CHAPTER 1

Translational Education Research

Advance Organizer. Chapter 1 defines the concept of translational research and compares basic and applied research paradigms. The chapter includes Brabeck's (2008) quote that sets out the rationale for applying the translational medical research model known as bench to bedside to the authors' translational education research model: lab to learner. The chapter also sets out the dilemma of translational research for end users and describes the purpose and activities of the related Freddie Reisman Center for Translational Research in Creativity and Motivation (FRC) at Drexel University.

1.1 Introduction

Researchers publish their work for other academics in journals and funded grant reports and materials; however, these sources are not readily or easily accessible to teachers and their students, students' parents/guardians, or corporate trainers. As these individuals are not the target audience of researchers, it is difficult – if not impossible – for these non-researchers to translate the research findings into language or activities that would benefit their learners. Simply put, researchers' findings are not readily accessible or understandable to those who are in a position to implement the research. Generally, the research languishes in journals and reports for a subsequent researcher to read and utilize for the next research study. This problem is at the heart of the need for translational education research.

Evidence-based practice uses the best available research findings and is considered the gold standard in patient care. In medical research, it has typically taken hospitals and clinics about seventeen years to adopt a practice or treatment after the first systematic evidence showed it helped patients (AACN, 2016; NCATS, 2016; NIH, 2021; Niven, 2017). Although there has recently been movement in the medical model in decreasing the lag time as a result of the creation of Pfizer, Moderna, and Novavax vaccines in response

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to the COVID-19 epidemic, it is not yet known if the lag time decrease was the beginning of a trend or a temporary exception. Translational education research, however, aims to significantly decrease the lag time between the discovery of excellent research findings and those findings' potential impact on learning and instruction.

1.2 Translational Education Research Defined

"Translational research involves moving knowledge gained from the basic sciences to its application in clinical and community settings" (Davidson, 2011). Bench-to-bedside research is a summary phrase often used to describe this concept. This phrase describes the process of how laboratory research results are directly used to develop new ways to treat patients. That is, translational medical research derives from scientific discoveries made in the laboratory, clinic, or field. Those discoveries are then transformed into new approaches to medical care and into treatments that improve people's health. The bench-to-bedside translational medical research model served as the authors' prototype for their translational education research model, namely lab to learner. The lab to learner model underlies both this book and the FRC at Drexel University, with the FRC described later in this chapter (see Figure 1.1).

The term "translational research" first appeared around 1993 in medical journals and referred to transforming scientific discoveries in the laboratory into treatments for patients – mainly for individuals experiencing cancer. In that model, basic lab investigations were translated to benefit patients. Translational research in the medical field is one-directional, whereby research results go from the researcher's bench to the patient's bedside. However, the translational education model proposed by the authors of this book is a two-way, reiterative model. That is, research is translated into instructional-based modules (lesson plans) to benefit end users (e.g., teachers and their students, corporate trainers, and company employees), while feedback from end users can modify these lesson plans and possibly lead to the identification of new research goals, as shown in Figure 1.1. This is the translational education research cycle. Thus, the authors' model of translational education research is synergistic, as opposed to the one-way, linear, medical version.

Mary Brabeck, Dean Emerita of the Steinhardt School of Culture, Education, and Human Development at New York University, whose

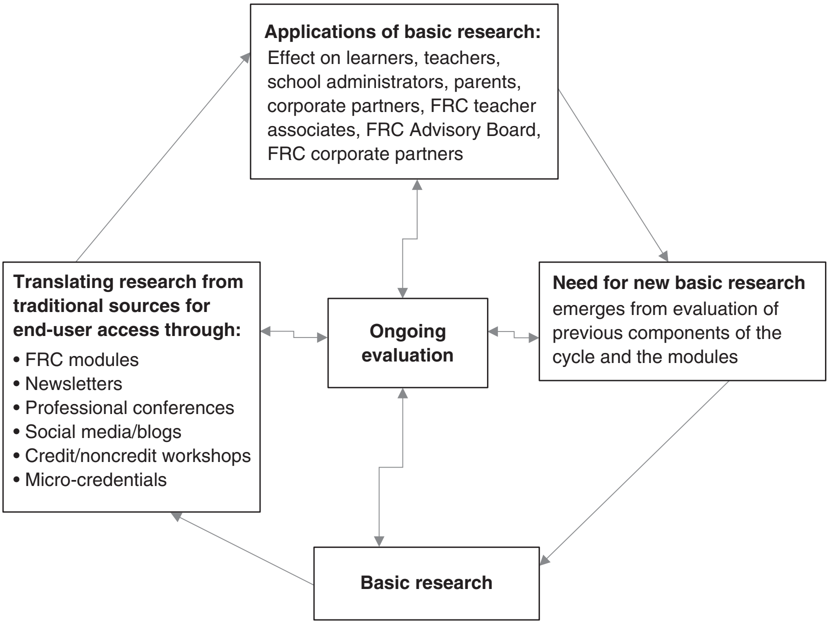

Figure 1.1 Translational education research cycle.

