To a great extent (5)					To a great extent (5)				
	extent (5)					extent (5)					extent (5)				
Research question															
Formulate question and aims	1	2	3	4	5	1	2	3	4	5	1	2	3	4	5
State underlying philosophical assumptions	1	2	3	4	5	1	2	3	4	5	1	2	3	4	5
Use of theory or conceptual framework to shape the question															
Design/approach															
Grounded theory	1	2	3	4	5	1	2	3	4	5	1	2	3	4	5
Narrative analysis	1	2	3	4	5	1	2	3	4	5	1	2	3	4	5
Phenomenology	1	2	3	4	5	1	2	3	4	5	1	2	3	4	5
Case study	1	2	3	4	5	1	2	3	4	5	1	2	3	4	5
Ethnography	1	2	3	4	5	1	2	3	4	5	1	2	3	4	5
Community based participatory research															
Sampling															
Sampling strategies (e.g., purposive)	1	2	3	4	5	1	2	3	4	5	1	2	3	4	5
Ethical principles of consent and recruitment	1	2	3	4	5	1	2	3	4	5	1	2	3	4	5
Data collection															
Principles of non-directive interviewing	1	2	3	4	5	1	2	3	4	5	1	2	3	4	5
Focus group	1	2	3	4	5	1	2	3	4	5	1	2	3	4	5
Semi-structured interviews	1	2	3	4	5	1	2	3	4	5	1	2	3	4	5
Participant observation	1	2	3	4	5	1	2	3	4	5	1	2	3	4	5
Documentary materials	1	2	3	4	5	1	2	3	4	5	1	2	3	4	5
Audio-visual materials	1	2	3	4	5	1	2	3	4	5	1	2	3	4	5
Analysis															
Broad and fine coding of data	1	2	3	4	5	1	2	3	4	5	1	2	3	4	5
Analysis of observational data	1	2	3	4	5	1	2	3	4	5	1	2	3	4	5
Development of themes	1	2	3	4	5	1	2	3	4	5	1	2	3	4	5
Relating themes to one another	1	2	3	4	5	1	2	3	4	5	1	2	3	4	5
Dissemination															
Writing results involving qualitative methods	1	2	3	4	5	1	2	3	4	5	1	2	3	4	5
Communicate qualitative results to non-academic audiences	1	2	3	4	5	1	2	3	4	5	1	2	3	4	5
	My ability to define/ explain					My ability to apply to practical problems					Extent to which I need to improve my skill				

QUANTITATIVE	My ability to define/ explain					My ability to apply to practical problems					Extent to which I need to improve my skill				
	Not at all (1)					To a great extent (5)					Not at all (1)				
MIXED METDODS	Not at all (1)					To a great extent (5)					Not at all (1)				
Research question															
Formulate question and aims that link modes of inquiry	1	2	3	4	5	1	2	3	4	5	1	2	3	4	5
State underlying philosophical assumptions	1	2	3	4	5	1	2	3	4	5	1	2	3	4	5
Rationale for mixed methods study	1	2	3	4	5	1	2	3	4	5	1	2	3	4	5
Design/approach															
Identifying integration points in a design	1	2	3	4	5	1	2	3	4	5	1	2	3	4	5
Explanatory sequential designs	1	2	3	4	5	1	2	3	4	5	1	2	3	4	5
Exploratory sequential designs	1	2	3	4	5	1	2	3	4	5	1	2	3	4	5
Convergent parallel designs	1	2	3	4	5	1	2	3	4	5	1	2	3	4	5
Intervention designs	1	2	3	4	5	1	2	3	4	5	1	2	3	4	5
Program evaluation designs															
Case studies															
Threats to internal validity in mixed methods	1	2	3	4	5	1	2	3	4	5	1	2	3	4	5
Threats to external validity in mixed methods	1	2	3	4	5	1	2	3	4	5	1	2	3	4	5
Diagram of the mixed methods design	1	2	3	4	5	1	2	3	4	5	1	2	3	4	5
Sampling															
Sampling strategies that link qualitative and quantitative methods (e.g., random followed by purposive)	1	2	3	4	5	1	2	3	4	5	1	2	3	4	5
Ethical principles of consent and recruitment	1	2	3	4	5	1	2	3	4	5	1	2	3	4	5
Data collection															
Strategies for concurrent data collection	1	2	3	4	5	1	2	3	4	5	1	2	3	4	5
Strategies for sequential data collection	1	2	3	4	5	1	2	3	4	5	1	2	3	4	5
Analysis															
Combining q and q data (e.g., joint matrix)	1	2	3	4	5	1	2	3	4	5	1	2	3	4	5
Cultural consensus analysis	1	2	3	4	5	1	2	3	4	5	1	2	3	4	5
Inference that links qualitative and quantitative (i.e., metainference)	1	2	3	4	5	1	2	3	4	5	1	2	3	4	5
Dissemination															

