Rationale of the Essence of Innovative Steam Education Model towards Effective Teaching Practices

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Abstract
The country's educational curriculum and learning models validate the STEAM framework's implementation (Science, Technology, Engineering, Art, and Mathematics). Therefore, this paper explores the theoretical frameworks relating to the development of information in the STEAM framework as an effective teaching and learning method and explains the knowledge gained in the STEAM tertiary education methodology's multidisciplinary teaching and learning usefulness. The methodology was accompanied by semi-systematic existing literature from the expression of papers published electronically from 2010-2019, located in the Scopus, Science, ISI, Scielo and, other databases following Snyder (2019) in the mapping of theoretical aspects, the identification of knowledge gaps, the combination of consulted authors and the research issue. Three kinds accompanied the validity and reliability: STEAM technique as a teaching process, multidisciplinary STEAM pedagogy, and STEAM interdependence in the curricular material. According to Levy & Ellis (2006), content validation was framed by the relevance of documents, innovation, and quality. This job is about to show when and how can a STEAM educational concept can be delivered in a system that seems to have been destroyed from its old mistakes and can give a real boost to a new oriented public school in the best possible integrated educational system for preparing students for the university and beyond. The findings highlight the advantages of the systemic condition in constructing knowledge to overcome the fragmentation of pedagogical dynamics. It concludes with the choice that STEAM offers to exercise intelligible movements in developing creative content and innovation.
Keywords: *STEAM, Education, Benefits, Teaching Practices, Challenges*

1.0 Introduction

With the rampant increase in the technological development in Science, Mathematics, Engineering, Arts and Technology in the industrial revolution of many developed such as USA, Germany, United Kingdom, South Korea and many more and high income-developing economies such as China, India, Rwanda, and South Africa, many researchers have emphasized the importance of innovative education to economic development. Because many developing countries face significant financial and educational problems such as the lack of sophisticated capacities and talents, the burden of economic and monetary alteration, and the exertion of education restructuring and modification (Wang, Xu & Guo, 2018). Hence, the literature supports the fact that STEAM education is indispensable in facilitating development, international competitiveness, and creating jobs for the masses. STEAM education is regarded as a priority in high-income, middle-income, and low-income countries (Burnett & Jayaram, 2012; Ohize, 2017; Ostler, 2012). However, STEAM education is lagging in some parts of the world, such as in Africa, where there are many low-income countries compared to the largest developing economy, China. During new industrial revolution directly necessitates elevated real-world talents and pioneering talents who possess advanced knowledge, attitude, and skills necessary for the present need of organizations, educational institutions, entertainment sectors, and any developmental sectors of the country. One may ask whether many developing countries' current talent training condition in educational institutions at the elementary to high school level to the university level permits this goal's achievement in their country (Aleksankov, 2017). Ismail (2018) opined that literature does not specify the perceived benefits from the practice of STEAM education.

Many researchers such as (Yan, Xie & Li, 2009; Tian, 2014; Shi, 2015) have revealed a need to adopt new models of educating students that cultivate talents that meet developing countries' economic development needs. There have been technical inconsistencies between the elementary to high school level unified talent model, and the industry request for ground-breaking talents has become prominent (Zhao, He & Mang, 2015).

This can be achieved when the country becomes a knowledge-based society. A Knowledge-based society concentrates more on emerging persons' assortment and inventive talents capable of fabricating exclusive, real-world, and intellectual principles relatively than only growing specialists or intellects. STEAM education is a relatively globalized educational practice common among the Commonwealth countries under the United Kingdom. European and Asian, and most African countries tend to follow developments in the United States (Perrault, 2016). However, most technologies that developing countries need to reduce poverty, add value to natural resources, and improve domestic industries' efficiency have already been invented and are widely used in high-income countries. The issue is that these technologies are not very prevalent in many countries.

Consequently, STEAM education's priority requires developing engineering, technical and vocational skills and conducting state-of-the-art research and development (Estapa & Tank, 2017). For example, tertiary science and technology education can accelerate a knowledge-based economy in developing countries. Also, many researchers must focus on establishing school curriculums that incorporate STEAM educational practices.