definition of translational research the authors apply to education, stated that:

> In medicine, translational research is often identified as *bench to bedside*. It recognizes the gap between basic research in the lab and the practice of medicine that can make a difference in health outcomes. The role or goal of translational research in medicine is to quickly provide practitioners with the latest information from basic research labs in usable form. The idea is to produce better medications, improve diagnostic and treatment strategies, and enhance health through the application of information from basic science research. (Brabeck, 2008, emphasis added)

The translational education research cycle (Figure 1.1) depicts the FRC's version of lab to learner translational education research. The process begins with FRC team members continually vetting the best of past and current research in creativity and motivation to extract the most important studies that affect learning. Instructional modules (lesson plans) for use in the education arena were created by the FRC as the initial vehicle for providing end users with access to the research in understandable terms

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and formats. The FRC will eventually branch out into translating research for corporate trainers and other relevant fields.

1.3 Value–Practice Gap

The authors' premise is that teachers and other end users must not only value basic educational research, but also use it. A UK study found a value–practice gap between teachers' value of research and their actual use of the research in their teaching (Jones, Proctor & Younie, 2015). Our two-pronged goal is for instructors to (1) *have access* to basic educational research and (2) understand and *apply* it for the benefit of their learners. The following section discusses and compares basic and applied research.

1.4 Basic and Applied Research

Research is most often categorized as either basic research or applied research. Bush (2020) distinguished between basic research and applied research as follows:

> Basic research is performed without thought of practical ends. It results in general knowledge and an understanding of nature and its laws. This general knowledge provides the means of answering a large number of important practical problems, though it may not give a complete specific answer to any one of them. The function of applied research is to provide such complete answers.

Definition of Basic Research

Basic research focuses on adding new scientific knowledge to an existing body of knowledge. Basic researchers create and test new theories with goals that do not address applications for end users.

Basic Research Tools

Basic research tools range from brain imaging to full-body exploration through various methods with varying degrees of specificity and invasiveness. Methods include:

- **functional magnetic resonance imaging**, a technique that measures brain activity through the detection of changes associated with blood flow

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- **electroencephalogram**, a test that measures the electrical activity of the brain
- **positron emission tomography**, a functional imaging technique that uses radiotracers (a radioactive substance) to measure changes in metabolic processes and other physiological activities (e.g., blood flow, regional chemical composition, and absorption)
- **computerized tomography**, a computer imaging process that combines multiple X-ray images collected from different angles of the inside of a body; the results are cross-sectional images (slices) of the bones, blood vessels, and soft tissues
- **ultrasound imaging**, a technique that produces functional screen images created by sound waves (also known as a sonogram) of organs, tissues, and other structures inside the body.

Definition of Applied Research

Whereas basic research focuses on advancing knowledge rather than solving a problem, applied research seeks to identify solutions to specific problems.

Examples of Applied Education Research

Applied education research focuses on learners' generic influences on learning, which are used to design instructional modules. Generic influences on learning fall into several categories: cognitive, psychomotor, physical, and sensory influences, as well as social and emotional needs (Appendix 5A provides the definitions of these generic influences and Appendix 5C lists tips for teachers for implementing the generic influences). Generic influences include areas such as engaging in creativity and motivation activities, retaining information, applying visual discrimination, demonstrating low vitality and fatigue, and being aware of cues in the environment, as well as becoming overly upset, moody, sad, or happy, or other reactions that represent extremes of emotion that one typically learns to control under normative development.

