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Teaching for implementation: A framework for building implementation research and practice capacity within the translational science workforce

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Abstract

Implementation science offers a compelling value proposition to translational science. As such, many translational science stakeholders are seeking to recruit, teach, and train an implementation science workforce. The type of workforce that will make implementation happen consists of both implementation researchers and practitioners, yet little guidance exists on how to train such a workforce. We—members of the Advancing Dissemination and Implementation Sciences in CTSAs Working Group—present the Teaching For Implementation Framework to address this gap. We describe the differences between implementation researchers and practitioners and demonstrate what and how to teach them individually and in co-learning opportunities. We briefly comment on educational infrastructures and resources that will be helpful in furthering this type of approach.

Background

The purpose of translational science is to positively impact population health, with the goal of effective research products (programs, practices, and interventions) being widely implemented in real-world clinical and public health settings.[1] This process inevitably requires users of research to identify, adopt, and normalize new policies and practices within complex, real-world contexts.[2] Implementation science describes this process, identifies the multi-level factors influencing it, and informs efforts to make it happen more readily, more equitably, and on a broader scale. Because of this, implementation science offers a compelling value proposition to translational science, namely, as a tool for accelerating translation and achieving health impact.[3,4]

The field of implementation science includes both implementation research and practice. Implementation research consists of *generating* knowledge about how to implement research products in specific settings (e.g., schools, health departments, and clinical settings). Implementation research is primarily the work of implementation researchers and (as in community-based participatory research[5]) the stakeholders with whom they partner in the process of learning. Implementation practice focuses on *applying* knowledge about implementation to guide process change. It is primarily the work of implementation practitioners,[6] a diverse group of non-academic stakeholders (e.g. public health practitioners, healthcare providers, policymakers, leaders from community-based organizations, and other implementation support practitioners[7]) Implementation research and practice represent two ends of a "studying-to-doing-implementation continuum" that overlap in important ways. Indeed, research and practice continuously inform and shape one another, and each depend on individuals with common implementation competencies in order to be carried out effectively.

Translational science stakeholders—particularly National Institutes of Health-funded Clinical and Translational Science Award (CTSA) Hubs—are actively seeking to develop and support resources and infrastructures that can optimize both implementation research and practice. Prior efforts have described the rationale and need for this activity broadly and highlighted workforce shortages and lack of implementation science expertise as key barriers
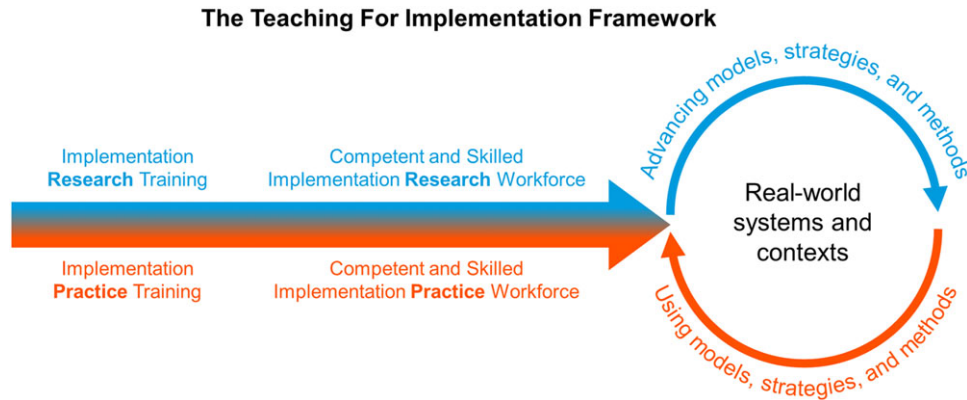
The Teaching For Implementation Framework

Fig. 1. The Teaching For Implementation Framework.

to progress.[8] As such, efforts are underway to recruit, teach, and train an implementation science workforce.

Current educational infrastructures may be well positioned for teaching and training either implementation researchers (e.g., as in degree-granting graduate programs) or practitioners (e.g., as in continuous professional development) in somewhat siloed ways, but few institutions can adequately teach both. Even fewer organizations have the capacity to train researchers and practitioners in a way that prepares them to work together synergistically and as collaborators within the same learning systems and contexts. CTSAs—embedded in academic health centers and comprising cores dedicated to education and community engagement—have this potential.