Currently, education in many countries focuses on merging the viewpoints of refining creative talents. The time has come for governments to create goals and content of knowledge based on models with numerous contests on ingenuity education aimed at promoting innovation and inventions at schools and society as a whole (Li, et al., 2018; Kim & Park, 2012; Yarkman & Lee, 2012). For the country to keep up with the fluctuating science and technology and innovation needs of the country, it is essential to provide STEAM education for elementary to high school level students. STEM (Science, Technology, Engineering, and Mathematics), which later evolved to STEAM (Science, Technology, Engineering, Arts, and Mathematics) education which formerly originated from the U.S. which very gives valuable reference and inspiration to its implementation and success (Song, 2017). For over twenty years, many developed and developing countries such as Germany, the USA, France, Japan, China, etc., have issued STEAM education implementation policies. This policy emphasizes the interdisciplinary nature of science, engineering, arts, and mathematics education practice at the elementary and high school levels (Fu & Wang, 2014). As a result, there is a need for an additional stage on evolving creative education is urgently desirable. During this time, the advent of Science, Technology, Engineering, Art, and Mathematics (STEAM) education is judicious support that provides innovative policies and gears unique curriculum creating multidisciplinary incorporation teaching structure and teaching methods (Honey, Pearson & Schweingruber, 2014). The introduction of STEAM education countries helps boost the understanding of the construction among science, mathematics, technology, engineering, and arts. This has become essential in the global educational structure (Tarnoff, 2011; Sousa & Pilecki, 2013; Sanders et al., 2011). Based on this backdrop, three research purposes were formulated to guide the study.

2.0 Theoretical Underpinning of Pyramid STEAM Model

One of the theoretical models that govern that study is a pyramid model designed by Yakman (2008). This model was generated for implementing the STEAM national curriculum established on surveys of historical practices of diverse arenas of educational theories. STEAM can be defined as "Science and Technology education, construed through Engineering and Arts, founded on the language of Mathematics" (Yakman, 2008, p.8). The incentive behind this model's proposal was to wipe out the structural deficiencies of the educational system. Some disciplines were regarded as superior to others, while others were outshined (DeRosa, 2017; Yakman, 2008, p. 11). The pyramid was grouped into four levels (content-specific to discipline-specific to multidisciplinary and lastly to the integrative approach at the top level (p. 17). Yakman described the interactions among disciplines as significant since all fields are considered essential. There is some interdependency level among (Science, Technology, Engineering, Arts Mathematics education (Yakman, 2008, p. 17). The findings of Yakman's study led to the development of a STEAM framework that talks about functional literacy where students are trained so that it becomes possible for them to understand and make the transfer of learning from one discipline to the other. (Yakman, 2012). In this study, it was revealed that functional literacy of STEAM helps students to appreciate better people and the historical setting of other disciplines, its importance to the society and individual standpoints and philosophies so they can communicate wherever they find themselves with people who are not with the same background of discipline. The study also suggested that "for teachers to provide in-depth explanations and coverage of the subject area, they can work with other teachers in different disciplines to reinforce students' learning" (Yakman, 2012). Moreover, the findings of Yakman established a significant relationship between educational psychologists' theories and STEAM education, such as Bloom's taxonomy, the idea of constructivism, the theory of proximal development, and the theory of Multiple Intelligences, and many more (Yakman, 2012). Figure 1 describes the STEAM framework in detail.

