

The Contribution of Research to Education in the Safety

Introduction

The term research is used by many to mean many things. Moreover, research, with its many definitions, is used for many purposes in our society. While there are several definitions for research, one might say in literal terms, it is to “search again” or, in essence, to seek information that has already been developed or discovered. However, it is proposed here, that there is wide acceptance of the fact that research is a process of developing new or original information or of gaining new understanding of existing information and of uncovering new contexts for existing information.

Journalists, historians, criminal investigators and fiction novelists do research to develop their stories, to understand how crimes may have been committed, to gain an understanding of past societies, cultures or civilizations, to base a novel on a real setting or in a real period in history. In each of these cases, a new understanding is developed or a new position can be stated. Other definitions explain that research is the search for new knowledge through a more thorough or a different or deeper understanding of existing knowledge or it is described as a systematic investigation to establish or understand facts.

The first stage in the research process is called the literature review. This allows researchers to determine what is already known about a topic, and then how and where they can strengthen the body of knowledge by first identifying gaps in that knowledge, and then filling those gaps with the new discoveries they hope to make through their research. Empirical, experimental research has to do with establishing a hypothesis, and conducting a series of qualitative and/or quantitative analytical steps involving data collection, control of variables, and some form of statistical, other quantitative, or qualitative analyses.

In general, this research has to do with the systematic process of discovering and interpreting information to gain human knowledge about scientific concepts or scientific knowledge about human performance concepts. For safety-related research, scientists explore how humans, the environment, the machines of industry, and the work space interact with each other and with natural and physical law in a safety context. In the fundamental or basic sciences, such as the life sciences (biology, biochemistry, etc.), psychology, physics, chemistry, and so forth, research is a necessary aspect of the strengthening, of the growth and of the continued pace-setting nature of these basic sciences.

One may argue, however, in an applied science such as safety that can draw upon the larger body of knowledge from the basic sciences, there is no need for specific safety-based research. Moreover, the applied science nature of the safety field demands practicality and answers to its questions, often long before research can deliver them. Even though this may be the case in the applied world, an aspect of the safety field that just seems to scream loudly for some form of research is the very complex nature of the interactions between the physical and natural worlds and the human world.

This article explores the issues and implications of research to understand the expectations of the safety community, and to explain the process involved in bringing new discovery to the practical world. Most importantly, this article describes the exploration in such a way as to explain the contributions that research and its findings make to education. In fact, it will be shown that the existence of a research process and the findings it produces are an absolutely essential component in the development of educational content, and the development of a critical-thinking, answer-seeking, problem-solving student population. Encouragement of scholarly inquiry in students and professionals is a foundational element in our understanding of what eventually becomes the well-known and widely accepted information that is used to make every-day, safety-related decisions in the workplace, develop safety-related policy and regulations in government, and deliver the course content taught in our universities.

Safety-related research is currently done by the National Institute for Occupational Safety and Health (NIOSH); however, it has been argued by many that a large percentage of NIOSH research is specifically health-related, and that this is at the expense of safety-related research. To remedy this perception or concern, ASSE membership and staff have expressed interest in conducting significant and impactful, safety-related research. While the ASSE Foundation has been funding research for a number of years, most of the studies have been small in scope and, as such, they have only slightly advanced our understanding of the safety problem. However, that is likely to change in the near future. In June of 2013, the Board of Trustees of the ASSE Foundation decided to take a big step into the world of scientific research by approving an expenditure of \$100,000 to fund a significant study in the coming year. It is a hope of the board that this program will both continue each year and expand in funding levels. This will be the Foundation's second \$100,000 research grant, and this is a serious and significant step towards increasing the amount of research that is done in the safety area.

It is proposed that it will strengthen the society's ability to contribute greatly to the educational content of the world, and even the world's health, and safety degree-granting programs. Similar to the NIOSH's "Research to Practice" philosophy, the author proposes the adoption of a complementary approach, titled "Research to Education," to be incorporated with the ASSE Foundation's research program. Another purpose of this article is to challenge the academics in the safety community to get involved in the research process, and begin to teach rising students of the various safety fields to take up the research quest in its true sense, and contribute to the development of new information, products, policies, practices, processes, and standards that, ultimately, lead to the protection of workers around the world .

What is Research?

In order for research to benefit education, it first has to qualify as research, and then has to be carried out in strict and systematic fashion to ensure that it is a new and an original contribution to the literature. To be able to discuss this contribution to education, first it is important that the types of research and the research process be explained in the context intended by the author.

There are two general types of empirical research: theoretical research and applied research. In theoretical research, researchers attempt to define and better understand phenomena in natural and physical world. Their purpose is to prove that these phenomena are true or not true or that they exist or they do not exist. If proven that they exist and are true, the research process then draws us towards a greater understanding of the extent to which they are true or the extent to which they exist. This proof, however, often does not appear in a usable way in society for many years. For example, theoretical researchers in chemistry may seek to determine if a particular molecular structure can be synthesized.

Society may not be ready for a newly synthesized molecular structure or material today, however further development of these findings by the same or other future researchers can lead to the availability of a future new medical treatment drug. Theoretical research results must be transformed or incorporated in some way in order to be used today in the applied world. These theoretical results can however, form the foundation on which applied research can be designed and built. Applied research, on the other hand, has to do with solving practical problems in today's applied world. This research may be done to compare several potential solutions to a problem to determine the most efficient or most cost-effective one. It may involve comparing the effectiveness of several types of protective technologies, so the most effective one can be selected, or it may involve analyzing several protection systems under various environmental conditions to determine which of them can best withstand these conditions.