QUANTITATIVE	My ability to define/ explain					My ability to apply to practical problems					Extent to which I need to improve my skill				
	Not at all (1)					To a great extent (5)					Not at all (1)				
Writing results incorporating both qualitative and quantitative methods in the same report	1	2	3	4	5	1	2	3	4	5	1	2	3	4	5
Communicate results involving both qualitative and quantitative methods to non-academic audiences	1	2	3	4	5	1	2	3	4	5	1	2	3	4	5

Section 3: Provide Feedback About the Skills Self-Assessment

List any skills you think are important that we did not ask about:

Describe your goals for the Mixed Methods Research Training Program. What skills and goals are most important to you? What would you like to learn?

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Table 1.

Responses to Questions about Professional Experiences from First Cohort ($n = 29$) of the NIH Mixed Methods Research Training Program for the Health Sciences, 2015–2016, Prior to the Retreat

Professional experiences	<i>n</i>	% 'yes'
I am primarily trained in qualitative research.	5	17
I am primarily trained in quantitative research.	23	79
I am primarily trained in mixed methods.	5	17
I have presented mixed methods research at a national meeting.	10	34
I have taken a course in mixed methods.	5	17
I have published a paper using mixed methods.	9	31
I wrote a dissertation involving mixed methods.	6	21
I mentor or advise others in mixed methods research.	6	21
I have reviewed mixed methods applications for a foundation or other organization.	4	14
I have reviewed mixed methods manuscripts as a peer reviewer for a journal.	6	21
I have presented mixed methods research at a local or institutional meeting.	12	41
I wrote a mixed methods application that received funding.	13	45
I wrote an application that did not receive funding.	13	45
I participate in a mixed methods work group.	5	17

Table 2.**Responses to Questions about the Need to Improve Skills before Program Participation**

Item	Cohort 1 Mean (<i>n</i> = 14)	Cohort 2 Mean (<i>n</i> = 15)	All Mean (<i>n</i> = 29)
Research Questions			
Formulate question and aims that link modes of inquiry	4.93	5.00	4.97
State underlying philosophical assumptions	4.71	4.86	4.79
Rationale for mixed methods study	4.71	4.79	4.76
Design/Approach			
Identifying integration points in a design	4.79	4.64	4.72
Explanatory sequential designs	4.79	4.71	4.76
Exploratory sequential designs	4.79	4.79	4.79
Convergent parallel designs	4.79	4.57	4.69
Intervention designs	4.86	4.64	4.76
Program evaluation designs	4.36	4.71	4.55
Case studies	3.93	4.29	4.14
Threats to internal validity in mixed methods	4.93	4.93	4.93
Threats to external validity in mixed methods	4.93	4.93	4.93
Diagram of the mixed methods design	5.00	4.71	4.86
Sampling			
Sampling strategies that link qualitative and quantitative methods (e.g., random followed by purposive)	4.79	4.93	4.86
Ethical principles of consent and recruitment	4.29	3.43	3.90
Data Collection			
Strategies for concurrent data collection	4.79	4.79	4.79
Strategies for sequential data collection	4.86	4.86	4.86
Analysis			
Combining qualitative and quantitative data (e.g., joint matrix)	5.00	4.93	4.97
Cultural consensus analysis	4.71	4.57	4.66
Inference that links qualitative and quantitative (i.e., meta-inference)	4.79	4.86	4.83
Dissemination			
Writing results incorporating both qualitative and quantitative methods in the same report	4.86	4.93	4.90
Communicate results involving both qualitative and quantitative methods to non-academic audiences	4.86	4.64	4.76