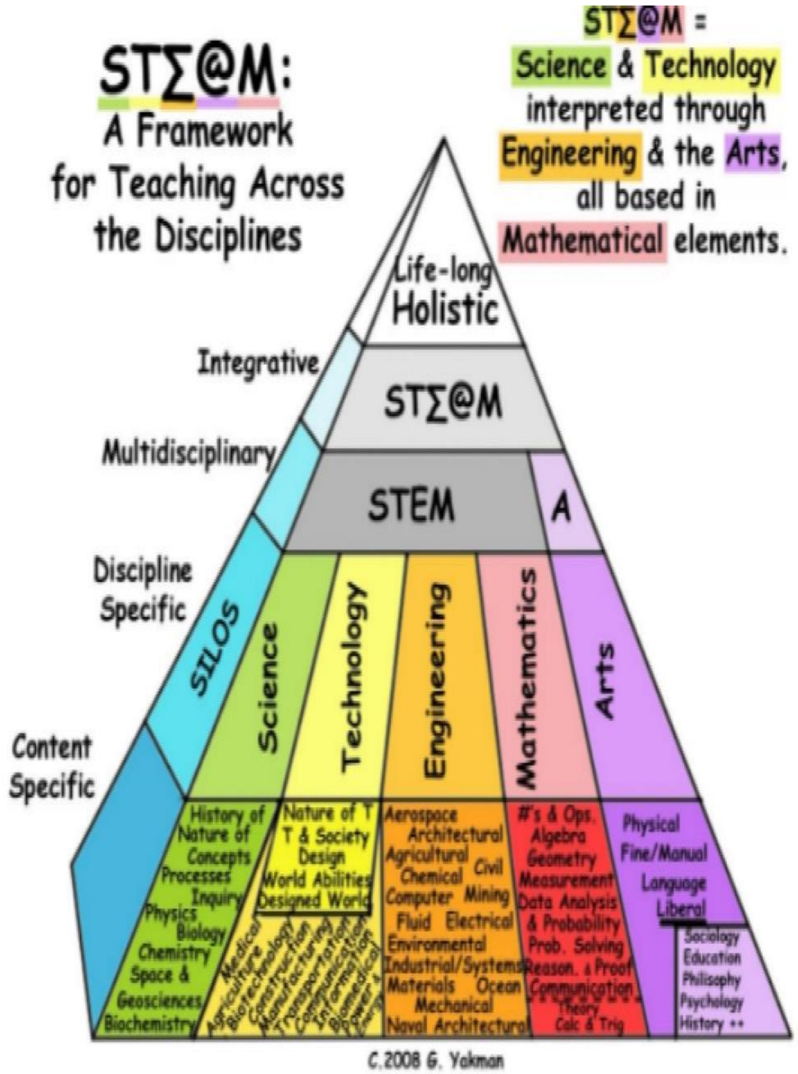

Figure1: STEAM Framework for Teaching Practices; Adapted from (Yakman, 2008)

2.1 Concept of STEAM Education

STEAM education framework involves applying ARTS into the already existing Science Technology Engineering Mathematics (STEM) framework. Similar to STEM, STEAM is a transdisciplinary approach that incorporates a wide variety of skills and knowledge from all individual STEAM disciplines to solve problems (Yakman, 2008; Winterman & Malacinski, 2015). STEAM education framework has been evolving to support a new educational theory. STEAM is based on STEM education, which grew out of the vast need to have more students achieve success in understanding the systems and connections (Baek et al., 2011; Yakman, 2008) that bind together the hard sciences, technology, engineering, and mathematics, to help solve the problems of a rapidly changing world (Dakers, 2006). One of the primary mandates of STEAM is to prepare students to solve problems "through innovation, creativity, critical thinking, practical communication skills. The STEAM is an emerging educational framework that supports new educational theories. STEAM education framework comprises the teaching and learning practices in which the subject matter is integrated so that all fields of study are unilaterally blended in educational practices such that learners are trained in a multifaceted approach that incorporates the diverse needs of learners.

Since the founding of the STEM educational framework in the U.S. aimed at improving Science, Technology, Engineering, Mathematics education, it has significant priorities of many countries in putting adequate effort in introducing contemporary educational practices in science, technology, engineering, arts, and mathematics (Gao, 2019). In line with the studies conducted by (Song 2008; Zhong & Yang, 2007), many countries have endorsed investigations on research and development centered on boosting teachers' teaching practices and a high industrial economy. The government drafted policies focusing on science and technology education (Dagdilelis, 2018). All this direction in science and technology education was aimed as the powerful force on its massive industrial economy journey. Several countries such as the U.S., United Kingdom, Germany have invested vast sums of money through research institutes, universities, and enterprises in rejuvenating country's educational structure by incorporating STEAM education in its existing academic design, which only focused on science and technology (Wang & Zhu, 2016; Mallinson, 2018).