Leveraging this opportunity, we propose an approach for teaching and training implementation that is specifically targeted to the goals, strengths, and infrastructure of CTSAs. We call this approach Teaching For Implementation (TFI). TFI is grounded in the idea that translational science stakeholders should focus on both equipping a research workforce to generate knowledge about implementation *and* improving the capacity of learning healthcare systems and other clinical, public health, and community contexts to more effectively implement research in practice. It emphasizes that, as it relates to implementation, both the science and practice are integral to successfully changing the healthcare system and improving care quality and impact.[9]

In this paper, we—members of the Advancing Dissemination and Implementation Sciences in CTSAs Workgroup—introduce the TFI Framework and show how teachers *for* implementation and related educational stakeholders can use it to tailor their educational targets, content, and pedagogy to meet the needs of real-world translational contexts and systems.

Teaching for Implementation

The TFI Framework

TFI is based on the goals of fostering both scientific and practical capacity for implementation and increasing the routine application of research knowledge in real-world systems (see Fig. 1). We believe that it is particularly appropriate for CTSAs or other translational infrastructures—learning healthcare systems, practice-based research networks, professional societies—that reach both researcher and practitioner networks and have and train an existing workforce. Below we demonstrate how to operationalize the TFI framework by articulating 'who', 'what', and 'how', one

might teach implementation based on its goals. We also describe ways leaders of educational infrastructures can create environments that support a TFI approach.

Who to Teach for Implementation

Under a TFI approach, the implementation workforce poised to benefit from training consists of all the people needed to carry out implementation-related tasks within a given system or context. An academic medical center, for example, is one system where implementation of research products is relevant. A community experiencing structural barriers to health and healthcare is another. The implementation needs of these and other systems vary greatly, and thus, it is essential that teachers for implementation be familiar with the settings in which their learners will work and understand the unique needs of these contexts. In some cases, it may be helpful or essential to collaborate with system stakeholders in recruiting learners.

When identifying potential students, traditional predictors of academic success (e.g. publications and grants) may be less relevant, particularly when the candidates have strengths that make them uniquely suited for affecting change on the ground. Recruiting students in this way may result in the inclusion of several "non-traditional" learners, including practitioners or administrative leaders that are not interested in obtaining degrees.

For example, many real-world delivery systems leverage the expertise of external implementation support experts in change efforts. Examples include technical assistance providers, implementation coaches, and consultants who often contract with delivery systems but are not embedded in or employed by the systems on a permanent basis.[7,10] These individuals play a critical role in the day-to-day translation of evidence and serve as an important bridge between implementation research and practice. Yet, few formal training opportunities explicitly focused on equipping people for these roles exist. TFI is well suited to meet this growing workforce demand by producing boundary-spanning experts with understanding of both implementation research and practice.

Effective learners of implementation should be motivated by a passion for and commitment to improving health in the real world. Beyond this core similarity, learners can and will differ in many ways. It is incumbent on teachers for implementation to know their students well and to identify the characteristics, motivations, values, priorities, and capacities that distinguish them. Early in this discovery work, teachers for implementation should get a sense of where learners' aspirations lie on the research-to-practice

continuum so that educational opportunities and methods can be tailored to the needs of each learner.

For example, the Mayo Clinic CTSA is currently developing a course in rural health to support implementation efforts in rural settings. The course will be open to any interested learners, including community members. To assist with expectation setting and meeting learners' unique needs, all students will be required to describe their goals for the course and their perceived role in affecting change in rural health settings. This helps to guide and inform what and how to teach each learner.

What to Teach for Implementation

Ultimately, TFI takes its cues on "what to teach" from the implementation competencies required to operationalize real world, non-academic systems and contexts. We define an "implementation competency" as the capability to apply or use a set of knowledge, skills, or abilities to successfully carry out or perform an implementation-related task or function (e.g. an implementation research or practice task). Indeed, while several efforts have been made to delineate the competencies of implementation scientists[11–13] and practitioners[6,14–16] broadly, the implementation competencies TFI prioritizes are those that map to the expressed implementation-related needs of real-world settings. Many of these needs are generic and common to all systems and settings. For example, it is generally true that implementation practitioners in any context will need to be capable of 1.) identifying the research products (e.g., "evidence-based interventions") that should be implemented, 2.) identifying and communicating the barriers and facilitators to implementation in a particular context, and 3.) developing and deploying strategies for overcoming those barriers and facilitating implementation.

