Request #: 590 - TEAL - Dissertation

The Relationship Between Discipline-Specific Subject Matter Knowledge and Discipline-Specific Science Teaching Efficacy for Elementary Teachers

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Background

ABSTRACT: Because science teaching efficacy correlates with instructional methods, teaching engagement, and pedagogical choices, improving science teaching efficacy becomes critical for improving science teaching of young children. Science teaching efficacy also varies by discipline for elementary teachers: physical science teaching efficacy tends to measure lower than life science. This discrepancy leads to elementary teachers engaging in less effective science teaching practices with physical science. A major factor that influences science teaching efficacy is subject matter knowledge. Subject matter knowledge impacts science teaching efficacy because when teachers understand their content proficiently, they express confidence in their ability to provide students with accurate and meaningful instruction. Given that both subject matter knowledge and science teaching efficacy are domain specific, understanding the relationship between discipline-specific subject matter knowledge and discipline-specific science teaching efficacy will aid in developing interventional support to improve levels of science teaching efficacy by improving discipline-specific subject matter knowledge. However, little is known about the relationship between discipline-specific levels of subject matter knowledge and science teaching efficacy. Using an explanatory sequential mixed methods design through a multiphase data collection process, this study seeks to establish what, if any, relationship exists between discipline-specific subject matter knowledge and discipline-specific science teaching efficacy across physical and life sciences for in-service elementary teachers. Phase one includes collecting quantitative data from web-based surveys using the Science Teaching Efficacy Belief Instrument (STEBI) and Misconceptions-Oriented Standards-Based Assessment Resources for Teachers (MOSART) as a subject matter knowledge instrument. The STEBI instrument will be adapted to physical science and life sciences. Afterwards, phase two will include qualitative data from interviews to inform our understanding of 1) the teacher's perceptions of potential sources of their discipline-specific science efficacy beliefs and 2) information regarding connections between their efficacy beliefs and classroom practices.

Quantitative data from surveys will be analyzed using R Studio. To answer the first question, I will use a regression analysis using hierarchical linear modeling strategies. Two linear models will be computed separately. The dependent variable of each model will be teaching efficacy for each discipline. The independent variables (predictors) will be life science SMK and physical science SMK. Given that years of years of teaching experience has been shown to effect SMK (Nixon et al., 2019) and self-efficacy (Tschannen-Moran {&} Hoy, 2007), the model will account for possible covariates such as years of teaching experience. Given that disciplinary SMK may differ between grade level because each grade has different teaching standards, I will include the two grade levels 4th and 5th, coded as binary, as a possible covariate (Utah Core Standards: Utah Science with Engineering Education (SEEd) Standards Utah 3-5 Science, 2019). A test for an interaction is included in the models to measure any potential effects that SMK of one discipline might have on another discipline's STE. If a significant interaction exists, this could suggest that when discipline-specific SMK category changes, there may be an effect on overall STE effecting both physical and life science STE.

The proposed regression models are as follows:

ˆ{_{}} = 0+ 1({_{}}LS)+ 2({_{}}PS)+ 3({_{}}PS)*({_{}}LS)+ 4( )+ 5( )

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where LS is life science, PS is physical science, SMK is subject matter knowledge, STE is science teaching efficacy, and is a regression coefficient.

The hypothesis is that an increase in SMK score for either Physical Science or Life Science will result in an increase in the STE score for Physical Science and Life Science respectively, while controlling for years taught and grade level.

The effect of SMK on science teaching efficacy will be compared between life science and physical science. In addition, these comparisons will be made for each of the STEBI questions. Factors that may influence the effect of SMK on science teaching efficacy, such as teacher grade level, or school, will be accounted for in each of the models.

[See uploaded/attached dissertation proposal for further methods details]

Sample

Collected 139 surveys so far from 4th and 5th grade elementary teachers across the state of Utah.

Prior to data collection, a statistical power analysis was conducted for sample size estimation. To achieve a medium effect size in this study of 0.15 (Cohen, 1988), with an alpha = .05 and power = 0.8, the projected sample size needed with this effect size (GPower 3.1) is approximately N = 98 for a regression analysis. Thus, my originally proposed sample size was 123 to allow for some expected attrition.

Hypothesis

1. What, if any, relationship exists between elementary teachers' discipline-specific subject matter knowledge and teaching efficacy for life science and physical science?

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Progress

I have collected the teacher participant surveys, cleaned the data, and I'm now entering the data into my models using R.

Request

I need help with interpreting (or confirming my interpretation) my statistical assumptions and models within R.

Timeline

Hoping to have statistical interpretation nailed down by December 17 in preparation for a conference in early January.