In line with the recommendations by State Councils (2006), there was a need for new science and technology growth and development goals of 2006 to the year 2020 aimed at harmonizing arts education into the existing STEAM (Science Technology Engineering Arts, Mathematics) education (Li, 2013) All this was targeted at the traditional agriculture, automation, advanced and basic science research. Solas & Sutton (2018) opined that several developed and developing countries have wholly adjusted their educational reforms by restructuring the old STEM tactics to better bring the nationwide stratagem for social and economic growth and development. One cannot turn blind eyes to the fundamental advancement of Science, Technology, Engineering, and Technology in the country due to STEAM education. By introducing STEAM to students at the elementary to high school level, the country stands at a better chance of improving economic development; scientific innovation will accelerate economic growth and boost national cultural practices (Wen, 2011).

The incorporation of STEAM education at the elementary to high school level for many developing countries will widely encourage the grooming of students' high order thinking skills and abilities, innovative aptitude and create an educational platform with real-life practical needs of the country and even aspect of inadequate engineering education (Fu, 2015). Through the inquiry Song (2017) on the STEAM of the existing educational institutions, she found that STEAM education has not effective in many developing countries due to specific problems it has encountered, such as the limitation of teachers' skills to teach STEAM to students, difficulty in merging STEAM with the existing curriculum design of the country, and curriculum effectiveness verification. Despite the emergence of some institutions practicing innovative STEAM education, several educational institutions face specific difficulties making it difficult to effectively implement STEAM education at the elementary to high school level or any other level (Wang, Xu & Guo, 2018).

Herro, Quigley, Andrews & Delacruz (2017) point out that given the considerable dimension of the initiatives advocated by the STEAM technique, qualified educators are still expected for the dissemination of expertise in partnership with stakeholders who need the efficacy of instructional methods, in parallel to the problem-solving assessment, both independently and in creative teams of the objectives set with competencies. The STEAM measures are visualized in table 1 below.

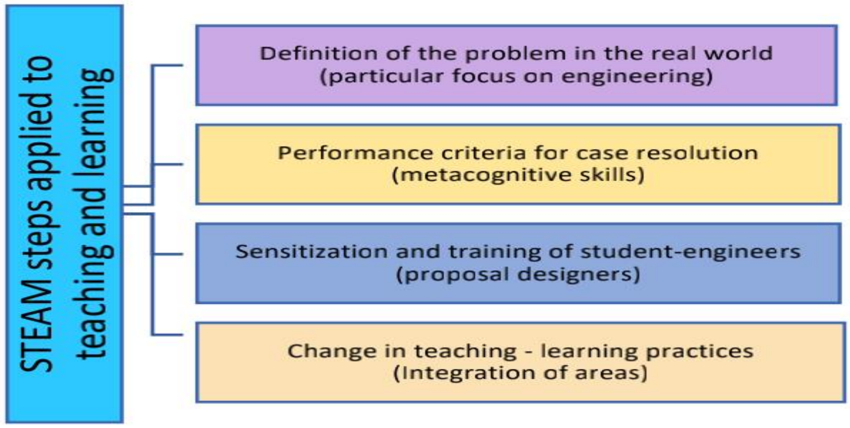

Figure 1. Steps in the STEAM methodology.
Source: Adaptation of Connor, Karmokar & Whittington (2015).

From Figure 1, it has been illustrated some stages in the implementation of the classroom instruction STEAM method of analysis, which starts only with a problem statement in the actual world from specific and limited methodologies that will need to be acknowledged through project design transforms the student into an engineer. The core purpose granted in the value of the STEAM methods is fascinating and, in words of Henriksen (2017), further than convergence, as it is the possible future thought of engineering design, as a challenge of multidisciplinary inclusion of structural parts in layout, by integrating the intertwined team to the goals and activities planned in the education system, creative timely. By agreeing with the aforementioned, creativity, interdisciplinarity, motivation, and emphasis used in the real world of problem situations open to the redesign of thinking are identified, given the diversity of alternatives, ways of thinking and making them conjugate as a common foundation in decision-making based on empathy, the definition of the events that can hit the target towards the problem statement through the creation of ideas and in the context of a prototype of the project that deploys as a practice of meaning and functional meaning from the design of the STEAM methodology (Gratchev & Jeng, 2018).