Often, however, health and healthcare delivery systems have unique implementation needs that demand-specific competencies. For example, a public health system seeking to implement cancer screening protocols in diverse communities may require an implementation workforce that is capable of engaging stakeholders in culturally sensitive and responsive ways and using participatory methods. Conversely, large, integrated health systems may value implementers who can analyze electronic health record-based data sets and who are capable of changing organizational cultures. Given this variation, it may be useful for CTSAs to formally evaluate the implementation training needs of their stakeholders. If CTSAs discover that their learners are predominantly beginners, for example, they can focus on offering introductory training that emphasizes core principles. For more varied levels of experience and expertise, a grant-writing course or tailored speaker series may be appropriate and specific areas of interest or need can be emphasized.

Developing comprehensive curriculum and training resources that address the different needs of such diverse systems and learners can be challenging.[17] Perhaps because of this, the implementation workforce is often segmented and, consequently, researchers and practitioners often learn different contents in different ways. A tenet of TFI is that it may be valuable for implementation researchers and practitioners to spend at least some time learning together. Co-learning is possible because the competencies of implementation scientists and practitioners overlap in important ways (see Table 1). By leaning into this area of overlap, teachers for implementation can ensure that all learners have a common language and core understanding of key principles in the field. The expectation is that teaching in this way will pay off in the future when the

learners and doers of implementation find themselves working together in the real world.

For example, the UTHealth CTSA provides training on implementation strategy planning using Implementation Mapping[18] and recruits both researchers and practitioners to participate. The training utilizes a problem-based learning approach in which teams are engaged in both planning implementation strategies and their evaluation. Learning in this way provides an opportunity for researchers to apply implementation science concepts while incorporating principles of community engagement and team science, two concepts central to translational research and a focus of CTSAs. It also provides an opportunity for implementation practice stakeholders to learn and apply similar principles while realizing their pragmatic value.

Similarly, Columbia University's CTSA integrates and provides training in implementation science as part of their community-based participatory research training course that academic researchers and community partners undergo together, and the University of Colorado's Dissemination and Implementation Science graduate certificate program welcomes both implementation research- and practice-oriented learners.

While a one-size-fits-all approach is not feasible, there are common elements that can ground a single, accessible curricula. Specifically, our collective experience and the literature suggest that a joint research and practice training curriculum should cover the following foundational pillars: 1) what evidence-based interventions (EBIs) and implementation strategies are and how they differ and relate, 2) the role of theories, models, and frameworks in guiding, describing, and evaluating implementation efforts, and 3) basic methods and approaches to doing implementation research, including basic study designs, stakeholder engagement strategies, and implementation outcomes and measures.[19]

For each of these curricular pillars, there may be both commonalities and differences in what is taught. For example, it may be useful for all implementation trainees to learn about resources and databases for identifying and assessing existing EBIs that might merit implementation. In teaching *researchers*, however, one might focus more on increasing the learner's capacity to evaluate the external and internal validity of evidence for interventions based on the literature. On the other hand, implementation *practitioners* may be better suited by gaining experience with hands-on tools (like The Hexagon Tool[20]) that can assist with choosing EBIs for specific contexts.

Similarly, when teaching the foundations of implementation research methods, there is value in all learners being aware of the range of study designs that exist, but the emphasis and depth of understanding may need to vary. For example, it may be useful for all learners of implementation to grasp the role of social networks in influencing change. As it relates to this, researchers may need to know how to conduct social network analyses and use specialized analytic software, whereas practitioners might need to know how to identify social network influencers and opinion leaders via informal methods (e.g., by asking participants to nominate influential stakeholders). For other examples of "what to teach" for implementation and how these competencies are differentially applied across the breadth of implementation learners see Table 1.

How to Teach for Implementation

Embracing the diversity and breadth of implementation competencies that real-world systems demand presents clear challenges.