Note: Scholars rated the extent to which they “need to improve” skills on a scale from “not at all” (coded 1) to “to a great extent” (coded 5). Data from the first and second cohort (*n* = 29) of the NIH Mixed Methods Research Training Program for the Health Sciences, 2015–2016, prior to the retreat.

Table 3.

Cohort 1 and 2: Change in scholar mixed methods skill ratings from before program participation to ratings after the retreat on their ability to “define or explain” a concept on a scale from “not at all” (coded 1) to “to a great extent” (coded 5)

	Pre-Assessment		Post-Assessment		<i>t</i>	Cohen <i>d</i>
	<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>		
Research Questions						
Formulate question and aims that link modes of inquiry	2.79	0.73	4.00	0.65	6.91***	1.28
State underlying philosophical assumptions	2.62	0.94	3.72	0.70	6.09***	1.13
Rationale for mixed methods study	3.52	0.91	4.59	0.57	7.21***	1.34
Design/Approach						
Identifying integration points in a design	2.38	1.08	4.17	0.71	8.21***	1.52
Explanatory sequential designs	2.76	1.33	4.48	0.74	6.25***	1.16
Exploratory sequential designs	2.76	1.27	4.45	0.78	6.93***	1.29
Convergent parallel designs	2.41	1.38	4.34	0.90	6.68***	1.24
Intervention designs	2.48	1.27	4.14	0.74	6.63***	1.23
Program evaluation designs	2.31	1.00	3.69	0.76	7.32***	1.36
Case studies	2.48	1.09	3.45	0.91	6.01***	1.12
Threats to internal validity in mixed methods	2.21	1.05	3.48	0.63	7.16***	1.33
Threats to external validity in mixed methods	2.24	1.09	3.45	0.63	6.65***	1.23
Diagram of the mixed methods design	2.21	1.05	4.24	0.83	7.82***	1.45
Sampling						
Sampling strategies that link qualitative and quantitative methods (e.g., random followed by purposive)	2.62	0.98	3.72	0.80	6.09***	1.13
Ethical principles of consent and recruitment	3.62	0.94	4.14	0.79	2.73*	0.51
Data Collection						
Strategies for concurrent data collection	2.79	1.05	3.83	0.71	4.50***	0.84
Strategies for sequential data collection	2.76	1.12	4.00	0.80	5.04***	0.94
Analysis						
Combining qualitative and quantitative data (e.g., joint matrix)	2.03	0.91	3.62	0.78	9.03***	1.68
Cultural consensus analysis	1.34	0.72	2.07	0.96	4.64***	0.86
Inference that links qualitative and quantitative (i.e., meta-inference)	1.59	0.82	2.55	1.02	5.30***	0.98
Dissemination						
Writing results incorporating both qualitative and quantitative methods in the same report	2.52	1.02	3.83	0.71	6.04***	1.12
Communicate results involving both qualitative and quantitative methods to non-academic audiences	2.45	0.91	3.90	0.62	8.57***	1.59

Note: Data from the first and second cohort ($n = 29$) of the NIH Mixed Methods Research Training Program for the Health Sciences, 2015–2016.

* $p < .05$

**
 p .01

 p .001, based on paired t -tests.

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Table 4.