2.2 Practice of STEAM Educational Model in Developed Countries

STEAM educational model has been practiced and implemented in several developed and developing countries in boosting teaching practices that prepares students to meet the needs of current world practices. Countries such as The US, UK, South Korea, Canada, Australia, Finland and many more has included STEAM educational practices in the existing national educational curriculum. The element "ART" was included in the pre-existed STEM education which only neglected the "ARTS" component of educational practices. The introduction of STEAM expanded students' learning experiences and discovery of new talents that could fit into students' progress through the basic to the tertiary level of education. Goates, et al. (2017) revealed that the introduction of arts components such as music and dance at the lower primary and junior high school level can help students acquire adequate physical knowledge of music linking STEM and STEAM. A series of exercises aimed at piquing the imagination of younger school children in physical phenomena may be incorporated into the STEAM-education system (Sabirova & Deryagin, 2018; Mullins, 2019).

According to researchers at the University of Ghent, integrating art into Education systems will make educational practices increasingly appealing to a larger audience. They portray the international week of robotics and art for high school students as an example of such educational activity (Wyffels, et al., 2016). It is obvious that teaching and learning staff training is needed, and the Acoustics Research Group at Brigham Young University (BYU) has had such experience working with primary school teachers who have successfully incorporated art into their classroom instruction (Goates, et al, 2017). Researchers from Finland (Thuneberg et al., 2017) argue that innovation in mathematics education should be improved in schools. They have "The Art of Mathematics" as an engagement mathematical exhibition aimed at making mathematics interactive and practical for students. Educators in Australia have created an instructional curriculum that includes the culture and history of Aboriginal and/or Torres Strait Islander communities, and also the economic and cultural forces of Asia and the middle east, in STEM programs (Taylor, 2018).

In the US, the "Scientist for the Future" (SfT) project has been funded since 2011. The SfT project is a collaboration between universities and colleges, out-of-school groups, and non-formal educational institutions to use a STEAM-based training program. Multiple teaching modules, like "Alternative energies," "Physics of sound and mathematics of music," "People and plants," "Robotics," and "Astronomy," are learned in the time free from basic studies or work during the academic year in all cultures (Caplan, 2017). This problem is indeed recognized in Russia, which is why the Centers for Technical Education Support (TSTPO) are being developed, with the aim of engaging learners in engineering and robotics. Businesses are actively engaged in the development of programs for subject-oriented curriculum of children and teens, demonstrating the validity of this educational strategy. The aim of such initiative is targeted at swelling the level of knowledge in the areas that has attracted growth and interest of positive attitude towards STEAM education in educational practices.

The findings of an international study involving high schools in Australia, the United States, and Canada convincingly justify the need for a multidisciplinary subject in STEAM education (inter-, trans-, and cross-disciplinary learning), incorporated with the support of class teacher, and the use of innovation in the practice of high school teachers for the creating a learning environment in learners (Harris & Bruin, 2018). The survey suggests that building a trustworthy relationship between teachers and students creates favorable conditions for both of them to grow their creative potential. Experiments on the use of multidisciplinary methods for undergraduate and primary school teachers are being performed in some countries. The findings show that when high school students, college students, and undergraduates use STEAM-technologies in pursuing physical and mathematical disciplines, their performance and self-esteem increase, and their creative abilities grow (Segura, 2017; Chanthala et al., 2018). The study experience in Korea in the field of STEAM education also indicates that conducting physical research in conjunction with both the humanities and art is preferable (Paik et al., 2018; Moon & Kang, 2015). As a result, STEAM education can be implemented at all levels of education, from preschool to professional, and sometimes in close collaboration with both academic and non-academic organizations.

