

Supplemental Material

CBE—Life Sciences Education

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Supplemental Information

In recent years there has been increased attention to theoretical and conceptual frameworks. This push has been broadly in K-12 science education research, and more slowly building within undergraduate STEM education fields. For example, Reeves and Crippen (2020) conducted a review on virtual laboratories in undergraduate science and engineering courses, and they stated, “This review reveals a dearth of varied theoretical and methodological approaches regarding V-Labs. Nearly half of the articles did not explicitly state a theoretical perspective in interpreting student outcomes or offered research questions that guided the study (p. 11).” Physics education researchers have also noted the need to attend to theory during the research process (Docktor & Mestre, 2014). This trend is also evident in our review of published *CBE-LSE* studies over five years (2015-2019), in which theoretical and conceptual frameworks were used sparingly (see Figure 1).

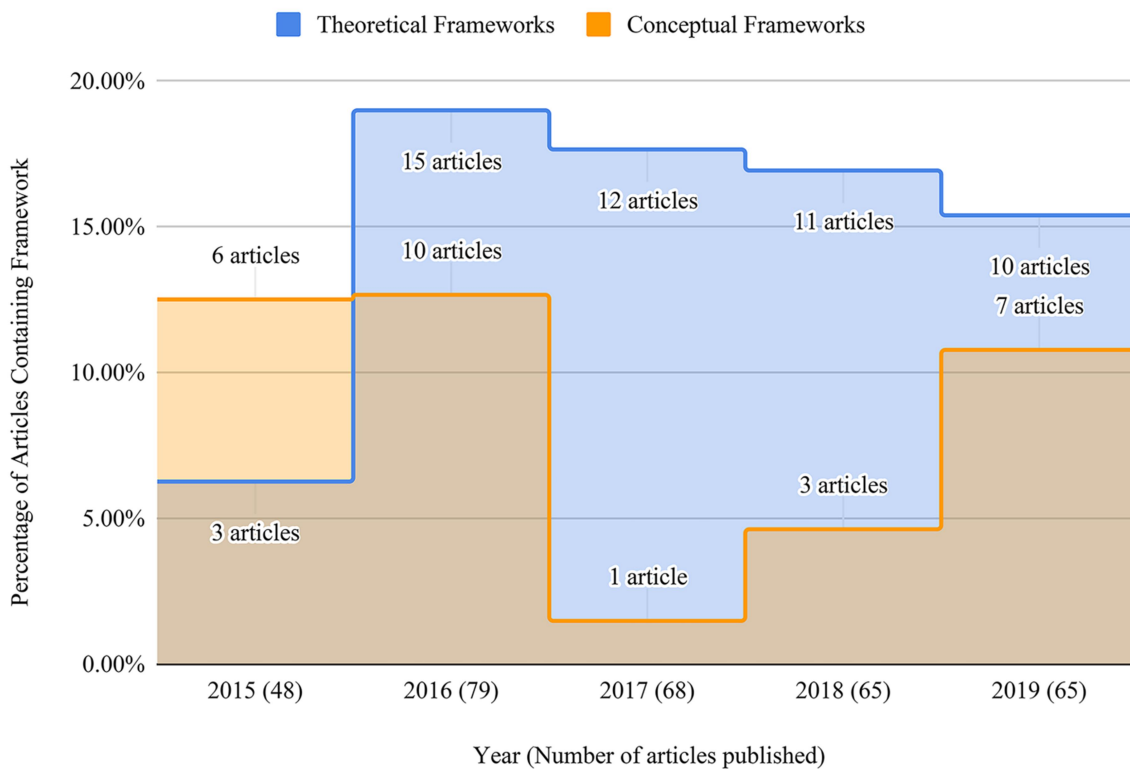


Figure 2.

Prevalence of Theoretical and Conceptual Frameworks in CBE-LSE Research Articles from 2015-2019

To assess the presence of theoretical and conceptual frameworks within *CBE-LSE*, we reviewed each research article published in *CBE-LSE* from 2015-2019. An article did not need the exact phrase “conceptual framework” or “theoretical framework” to be counted as present. We read each article from the start of the introduction through the end of the methods to identify explicit discussion on either framework. These frameworks should be presented before the results, so we did not analyze articles beyond the methods section. If articles explicitly described how a theory guided their research design it was counted as a theoretical framework, even if not identified as such. If articles explicitly described how they conceptualized the phenomenon it was counted as a conceptual framework, even if not identified as such. These were often found in sections that followed the introduction and preceded the methods. If the introduction simply cited a theory or provided an introduction to a theory but did not describe that the theory guided the current design it was not counted as a theoretical framework. Some articles contained both a theoretical and conceptual framework and were counted in both data series.

We began our review with three authors individually analyzing 18 articles from Issue 4 in 2019 for the presence or absence of explicit conceptual and theoretical frameworks. We then discussed each article to reach consensus and establish reliability across team members. The remaining *CBE-LSE* issues were divided up for individual review. Only research articles were reviewed (essays, meeting reports, etc. were excluded).