Applied Education Research Methods

In education, applied research is used to understand teaching and learning behaviors in the classroom. The following are examples of common applied education research methods:

- **Experimentation.** Experiments in education research include observations, interviews, and administering surveys and questionnaires that tap attitudes and self-perception.
- **Observation.** This research method involves the researcher paying close attention to the subject's verbal and nonverbal behavior and actions.
- **Interview.** In this research method, the researcher asks participants questions in a one-to-one (interviewer/interviewee) manner or within a small, focused group of interviewees being questioned on a subject to gather in-depth information about an experience. Interviews may be structured or unstructured, depending on the research goals. In a structured interview, the researcher asks predetermined questions. In contrast, in an unstructured interview, the researcher starts with a question and then guides the subject to elaborate with relevant follow-up questions.
- **Questionnaire.** A questionnaire is a survey (generally a paper-and-pencil or online method of data collection) consisting of a series of questions. Participants' responses are often collected using a Likert-type scale (Box 1.1). Questionnaires may also be self-report assessments.

Box 1.1 Likert-type scales

Likert-type scales were introduced into research by the US social psychologist Rensis Likert (1932). They measure people's thoughts and feelings, including through opinion surveys, personality tests, and attitude responses. The scales comprise a series of statements to which the research participants provide response ratings. The statements express a positive or negative opinion. Such statements may be taken from a teacher self-assessment checklist such as the Reisman Diagnostic Creativity Assessment (RDCA), for example "I keep an open mind," "I will use more effort on an activity or task if there is some kind of incentive," and "I regularly come up with novel uses for things" (Reisman, Keiser & Otti, 2016). The scale used to rate each statement may be a 5-point, 6-point, or 7-point scale or some other appropriate point response ranging from "strongly disagree" to "strongly agree," "strongly disapprove" to "strongly approve," or "least like me" to "most like me." The RDCA assessment uses a 6-point Likert-type scale that ranges from "strongly disagree" to "strongly agree." Dr. Likert shared with Dr. E. Paul Torrance – a creativity researcher who is considered by many to be the "Father of Creativity" – his frustration with people modifying his scale without acknowledgment and suggested that it henceforth be cited as a Likert-type scale (and Dr. Torrance disclosed this to Dr. Reisman, the lead author of this book).

1.5 Example of Lab to Learner

This section sets out a real-life example of the authors' lab to learner model. In 1979, while on faculty at the University of Georgia in Athens, Georgia, Dr. Reisman was engaged in basic research with a colleague, John Braggio. Having refined his skills as a basic researcher at the Yerkes National Primate Research Center in Atlanta, Georgia, Dr. Braggio migrated to a faculty position at the University of North Carolina in Asheville, North Carolina. Braggio contributed his skills as a basic researcher to his collaboration with Reisman, the educator.

Reisman and Braggio recruited a group of Asheville 4th graders who were in their school's learning disabilities program. Physiological measures – namely a laryngograph and measures of respiration (including amplitude and frequency) – were taken while the students were engaged in a math computation test. The number of student participants is not recalled, but the subjects comprised an equal number of boys and girls. Each student was asked to complete a computation test created by Reisman in which 4th-grade-level items progressed from simple to difficult, while Braggio monitored students' physiological measures.

The laryngograph method consisted of placing a small disc on a student's larynx, while each student was simultaneously hooked up to a respiration machine. Acquiring physiological measures was made into a fun experience for each child so that each was comfortable with the procedure before starting the computation test. In testing of this sort, there is a phenomenon referred to as the U graph (Box 1.2). As shown by the graph, at first, participants typically experience a high level of activity (perhaps due to anxiety) as measured by the assessment tool. That period is followed by a period of calming down. In this specific instance, laryngograph activity increased as the computation problems got more difficult.

The U effect was apparent for those children who got the most items correct. These students were anxious at the start of the test (the upper left part of the U). They quickly calmed down as they completed the easy items (the low portion of the U). However, as the difficulty of the test items began to increase, the physiological measures increased (the upper right portion of the U). This reaction was expected and reflects the effort and anxiety expected in a normal U graph. The upper portions of the U graph were indicative of rapid laryngography muscular movement and rapid and deep breathing, while the bottom of the U indicated normal breathing and less muscular activity of the larynx. The physiological measures of the children who did poorly on the computation items varied. In other words,

Box 1.2 Inverted-U theory

Psychologists Robert Yerkes and John Dodson (1908) created the inverted-U theory. This theory uses the "U" shape to represent the relationship between pressure and performance in identifying the optimum level of positive pressure at which people perform at their best. Either too much or too little pressure can lead to decreased performance. The upper left of the U indicates too little pressure. Following the left side of the U down to the bottom represents the gradual rate of performance improvement in relation to the gradual increase in positive pressure, but only to a point. The mid-point of the bottom of the U represents the optimal intersection of positive pressure and performance. Past the mid-point of the U's bottom, the rise of the right-hand side of the U represents a decrease in performance related to increased pressure. It culminates at the upper right of the U, indicating the ultimate amount of pressure being applied coinciding with the lowest level of performance. The U shape illustration also provides a visual highlighting that the level of nonperformance is equal for both too little and too much pressure.

there was no pattern of physiological response related to item difficulty – no U curve was noted. Chapter 3 provides a more in-depth explanation of the U curve theory related to motivation.