2.3 Previous literature on STEAM education and its limitations

STEAM is presently acknowledged and extensively used as a multi-discipline curricular that connects applications in content area disciplines such as science, technology, engineering, and mathematics to generate awareness as a whole (Sebastianelli, 2018). Many world leaders, multinational corporations, financial analysts, economists, politicians, and educationalists have provided support for STEAM-based teaching practices to upsurge academic thoroughness in schools and initiate students' skills and knowledge that are of growing importance to tomorrow's workforce. With the cumulative research awareness on the practice of STEAM education in developing and developed countries, there have been several studies that surveyed teachers' practices of STEAM education using teachers' perception such as (Lee, Park, & Kim, 2013; Lim & Oh, 2015; Liu, 2012; Liu, Liang & Liu, 2012; Lim, Kim, & Lee, 2014; Noh & Paik, 2014; Shin, 2013; Shin & Han, 2011; Song, 2017; Tarman, 2018). The findings of the studies mentioned above suggest that a significant number of teachers believe that STEAM education is desirable and believe in the significant positive impact of STEAM education on students' learning and society. Other research has also found a considerable gap between teachers' practice of STEAM education aimed at reforming teaching practices and how educational stakeholders perceive STEAM education and should be practiced in class. For instance, Shin (2013) revealed that despite that teacher (about 65%) agreeing on the need for practicing STEAM education, only a few teachers executed STEAM education in their class. In fostering innovative STEAM in schools, these interventions aim not to produce additional scientists, engineers, or mathematicians (Vasquez, Sneider, and Comer 2013) but to improve capable students who can work in a robust and sophisticated environment based on numerous disciplines. Consequently, STEAM education and research facilities can be located in nations around the world (Delaney 2014). Despite STEAM education's attempts to expand inclusion in related fields (Tsui 2007; Reyes, 2012), STEAM occupations still are extremely homogeneous; only 28% and 10% of STEAM jobs are held by women and ethnic minorities, respectively (National Science Board, 2014).

Regarding the challenges teachers face in implementing STEAM education, it appears there were no studies conducted on the subject matter; however, related studies conducted in South Korea, Japan, the USA, U.K. on the challenges teachers face when implementing STEAM education. Educationists ought to modify the way we think about and train STEAM to strengthen the STEAM workforce to represent different viewpoints and expertise. This program "commences in primary school and progresses through to the faculty as well as the remainder of the populace" (Educational Testing Service, 2015, p. 3). To resolve the issue of recruiting and maintaining a representative STEAM workforce, it is essential to re-conceptualize the education system to attract and sustain alternative viewpoints that will help solve the world's most urgent problems. Therefore, researchers adapted those studies as a comparative study to compare the challenges teachers face in the practice of STEAM education. Findings of studies such as (Han & Lee, 2012; Lee, Park, & Kim, 2013; Lim & Oh, 2015; Shin, 2013) discovered that teachers faced difficulties in lesson preparations for STEAM education, inadequate instructional teaching and learning materials, lack of teaching experience in implementing STEAM lessons, the problem in co-operating with other teachers and difficulty in understanding some concepts in STEAM education (Lee, Park, & Kim, 2013; Noh & Paik, 2014). An extensive review of literature offers significant evidence on the practice of STEAM education and teachers' perception; there appears to be much remaining unknown of STEAM education. For example, teachers' Elementary to high school level practices of STEAM education varies, according to teachers' demographic characteristics. There appears to be little information about the relationship between perceived challenges and teachers' characteristics in the same vein.

2.4 Benefits of STEAM education

Evidence from literature assents with the general view that science, technology, engineering, arts, and mathematics (STEAM) education is necessitous to enable economic development, international competitiveness, and job creation. However, the literature does not specify the particular benefits of STEM education in developing countries since the consensus is that STEAM education is generally lacking in these countries. Moreover, the gender gap in STEAM education is prevalent in some developed and most developing countries (UNESCO, 2017:20). However, STEAM has been useful for enhancing teacher training in developing countries, stimulating innovative approaches for secondary education and aligning the demand and supply of skills (Burnett & Jayaram, 2012; Hooker, 2017). The literature on STEAM education in developing countries focuses on the challenges many young people face concerning access to secondary and tertiary education in general and the gender gaps in STEAM education. It, therefore, proposes strategies for overcoming these difficulties. Studies on STEAM education usually adopt a regional focus such as Africa or Asia, and therefore the reports amalgamate data from middle-income and low-income countries. There is some literature on the benefits of science and technology (as a sector) on economic growth or combating diseases such as HIV or malaria. The literature does not discuss STEAM education's benefits beyond the general view that STEAM facilitates economic growth and competitiveness.