Table 1. *Examples of distributing learning objectives for implementation competencies among implementation researchers and practitioners*

Implementation competency	Learning objective that supports competency for researchers	Learning objective that supports competency for both researchers and practitioners	Learning objective that supports competency for practitioners
Demonstrate the influence of context on implementation	Design studies to evaluate the relative contributions and empirical impact of different determinants of implementation success	Understand determinants of implementation, including relevant theories and frameworks	Use implementation frameworks to conduct pragmatic assessments of implementation contexts
Assess the value of implementation strategies	Design studies that result in generalizable knowledge about the effectiveness of implementation strategies	Describe methods for evaluating the impact of implementation strategies on implementation outcomes	Use methods, such as quality improvement cycles, that evaluate implementation strategies within their unique context
Engage relevant stakeholders	Demonstrate how to find and partner with community-based agencies	Describe the contributions of community-academic partnership to implementation and core principles of community engagement	Demonstrate how to find and partner with academic institutions
Account for threats to implementation fidelity	Develop and use study designs that can account for and track the effects of intervention adaptation over time	Describe the concept of implementation fidelity and the rationale for making adaptations carefully	Demonstrate how to use adaptation frameworks to carefully guide the intervention adaptation process

Namely, teachers for implementation must grapple with how to match those needs with the diverse strengths, interests, and aspirations of implementation learners. They must also acknowledge their own scope of expertise and its related strengths and limitations. Indeed, no single teacher for implementation is likely to be able to meet all of the educational needs of every learner. Similarly, few learners of implementation will be well-suited by any single training curriculum.

For these reasons, TFI suggests that education be tailored to the unique needs of individual learners. Because few centers have the capacity to meet the diverse needs of all implementation learners, it also requires that students receive help in selecting from existing and external educational offerings. Mentorship is key in this regard and is critical to the effective training of both implementation researchers and practitioners.[21–23] As it relates to TFI specifically, mentors are often ideally positioned to foster skill development and practical knowledge that are essential to competency attainment. As such, we recommend all learners of implementation have mentors with connections to and experience in the contexts and fields where they intend to work.

Learners should work with these mentors and other teachers for implementation to structure a personalized curriculum that is robust and feasible and that will address key competency gaps. Efforts are underway to catalog and categorize the many educational resources and opportunities that currently exist for both implementation science and practice, which will aid in this process. Here, we present only archetypes of existing training options[17,24] to show how they can be used as part of a tailored training plan for different learners (see Table 2).

Of course, TFI is more than simply making existing training options available to learners. It is also ensuring that those options are delivered in a way that is effective. For some existing training options, it can be difficult to know their target audience, competencies addressed, and methods of teaching. In these situations, it is best to contact and directly inquire of program coordinators. An alternative approach where feasible is to develop and deliver all core implementation curriculum in house and to supplement learners' specialized and additional needs with focused, external training options. This approach gives teachers for implementation more control over equipping their workforce and ensuring specific needs are met. With that approach in mind, we recommend teachers for implementation develop curricula and programs that are built on contemporary educational philosophy and theory.

Especially relevant bodies of work to draw from include those centered on competency-based education,[12,25–27] interprofessional education and collaboration,[28] and online learning strategies.[29]

Teachers for implementation should be strategic but generous with co-learning opportunities for implementation researchers and practitioners. Such opportunities may advance both the science of implementation and its application in practice. For example, while various implementation frameworks describe contextual factors that influence implementation outcomes, the relationships between these factors are not well explicated and an important area of new research. Practitioner–researcher co-learning in this area can help generate hypotheses about these relationships as well as identify leverage points for intervention. As mentioned above, a core curriculum based on the foundations of implementation science is well suited for teaching in a way that will stimulate discovery. Additionally, surveys of implementation scientists and practitioners suggest that several of the most important professional skills they have learned were learned "on-the-job" and after their formal education.[30] As such, it will only benefit implementation learners to structure educational opportunities that emulate the real world and that allow each member of the interprofessional implementation team to learn and practice their roles.