The Ashville students' results are an example of translational education research. The lab findings were shared with the children's teachers, along with suggested pedagogy that translated the experimental results into classroom activities and environments, enhancing learning. Specifically, in this case, the following strategies were suggested, and the teachers stated that they would implement them:

- provide practice activities that involve different role-playing scenarios related to effort and anxiety that are appropriate to various tasks
- encourage and observe the development of the student's self-concept, self-efficacy (know you can do it), and perseverance to successfully complete a task
- use techniques such as relaxation imagery, centering, deep breathing, and affirmations (harnessing positive thinking)
- have students use concrete examples of arithmetic computations (see the discussion of Reisman counting boards in Chapter 9)
- encourage students to practice saying the steps aloud when solving computations
- allow students to create and solve their own math computation problems

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- use formative evaluation to monitor changes in students' self-efficacy, self-concept, and task perseverance as they are involved in learning math and other subjects
- keep notes that document the move from a teacher-directed environment to a more creative student self-directed classroom

Although Ashville students' results suggested a possible relationship between the laryngograph results and subvocalization, a question still remains about this relationship. At the time of the research, Reisman and Braggio could say only that laryngograph activity demonstrated muscular activity in the larynx; they could not confirm their hypothesis of a connection between laryngograph activity, subvocalization, and metacognition.

Another question that arose was: Why might subvocalization be important to learning? Subvocalization while performing a task relates to Flavell's (1979) discussion of metacognition, also known as cognitive monitoring, and is a helpful strategy for problem-solving. Reisman and Braggio hypothesized that laryngograph activity, if it did indeed represent subvocalization, implied that the students talked themselves through the computation items while incorporating cognitive monitoring. Box 1.3 is an example of one of the children who did well on the computation test and shared their metacognitive activity aloud with us while attempting one of the assessment items in the Reisman and Braggio experiment (Braggio et al., 1979).

The following section describes the FRC, a university-wide research center that has been created to address the new model of translational research described in this book. The FRC provides specific lesson plans for end users in Chapters 9 and 10 in the form of instructional modules with an initial emphasis on creativity and motivation.

Box 1.3 Example of a student talking through a math computation

$$\begin{array}{r} 15 \\ +\ 23 \\ \hline \end{array}$$

The student said aloud, "I need to add the 5 and the 3," while looking at the "ones" column. They then said, "Ok . . . 5, 6, 7, 8," as they proceeded to total the column.

The student then moved to consider the "tens" column and said aloud, "Then I need to add the 2 and 1 to get 3."

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1.6 FRC at Drexel University

Purpose

The FRC addresses the disconnect between research and its application. For example, one of the topics considered by the FRC is the research-derived characteristics of creative students in comparison with teachers' lack of knowledge of creative and motivated students and the resulting unfounded beliefs that affect how teachers stifle rather than nourish creative students.

The medical translational research model – referred to as bench to bedside – served as the prototype for the FRC's model, lab to learner. Through the lab to learner model, relevant research that is currently "hidden" in journals that are not accessible to educational end users will become available to teachers. The FRC will also address translational research for corporate trainers and talent managers. The FRC has expanded on the medical model of translational research and applied it to education, aiming to significantly decrease the lag between excellent research findings and teachers' and corporate trainers' access to these findings. In this way, education-related research can begin to be used for the benefit of end users.

How We Implement the FRC Purpose

A stellar group of researchers from the creativity and motivation fields make up the FRC's Advisory Board. The Advisory Board members assist in gathering basic creativity research for translation from the USA and around the world that relates to improving pedagogy in terms of understanding and valuing the roles of the learners and their cognitive, social, and emotional characteristics and needs. The results from translating the creativity research are disseminated to end users (e.g., teachers, school principals, college faculty, doctoral students, instructional designers, parents, corporate trainers, and business leaders) for use with their learners (e.g., preschool through college [K–16] students and corporate employees). Continuous updates on and biographies of the current FRC Administration and Advisory Board members can be found on the FRC website at www.frcenter.net/.