Given that the literature does not address the query directly, the following approach is used in this rapid literature review: literature from developed and developing countries is used to discuss the rationale for STEAM education and the key trends in this field. Statistics relating to the gender gap are presented, and the impact of some program which aims to improve female participation in STEAM in developing countries is discussed. Since much of the literature on STEAM education mention teacher training, this is discussed as a benefit of STEAM education and meeting the demand for skills and innovations for secondary education.

The inclusion of Arts into STEAM generates a variety of benefits. Recent studies have shown that including Arts-based teaching in STEAM increased student motivation, engagement, and STEAM content learning. (Henriksen, 2014). This study's finding was confirmed in Rinne and colleagues' study, which showed that Arts training helped with long-term retention of content (Rinne et al., 2011). Additionally, Arts as a STEM component increase students' skill, global competencies, and learning strategies. Learning music has been shown to increase visual-spatial reasoning skills, which can be applied towards STEM (Catterall & Rauscher, 2008). Proponents of the physical and visual arts argue that "artistic expression and principles could assist learners in structuring and organizing ideas, exploring disciplinary and cross-disciplinary connections, and solving scientific problems" (Catterall, 2013, p. 2). Connected to improved problem solving, integrating liberal arts and language into science resulted in enhanced achievement in science and mathematics (Miller & Knezek, 2013). Additionally, STEAM provides students who were disengaged with STEM due to fear of STEM or fear of failing, in general, a means to reengage with it. Miller (2016) further noted that STEAM, in its promotion of divergent and convergent thinking, effectively generates innovation.

The rationale for STEAM education's investment relates mainly to its association with improved economic outcomes (African American Institute, 2015; Williams, 2011). This includes unemployment in the Middle East and Latin America is linked to the inadequate supply of skills required by employers (Burnett & Jayaram, 2012). The 21st-century job market requires a new set of skills, and there is more emphasis on technology skills (Voogt & Roblin, 2012). Across the world, only 30% of female students pursue STEAM-related higher education studies (UNESCO, 2017); UNESCO (2017) regards access to STEAM education for girls as a human right; Science Technology, and Mathematics clinics in Ghana have provided training to over 40,000 girls from 1986-2010 (Bermingham & Engmann, 2012). Technical Vocational Education and Training (TVET) education is recommended for bridging the demand and supply of skills in Africa and Asia (Burnett & Jayaram, 2012). TVET is necessary at the secondary school level to prepare students for self-employment and entrepreneurship (Likly et al., 2018). Apprenticeships and continuing education can provide STEAM-related training to informal sector workers (Lwakabamba & Lujara, 2003); STEAM education should address local development needs (Sohoni, 2012).

2.5 STEM education for Sustainable Work

The concept of sustainable work is proposed to challenge the perspective that work is mainly for financial gain (Likly et al., 2018). It recognizes that there are many forms of unpaid or informal work which contribute to society. According to Likly et al. (2018), STEAM education can contribute to sustainable employment and boost skilled workers' supply for social professions. For example, there is a need for 5.7 million teachers and 3.8 million health workers in sub-Saharan Africa. Given the informal sectors' scale in many LICs, secondary education should provide the skills for self-employment and entrepreneurship. Many artisan and trade occupations require STEAM knowledge, although there is more emphasis on technology. Hence, TVET is essential, and it may be necessary to offer it earlier at the secondary education level. Rapid urbanization and internet expansion create job opportunities in the ICT sector; therefore, it is critical to have training in ICT at the secondary school level; Lower secondary education should provide adequate STEAM knowledge of hygiene and health to enhance living standards. For example, knowledge on disease and infection are included in the biology curriculum at the lower secondary level in Tanzania; Vocational subjects such as agriculture and domestic science include STEAM content which may be useful for rural students who undertake cattle hoarding small-holder agriculture or fishing. Voluntary and creative work requires basic STEAM knowledge such as ICT skills for audiovisual editing or chemistry knowledge for mixing dyes.