For example, to teach implementation research methods in a problem-based and multi-professional way, a teacher for implementation might convene a stakeholder panel to speak and answer questions about a key health problem with all learners. Small multidisciplinary groups might then break up to discuss the problem and suggest ways to address it. Researchers may need to draft a protocol or proposal for an implementation study, while practitioners select and pilot pragmatic tools for measuring the impact. The group could then demonstrate what they learned in a shared presentation.

Brief, interactive modules to convey content and teach key principles (e.g., brief videos, "ignite" sessions from experts) may be especially helpful when they are followed by activities that allow learners to apply the material to their own settings and contexts. Existing modules and toolkits that can be used in this way are also available from CTSAs (see https://sites.wustl.edu/wudandi/di-toolkits/ and https://www.youtube.com/channel/UCJhGTpULmVIENeYHPDy-jLg/videos). Other methods and approaches to teaching for implementation based on these principles are presented in Table 3.

Table 2. *Archetype training options for incorporation in tailored implementation science training plans*

Training option	Format	Curriculum	Potential use
Training Institute for Dissemination and Implementation Research in Cancer (TIDIRC) https://cancercontrol.cancer.gov/is/training-education/TIDIRC-open-access	Facilitated (or open access) viewing of modules, completion of readings, responding to questions around dissemination and implementation (D&I) research project idea	Intro to dissemination and implementation (D&I) science, fidelity and adaptation of interventions, theories and frameworks, measures, study designs, and implementation strategies	As a mentored training program for investigators seeking to become implementation researchers and conduct funded implementation research in the area of cancer control and prevention
Training in Implementation Practice Leadership (TRIPLE)[34]	3 in-person half day training sessions plus coaching and technical support	Service quality assessment, identification of evidence-based interventions (EBIs), strategies for introducing EBIs and developing support, stakeholder engagement, data monitoring	As training for mid-level leaders and managers in care and service delivery organizations who will function as implementation practitioners
Veteran's Affairs Quality Enhancement Research Initiative's Implementation Facilitator Training	14 h; multifaceted with didactic, prep work, interactive role-play, group exercises	Competencies and characteristics of facilitators, models and activities involved in implementation facilitation	As supplementary instruction for clinical and operational managers who will function primarily as implementation practitioners and want to learn facilitation skills or how to use facilitation in implementation of key initiatives in healthcare settings
University of Colorado-Denver D&I Graduate Certificate Program	12 credit hours of core and elective graduate coursework with didactic learning and interactive, personally-relevant applications	Introduction to D&I, designs and mixed methods in D&I, designing for dissemination and sustainability, understanding context & adaptation, and grant writing	As "pragmatic training to researchers who want to develop competencies in D&I science and practice which can be applied across multiple topic areas and settings in health services, clinical and community health, and public health research."
Mayo Clinic's intro to D&I research modules (https://1825021.mediaspace.kaltura.com/playlist/details/0_4b10jn7m/categoryid/141880062)	8 open access web-based modules, each 10–20 min long with discussion questions	Purpose of implementation research, theory and frameworks, implementation strategies, outcomes, study designs, user-centered design, adaptation and fidelity, and grant-writing	As introduction to key concepts for learners wanting to do implementation research or established investigators new to the field; as "prework" for group or individual discussions with teachers or mentors
Texas Institute for Implementation Science-University of Texas Health Science Center at Houston	4-hour webinar series and an 8-hour research workshop	Overview of implementation research and practice with monthly seminars (in the Fall) that include examples of application in practice. Workshop includes tutoring on implementation research.	As research training for individuals seeking both a basic introduction to implementation research and (through workshop) individualized feedback on potential research studies with expert facilitators and mentors.