Cohort 1 and 2: Change in scholar mixed methods skill ratings from before program participation to ratings after the retreat on their ability to “apply to practical problems” on a scale from “not at all” (coded 1) to “to a great extent” (coded 5)

	Pre-Assessment		Post-Assessment		<i>t</i>	Cohen's <i>d</i>
	<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>		
Research Questions						
Formulate question and aims that link modes of inquiry	2.69	0.85	3.83	0.60	7.35***	1.37
State underlying philosophical assumptions	2.34	0.77	3.69	0.66	8.07***	1.50
Rationale for mixed methods study	3.31	1.04	4.07	0.59	3.75***	0.70
Design/Approach						
Identifying integration points in a design	2.34	1.04	3.83	0.66	7.81***	1.45
Explanatory sequential designs	2.34	1.11	4.03	0.63	7.08***	1.32
Exploratory sequential designs	2.31	1.07	3.79	0.73	7.12***	1.32
Convergent parallel designs	2.03	1.05	3.66	0.81	6.75***	1.25
Intervention designs	2.34	1.14	3.55	0.63	5.52***	1.03
Program evaluation designs	2.14	0.99	3.03	1.02	5.36***	1.00
Case studies	2.17	1.10	3.00	0.89	4.61***	0.86
Threats to internal validity in mixed methods	2.00	0.85	3.24	0.51	9.70***	1.80
Threats to external validity in mixed methods	2.07	0.92	3.24	0.51	8.89***	1.65
Diagram of the mixed methods design	2.07	1.00	3.79	0.82	6.96***	1.29
Sampling						
Sampling strategies that link qualitative and quantitative methods (e.g., random followed by purposive)	2.38	0.86	3.34	0.77	5.74***	1.07
Ethical principles of consent and recruitment	3.55	0.95	4.03	0.91	2.25*	0.42
Data Collection						
Strategies for concurrent data collection	2.52	0.99	3.52	0.78	4.51***	0.84
Strategies for sequential data collection	2.55	1.15	3.69	0.81	4.52***	0.84
Analysis						
Combining qualitative and quantitative data (e.g., joint matrix)	1.83	0.76	3.28	0.75	8.23***	1.53
Cultural consensus analysis	1.28	0.65	1.97	0.98	4.37***	0.81
Inference that links qualitative and quantitative (i.e., meta-inference)	1.48	0.78	2.45	0.87	5.74***	1.07
Dissemination						
Writing results incorporating both qualitative and quantitative methods in the same report	2.34	0.90	3.31	0.81	5.30***	0.98
Communicate results involving both qualitative and quantitative methods to non-academic audiences	2.28	0.84	3.45	0.69	7.10***	1.32

Note: Data from the first and second cohort ($n = 29$) of the NIH Mixed Methods Research Training Program for the Health Sciences, 2015–2016.

* $p < .05$

**
 p .01

 p .001, based on paired t -tests.

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Table 5.

Grants and publications of U.S.-based scholars in the NIH Mixed Methods Research Training Program ($n = 28$)

	Involving mixed methods	Not involving mixed methods
Grants Funded		
NIH K	1	0
NIH/AHRQ R01	1 ^a	3 ^b
Other NIH	3 ^b	0
PCORI	1 ^a	0
Foundation	6 ^c	1 ^a
Internal award	8 ^c	4 ^a
Total	20	8
Grants Submitted		
NIH K	4	0
NIH/AHRQ R01	8 ^d	5 ^b
Other NIH	6 ^a	3 ^a
PCORI	2 ^a	0
Foundation	7	3 ^a
Internal award	11 ^b	4 ^a
Total	38	15
Publications Accepted		
Empirical articles	10	19
Methodological articles	2	0
Book chapters or other	3	4
Total	15	23
Mixed Methods Presentation		
National or international conference	19	n/a
Local or institutional	20	n/a
Total	39	n/a

Note: Counts refer to number of scholars. For funding, counts refer to Principal Investigator role unless otherwise noted

^{a)} as co-investigator

^{b)} 1 as co-investigator

^{c)} 2 as co-investigator

^{d)} 3 as co-investigator

n/a, not applicable.