Adding Arts to STEM does present some challenges regarding implementation. Some of these challenges include teachers not having the arts' expertise to implement beyond the primary stages of digital/design arts. Also, teachers require art experts' support to make connections between their content area and the different art forms. There is difficulty supporting productive collaboration among students (Quigley & Herro, 2016), Using a transdisciplinary problem-solving approach instead of a focus on disciplinary content (Sinay & Jaipal-Jamani, 2016).

3.0 Implementation of the Practice of STEAM Education in Teaching and Learning

Fredette (2013) generated the following guidelines for how K-12 schools can implement STEAM. Collaboration must take place between teachers of varied disciplines. Teachers across disciplines such as science, visual arts, and music must fuse their subject areas. Teachers must model to students the importance of trying new things and removing the stigma of failure. Collaboration amongst students and having them work in teams must be encouraged. And finally, schools must connect with community organizers to promote a range of modern 21st-century jobs that are technology-infused and fall outside the traditional scope of professions such as teachers, nurses, and lawyers. Multiple strategies can be used to implement STEAM within school boards. Students must be allowed to use media/technology to solve problems (Miller & Knezek, 2013; Quigley & Herro, 2016). While also being allowed to choose the topics of study, technologies used to explore that topic, the methods of inquiry used, and the means they prefer to communicate the resulting knowledge they derive from it are essential (Quigley & Herro, 2016).

Additionally, embedded assessment strategies such as self and peer evaluations support STEAM learning (Quigley & Herro, 2016). In generating assignments for their students' teachers must also use various instructional strategies for more straightforward STEAM implementation. Specifically, teachers must promote problem-based learning that uses open-ended scenarios and real-world problems that are further situated in local contexts (Miller & Knezek, 2013; Kim & Song, 2013). And finally, teachers must integrate varied disciplines in a transdisciplinary approach that uses various perspectives and potential solutions to problems (Quigley & Herro, 2016).

4.0 Conclusions and Practical implications of the Study

The contributory theoretical synthesis of the different authors studied in this literature review considered the objective of analyzing the theoretical perspectives that concern the creation of knowledge in the STEAM methodology. STEAM education model as a resource for learning in higher education identifies the significant spaces for overcoming interdisciplinary obstacles that create tensions for the effectiveness of collaborative, comprehensive, systemic, and transdisciplinary learning. The STEAM methodology must be manifested in the pedagogical fact. This implies that the university faculties generate knowledge based on creativity to have freedom of intelligible movements in the development of cognitive aspects, contents, and innovative approaches of inclusive education (Colucci-Gray, Burnard, Cooke, Davies, Gray, & Trowsdale (2018). The availability of trained engineering staff, which should begin in high school and continue in colleges and universities through the support and successful implementation of STEAM education, is critical to the future of economic development.

This can be applied to Science, Technology, Engineering, Arts and Mathematics. Likewise, this literature review considered the orientation through the objective set to understand the lessons learned in the transdisciplinary pedagogical applicability of the STEAM methodology in higher education. This scenario, interpreted within the framework of theoretical contributions, implies the strength of new pedagogical trends that identify the dialogue necessary to address cognitive contents and specialties as concrete alternatives of standard proposals that incorporate social participation and knowledge. Critical thinking in the conceptualization of practical approaches to curricular reconstruction at higher, abstract thoughts that overcome the fragmented conditions of reality. In this order of ideas, new pedagogical, curricular, and technological dimensions that open the possibility of the emerging nature of the events of the social fact are necessary to overcome these epistemological barriers and disciplinary dilemmas that fragment learning in higher education, according to the research of Kromydas (2017) in the events intercepted in the educational know-how based on the STEAM methodology as a resource for learning in this new era of change that assumes interest based on self-knowledge, the construction in collaborative networks of education and the reaffirmation of the open curriculum (Erwin, op. cit.) beyond the University classroom. Hence, the prospects for future research in this field are linked in an underlying way in the effects of a real revolution in higher education, in recognizing broad, innovative, and open levels of learning that are transcendent in their holistic and inclusive scope.

Conflict of Interest

The authors declare no conflicts of interest regarding the publication of this paper.

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