

Using Theoretical / Conceptual Frameworks to Inform Engineering Education Research

Social scientists use frameworks when studying social phenomena. This can be quite different from how scientists and engineers approach their research. These frameworks are variously referred to as “theoretical perspectives,” “conceptual lenses,” or “theoretical / conceptual frameworks. They serve as “explanatory frameworks” that provide theoretical and conceptual underpinnings for explaining the findings [1].

What makes theoretical and conceptual frameworks different from each other? The main differences can be summarized in the table below, based on two publications [2, 3]. In comparison, a *theoretical framework* is defined as “a philosophical stance comprised of the different theories supported by empirical research, that help explain a phenomenon;” and a *conceptual framework* is referred to as “different concepts to understand a particular phenomenon, without intending to create causal links across variables and outcomes”[3]. Researchers need to delve into academic literature to locate, connect, or synthesize theories or concepts that are relevant to the social phenomenon under investigation. When they cannot find a single specific theoretical framework to sufficiently explain the phenomenon that is being studied, they create a conceptual framework for their study.

Theoretical Framework	Conceptual Framework
Refers to a theory, a theoretical perspective or a philosophical stance that a researcher chooses to guide them in their research.	Refers to an end result of bringing together a number of related concepts to explain or predict a given event, or give a broader understanding of the phenomenon of interest.
Researchers adopt or adapt from a set or pre-existing theory as a theoretical framework.	Researchers develop a conceptual framework from a variety of conceptual or theoretical perspectives by synthesizing relevant literature.
It is explanatory , and mainly involves deductive thinking to apply it to research.	It is exploratory , and mainly involves inductive thinking to create one.

What theories can be used to inform engineering education research (EER)?

EER studies often draw upon theoretical perspectives from the disciplines of sociology, psychology and education, with a small number of frameworks having emerged from the EER literature itself. For example, if you study engineering students’ experiences and outcomes (e.g., engineering leadership [4]), you can consider a sociological theory that has been used for decades: the I(Input)-E(Environment)-O(Outcome) framework [5], which basically posits that both individual characteristics with which students enter their postsecondary education and the environmental factors within the postsecondary institution shape students’ development and outcomes. In addition to the I-E-O framework, 60 more theoretical perspectives have been identified in a literature review about research on engineering students’ experiences and development [6]. Some of these theories are presented in schematic diagrams (such as the Social Cognitive Career Theory).

Engineering educators interested in conducting intervention studies can refer to learning theories. These theoretical perspectives have been categorized in terms of theories such as behaviorism, cognitivism and situativity [7] and with respect to being student-centred, knowledge-centred, assessment-centred and community-centred [8]. Those researchers interested in equity issues in engineering education could use critical theory, for example, to frame their studies (e.g., [9, 10]).

Often a theory reflects a research paradigm (that is, the philosophical assumptions such as values and beliefs about the world) that the researcher brings into the study. For example, the I-E-O framework speaks to

the postpositivist paradigm whereas critical theory represents a transformative paradigm. More examples for this alignment are available in a chapter in the *International Handbook of Engineering Education Research* [11].

Do you have to use a theoretical or conceptual framework in your EER?

Methodological review papers [6, 12] show that not all published EER papers included frameworks in their studies. Variations in the use of frameworks in the existing literature reflect the evolving maturity of EER as a field of study. When you cannot locate a readily available framework to examine the phenomenon in your study, you may consider constructing one by incorporating concepts and propositions from literature that are relevant to your study, and exploring its validity.

If you take a look at those studies that included a framework, you will find that frameworks help researchers scope the study by informing research questions and defining variables or cases of interest, guide methods for data collection and analysis, and sharpen interpretation of the results. Arguably, frameworks offer a “lens” through which to examine the issues in question and serve as a “roadmap” to connect all the components of the study, thus adding coherence to the research. A study guided by frameworks is well anchored, enables deeper analysis, and enhances the potential for extending findings to wider contexts. Therefore, it is worth your efforts to use one in your engineering education research.

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