Table 3. *Example strategies to support teaching for implementation*

Strategy	Approach/Rationale
Didactic expert lectures	Invite expert scientists and/or practitioners to teach their areas of expertise and passion. Helpful in ensuring learners have exposure to breadth of content beyond a primary teacher's expertise; when guests are from real-world settings can have added benefit of helping learners understand these settings and the importance of stakeholder engagement
Engagement with applied tools and resources	Instead of providing learners with information that will not automatically be provided in the real world, encourage them to use tools and resources that are routinely needed. Ensures learners are able to "do" implementation when they enter the workforce
Creating a community of practice	Create a website and learning environment that recognizes expertise and resources from both practitioners and researchers and does not only value academic literature
Small group interactive exercises	Invite expert scientists and/or practitioners to share their current implementation program and have teams of researchers and practitioners brainstorm solutions
Feedback and assessment	Tailor to learning needs and interests (e.g. select an evidence-based intervention and develop a dissemination and implementation plan and strategies tailored to their setting and population); provide feedback on their application to frameworks, methods, approaches from implementation science in their projects
Discussion-based learning	Assign prep work that introduces concepts; use in-person time to solidify with prompts or questions that encourage critical thinking and the application of these concepts. Maximizes in-person learning time and respects the contributions and experiences of adult learners.
Personal application	Course products should ask learners to apply methods and techniques in the context of a personally relevant project (grant proposal, local quality improvement effort, or program evaluation)

Supporting Teachers for Implementation

The TFI Framework offers educational direction to stakeholders seeking to hasten implementation of research products in real-world settings. To support a TFI approach CTSAs and similar structures will need to innovate. Innovations may include strategies for making implementation training more consistent and accessible. This may mean offering "courses" that are open to learners that are not formally enrolled in a degree-granting program. These courses could be organized as a certificate program based on a TFI core curriculum while also awarding credit toward researchers' degrees. Cross-CTSA learning, collaboration, and sharing of resources would be invaluable in developing such a curriculum. Specifically, only a handful of training options explicitly focused on implementation practice currently exist.[19] CTSAs are well positioned to address this training gap through collaboration with related disciplines and efforts, such as those centered on healthcare quality improvement.

Finally, work is needed to develop educational models and structures that get learners of implementation out of the classroom and into real-world delivery systems during training. Indeed, it is natural and expected for basic science learners to spend time working in laboratories. The concept of implementation laboratories as avenues for conducting rapid-cycle implementation research would provide training opportunities for researchers and practitioners alike. Extending from learning healthcare systems, implementation laboratories[31] are explicitly focused on conducting pragmatic studies that can generate readily applicable, real-world evidence. From a training perspective, learning laboratories for implementation can provide opportunities for internships and clerkships that would, ideally, be central to a TFI approach. For example, researchers at Mayo Clinic, with pilot funding from its CTSA, partnered with the local Area Agency on Aging and other regional non-profits to develop a collaboration focused on healthy aging program implementation.[32,33] To foster learning within this "collaboratory," Doctorate of Nursing Practice students from a local university work with stakeholders to conduct small implementation research studies as part of their capstone projects. CTSAs are well positioned to provide consultations and "match-making" services that make these sorts of learning opportunities possible.

Discussion

CTSAs and other translational science stakeholders recognize the strong potential of implementation science as a tool for facilitating research translation. As such, many institutions are working to build implementation science capacity. In this paper, we introduced the TFI framework as a guide for educational stakeholders and teachers of translational research. The framework orients educational efforts toward the end goal of facilitating the implementation of research products in real-world systems and settings and demonstrates the implications of this orientation on who, what, and how to teach.

TFI builds on an existing and growing knowledge base about how to teach learners of implementation but makes explicit some key challenges and considerations for CTSAs. Specifically, TFI describes how CTSAs and the translational science infrastructure may be ideally positioned to advance teaching and training for implementation in key ways. To that end, we see many potential uses for the TFI framework. First, teachers for implementation can translate its principles in the classroom and in curricular development. Second, directors of KL2 programs and other educational

infrastructures may find the framework useful for thinking through the recruitment of learners and the designing of educational offerings. Finally, the larger community of implementation teachers and trainers within the CTSA consortium may use the framework to coordinate the creation and sharing of key resources.

Strengths of the framework relate to its value as a synthesis of several disparate bodies of work, its unique relevance to translational science teachers and stakeholders, and the diverse experience and perspectives of the authors from whom it is drawn. Important limitations include the framework's limited empirical basis. Indeed, future efforts should focus on using the framework; assessing its value; and refining, confirming, or refuting it.

In conclusion, we emphasize that teaching for implementation is not the same as teaching for the acquisition of knowledge. Related to this, affecting change in real-world systems may benefit from teaching and training a workforce that is uniquely equipped for implementing research products. We hope that the TFI framework offers a helpful guide for thinking through how to facilitate such an effort.

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