Moore et al. (2020) synthesized conceptual frameworks and definitions of STEM education. Ultimately, four common themes were identified as most common in STEM education research: STEM education is based on real-world problem solving, individual STEM disciplines share large conceptual ideas and practices, integration strategies vary, and integration relies on structures based in individual disciplines and/or pedagogies (Moore et al., 2020). Even with these common themes, STEM education research has significant variation in theoretical frameworks and how these practices and policies are enacted. Moreover, the way these STEM practices and policies are enacted often exclude the needs of historically excluded learners (Berry, 2021). Given this landscape in STEM education, this article has three purposes: (1) synthesize the literature around teacher and student perceptions on STEM education; (2) share perceptions about STEM education research methodologies; and (3) based on the synthesis of these diverse perceptions on STEM education, share implications and recommendations for future research directions.

Online STEM teaching of practical chemistry: Challenges and possibilities

Vongai Mpofu, Christopher Mutseekwa, in Academic Voices, 2022

Developing 21st century competencies in students

STEM education is variably defined to reveal its complexity (Li & Schoenfeld, 2019; Li, Wang, Xiao, & Froyd, 2020; Tan, 2020). For example, Kertil and Gurel (2016) view STEM education as a learning approach that integrates the four disciplines in STEM. To Tan (2020) it is a combination of disciplines whose existence is sustained by overlaps. With regards to its prime purpose, it is described as an approach in science education that fosters the development of 21st century skills, competencies as they are referred to in this chapter, which are needed for industrialisation (Hafni, Herman, Nurlaelah, & Mustikasari, 2020; Rampersad & Zivotic-Kukolj, 2018). These competencies are considered as both drivers (Strimel & Grubbs, 2016) and outcomes of STEM education (National Academy of Engineering & National Research Council, 2009). Fig. 1 shows in three categories the 21st century competencies which were drawn from literature (e.g. Chu, Reynolds, Tavares, Notari, & Lee, 2016; Li & Schoenfeld, 2019; Whorton, Casillas, Oswald, & Shaw, 2017). This categorisation brings forth the argument that an effective STEM education has the potential to develop in students competencies across the three categories.

Adapted from Chu, S. K. W., Reynolds, R. B., Tavares, N. J., Notari, M., &amp; Lee, C. W. Y. (2017). 21st century skills development through inquiry-based learning. Springer Singapore. https://doi.org/10.1007/978-981-10-2481-8.

Models which show that integrated STEM education can take place in many forms are extant in literature. Some provide distinct forms of integration. For example, Kertil and Gurel (2016) provide the content and context types of integrated STEM education. Content integration means offering a curriculum in which two or more STEM disciplines are covered while context integration emphasises on the teaching of one discipline by connecting it to two or more disciplines without compromising on its uniqueness. It can be concluded that these two models align to separatism and integrative STEM education, respectively. Other models, such as those put forward by Hurley (2001) and Jacobs (1989) frame integration into a continuum.