Methods Literature Review

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Introduction

The restrictions due to the ongoing global health crisis have attenuated the issue of access to labs in science courses. The lack of lab experiences can negatively impact student development of scientific competencies like computational thinking and collaboration (NRC, 2012). Virtual labs are online simulations of traditional physical labs used when resources or access to lab facilities are unavailable. As new educational technologies, teacher preparation and familiarity with the technology are crucial for the proper implementation and use of the platform in their lessons. This paper will compare five studies investigating the factors that impact teachers' self-efficacy in using and implementing new technologies in the classroom.

Literature Review

The five articles discussed in this section explore the factors impacting teachers' self-efficacy to implement new educational technology resources. The article by Barton and Dexter (2019) explores the impact of the type of professional development participation on the teachers' self-efficacy in integrating technology in their lessons. Kriek and Stols' (2010) article published in the *South African Journal of Education* aims to determine the impact of teachers' attitudes on their intention to use virtual simulations in their lessons. At the same time, Horvitz and Beach (2011) present their findings on the impact of professional development on teachers' self-efficacy to support their online teaching practices. The article *In-service Teachers' Self-efficacy, Professional Development, and Web 2.0 Tools for Integration* explores the relationship between teachers' self-efficacy and their ability and willingness to introduce online resources into their curriculum (Pan & Franklin, 2011). Additionally, the study by Geng et al. (2018) describes the

factors impacting teachers' self-efficacy and concerns about implementing STEM lessons in their classrooms. While all the articles discuss the different aspects of teachers' self-efficacy related to implementing and using new technologies, the researchers' methods and approaches are diverse. This section will compare the methods, population samples, instruments, and data analysis techniques utilized in the studies.

The methods used in the five studies range are primarily quantitative except for one mixed-method study. While four of the studies discussed followed a quantitative approach, the study by Barton and Dexter (2019) relies on a survey to collect quantifiable data and interviews to collect qualitative data for their mixed-method study. Three quantitative studies used a correlations methodology to collect and analyze their data (Kriek & Stols, 2010; Pan & Franklin, 2011; Geng et al., 2018). Although the research by Horvitz and Beach (2011) is not explicit about their methodology, their results show a correlational analysis to present their findings.

Similarly, the frameworks used by the researchers to support their studies relate to self-efficacy but include individual frameworks aligned to their research questions. Four of the five studies directly mention the self-efficacy framework as the base for their research, except for Kriek and Stols (2010), who use the theory of planned behavior, technology acceptance model, and the innovation diffusion theory. Additionally, Geng et al. (2018) include the Stages of Concern model to drive their instrument items in the survey. Additionally, two of the studies mention their results could inform policy and drive change in educational institutions in their countries (Kriek & Stols, 2010; Geng et al., 2018). The other three studies do not mention generalizations about their results besides their application at their institutions and contribute to the literature on the topic (Barton & Dexter, 2019; Pan & Franklin, 2011; Horvitz & Beach, 2011).

The authors developed the instruments used in most of the studies and included Likert-scale questions, and modified items from instruments used in other research studies. One study was the exception, Horvitz and Beach (2011) used the Sense of Efficacy for Online Teaching Scale previously validated in a different study as their primary instrument. The researchers who created their instruments certified its validity through expert faculty review and piloting the survey before the study (Barton & Dexter, 2019; Kriek & Stols, 2010; Pan & Franklin, 2011; Geng et al., 2018). It is important to note that while Kriek and Stols (2010) created their instrument items, they followed the guidelines defined in a different study.

The population sample and participants ranged greatly between the five peer-reviewed articles. The study by Barton and Dexter (2019) sampled science and math teachers from three schools that attended professional development on technology integration over two years and interviewed six participants through purposeful sampling. The number of participants in their study was limited due to all participants from one school declining to participate in the investigation further. Kriek and Stols (2010) had 24 physical science high school teacher participants from different parts of South Africa and various cultures. The study by Pan and Franklin (2011) has the most enormous participant population, with 461 participants nationwide from different regional classifications selected through an SPSS tool. Similarly, Geng et al. (2018) sampled the population of a regional conference on STEM education and recruited 225 science, math, and technology teachers as participants for the study. In contrast, Horvitz and Beach (2011) only counted on five faculty members as participants in their study due to scheduling conflicts among the other potential participants.

The five research articles had fewer commonalities in their proposed data analysis. Barton and Dexter used a codebook previously validated by a different study to analyze the

interview data collected. Later, analytical induction was used to assert the availability of self-efficacy data in their findings. Two studies utilized regression analytics to analyze the data collected (Pan & Franklin, 2011; Kriek & Stols, 2010). Although Pan and Franklin used regression analysis to identify the factors influencing the implementation of Web 2.0 tools, they also used descriptive statistics to analyze their data. Geng et al. (2018) analyzed their data through explanatory factor analysis. The researchers used principal component analysis to identify potential factors impacting the implementation of STEM lessons in the classroom. In contrast, Horvitz and Beach (2011) were unclear on their data analysis approach. In summary, while the five studies explore factors impacting teachers' self-efficacy, they do not perform the study in identical ways. The different methods utilized in each study can discuss the issues affecting teacher preparation and implementation of technology in various ways to build an understanding of the problem.

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