While it can take many forms, it almost always is applied in the day-to-day, practical world, and the results are available for use today. Since worker safety in a complex work setting is so multi-dimensional, and safety is more related to how things are done than it is to the suggestion that safety is its own specific entity or discipline, safety-related research is done by researchers from many different disciplines. Specific safety-related research often must be conducted by multi-disciplinary teams. These teams then apply, in a safety-related context, a traditionally non-safety related activity that could be associated with a business application or use of an established analytical method. Research performed on human systems that can be applied in a safety context may be done by the many disciplines outside of the safety discipline, such as biomechanics, behavioral sciences, physics, medicine, epidemiology, fluid dynamics, psychology, sociology, business, motor learning, education, and so on. This list is not all inclusive.

Another difficulty is with safety-related research findings; dissemination of this newly developed safety-related information appears extensively in traditionally non-safety-related journals. The opportunity to publish in the pure safety research journals is limited because there are so few of them. Because there are relatively few safety-related scientific journals, e.g., Journal of Safety Research, Safety Science, and so on, safety-related research is being published in many other scientific journals that serve many other disciplines, e.g., Journal of Financial Economic Policy, International Journal of Structural Integrity, Journal of Biomechanical Engineering, Journal of Fluid Mechanics, and so forth. This means it is less likely that the information will be read by the safety community .

The Scientific Research Process

To ensure that our readers know the context in which the authors discuss research, it is important to briefly describe the research process. This way, the connection to the ideas of original research and new discovery can be put into proper context for educational consideration. Safety-related research questions generally come from gaps in practice. These are often derived from national or industry-level injury, illness, and fatality statistics and case reports. Researchers benefit from strong relationships with industry safety practitioners in order to maintain currency with conditions affecting worker safety, and to develop research questions that dig at the heart of the way organizations and industries function. The literature review discussed in the introduction section is the step that allows a researcher to pose the main research question or questions, then formulate the hypothesis around those questions. The answers to those questions represent proof or disproof of the hypothesis. Once the researcher's interests and the gaps in the body of knowledge have been defined through this literature review, a question can be posed that, when answered, will fill a defined gap/s in the literature.

It is not expected that any one researcher will fill all gaps in a particular body of literature; rather it is more important for any one researcher to focus on just one, or maybe a few, specific and direct questions. This usually will result in a better defined study with less experimental error; thus, it will produce less uncertainty in the results. A question can be posed, such as, "Will the use of a particular material function in such a way as to prevent slips on steel surfaces, because of a higher friction coefficient?" These findings could then be used by boot manufacturers to make boot soles for use by steel erection workers. A researcher then proposes an answer to that question, then seeks to prove that the answer is correct. This is a critical point in the research that is often misunderstood. Many believe that if they fail to prove that the answer to their question is in fact "Yes," they have failed in the research; i.e., they proved that a material does not reduce slips as they originally proposed it would. If the research proves that the material is not appropriate for use on boot soles, the research was still successful, because through that research, we learn that this material may be unsafe, and better materials should be used. This result will mean that, subsequently, the material will not be used for the soles of these boots. Even in applied research, rigorous, systematic scientific method must be applied so that the results have credibility. The use of rigorous and disciplined analytical techniques is essential to ensuring consistency, validity, and repeatability of the results.

To give us confidence that the phenomenon that we are studying is in fact how and what we think it is, we must gather information and evidence that is observable, empirical and quantifiable, or measurable in some way. To ensure this consistency, validity, and repeatability, the process necessarily involves developing and implementing an experimental design that will allow us to statistically prove, with a reasonable level of confidence, that our hypothesis is supported or it is not. It involves the collection of data that represent the phenomenon of the subject study. These data represent actions or events that have occurred and that have been observed and quantified. Through statistical or other types of analyses of these data, results can be compared across and between the performance, defining variables that the data represent. There are many aspects of experimentation that must be addressed to ensure validity, reliability and repeatability, eliminate bias, identify and eliminate confounding effects, and reduce experimental error. While it is not in the scope of this article to teach experimental methods, it was important to describe the basic process so it then becomes possible to show the integration of research and education, and to describe the need for dissemination of research results partially through education.

Where to Go from Here?

We accept the argument that occupational health and safety (OHS) is indeed a unique discipline and profession, but we recognize that this notion is not accepted by other disciplines. OHS is an amalgamation of many traditional disciplines; it is multi-disciplinary. It is also very much an applied discipline. OHS is also a branch of learning that must be integrated into other disciplines. This fact muddles OHS at the private sector organization and the academic level. Where does OHS fit in? In an organization, OHS could report structurally within engineering, human resources, legal, operations, or could report directly to the executive. Moreover, in many low-risk and smaller organizations, where there may not be a dedicated full-time OHS practitioner, OHS could be an ancillary part of any of those functions' roles. In academia, the same conundrum applies. OHS programs and faculty are housed within many academic "homes," including, engineering, technology, health sciences, public health, business, and so on. Some are housed further within applied sector-focused disciplines, such as mining, agriculture, and construction academic schools. While we should celebrate the fact that OHS gets integrated, we need to be cautious and question if up-to-date, research-oriented safety knowledge is truly integrated into these other disciplines in a state-of-the-art manner.

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