Why the Focus on Creativity and Motivation?

The spotlight on creativity and motivation purposely delimits the initial work of the FRC to these two areas that affect learning. Years of research have not changed the fact that teachers do not recognize their students'

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creative strengths. Teachers believe that their creative students agree with them, do not question teachers' statements, do not display behavior problems, and smile at the teacher (Aljughaiman & Mowrer-Reynolds, 2005; Getzels & Jackson, 1962; Torrance, 1975). Teachers described students whose creativity they do not acknowledge as nonconformist, disruptive, and troublemakers (Westby & Dawson, 1995). Research has suggested that teachers who recognize their own creative strengths may be able to better recognize and appreciate the creative strengths of their students, resulting in higher quality learning (Whitelaw, 2006). This dilemma is discussed more in Chapter 2 in the section "Education Definitions of Creativity."

Motivation is an essential part of almost every aspect of human behavior. When one makes a decision, the choices are often influenced by the decision-maker's motivational state. When studying mathematics, the motivation to study mathematics affects how one learns it. Despite its obvious importance, empirical research on motivation has been segregated in different areas for years, making it difficult to establish an integrative view on motivation. Researchers have begun to recognize the importance of a more unified and cross-disciplinary approach to studying motivation (Westby & Dawson, 1995). A multidisciplinary, multi-method pursuit called motivation science is emerging (Murayama, 2018), in which motivation researchers are now taking an integrative approach. They draw from multiple disciplines (e.g., cognitive, social, and educational psychology, as well as cognitive/social neuroscience) and multiple approaches (e.g., behavioral experiments, longitudinal data analysis, neuroimaging, meta-analysis, statistical simulation/computational modeling, and network analysis).

Services Provided

Key creativity and motivation research is obtained from creativity and motivation trailblazers from the USA and internationally. The research collected is translated into language that K–16 teachers and higher education faculty (and corporate trainers), their students (and corporate employees), and their students' families and caregivers can immediately understand, with strategies provided for implementing creativity and motivation research across these audiences.

Specifically, a team of Drexel University faculty, research students from across multiple disciplines within the university, and select, like-minded organizations are in contact with researchers from around the world, collecting the best creativity and motivation research that has been undertaken. The research is assessed and its content is evaluated for inclusion, that is, whether it is deemed essential for FRC-trained staff to translate the research for end user implementation. The FRC's funding also supports the recruitment of practicing teachers from across the nation (as well as globally, as appropriate) who collaborate with the FRC's leadership on designing authentic lessons based on relevant translated research. This includes the experiences and feedback of practicing teachers who have implemented these lessons and their interactions with their students. Teacher feedback is used to modify the lesson plans and identify areas for future research.

The FRC will also offer an evaluation plan for teachers to assess the results of the translational research. The FRC's leadership will instruct teachers and higher education faculty on how to use the evaluation plan that is provided as a template for them to create their own assessments. Thus, the FRC will offer suggestions on instructional and assessment activities derived from relevant research for teachers to implement with their students. It is noted that corporate trainers can apply the FRC's services to their own learners.

The recent disruption to established educational models in the context of the COVID-19 pandemic has created a ripe environment for research to be applied to new educational environments, such as virtual instruction and self-directed learning (sometimes referred to as unschooling). Due to this disruption of historic educational models, traditional instructor–learner interactions will need to be modified and documented through the translational efforts of the FRC. This includes providing tested, teacher-developed lesson plans and related strategies that educators can immediately implement in the classroom.

1.7 Summary

Chapter 1 provides a new definition of and rationale for the transformation and revision of the application of the medical translational research model, which is currently used in most translational research. The chapter includes examples of the revision of the model from the one-way information flow of the medical bench-to-beside model (Brabeck, 2008) to a two-way, interactive lab to learner model.

The chapter further provides insights into the dilemma of translational research from the perspective of the end users and discusses a new research center dedicated to breaking down the current silos that house research and findings in the areas of creativity and motivation, namely

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the FRC. The development of the FRC and its practice is discussed, including how the FRC identifies cutting-edge research in creativity and motivation journals across multiple disciplines and translates this into language and instructional modules to better and more quickly communicate the research to end users. With the support of the FRC's stellar Advisory Board, which is made up of worldwide trailblazing creativity and motivation researchers, the FRC is initially working to benefit teachers and their students, followed by corporate trainers and their students, in their quest for learning.

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