KDU Journal of Multidisciplinary Studies (KJMS)
Volume 6. Issue 2 Nov 2024
DOI: https://doi.org/10.4038/kjms.v6i2.130

KJMS 2024 VOL.6 (2): 67-78

IMPACT OF STEM EDUCATION IN OVERCOMING POVERTY

N. A. D. K. Deshani and K. Hirimburegama

Department of Plant Sciences, Faculty of Science, University of Colombo, Colombo 03, Sri Lanka

ABSTRACT

Poverty in general is a state in which one lacks financial resources and essentials. Modern-day poverty is understood as a complex, multi-dimensional set of issues, introducing it in a relative manner rather than a single idea. Intellectual and ethical poverty are the two main types of poverty that are related to education, and both could be overcome by education. Mainly, intellectual poverty could be overcome by providing access to knowledge, critical thinking skills, information, and technology, while ethical poverty could be overcome mainly by social development and commitment of individuals. STEM is a teaching and learning process that combines Science, Technology, Engineering, and Mathematics and STEAM is the recent inclusion of Arts. STEM education provides opportunities for students to enhance problem-solving skills, and to become innovators, critical thinkers, and technologically literate. This study identified the definition of poverty in general and the definition of STEM education. It also identified the STEM education systems in the world and in Sri Lanka, and the methods involved in overcoming poverty through STEM education in Sri Lanka, by investigating and reviewing literature, acquiring information from specialists in the field. In Sri Lanka, industries, Research and Development (R&D), farmers, and Small and Medium Enterprises (SMEs) could be empowered with STEM education. As a result, Sri Lanka will be able to come out of the poverty cycle by increasing its purchasing power. This will lead to the socio-economic stability of the country making it move forward as a nation with sustained health, wealth, and happiness among Sri Lankans.

KEYWORDS: *Poverty, STEM, STEAM, R&D, SMEs, Socio-Economic Stability*

Corresponding Author: N. A. D. K. Deshani, Email: nadkdeshani@gmail.com

https://orcid.org/0009-0002-8453-6568

1. INTRODUCTION

Poverty could be generally introduced as a state in which one lacks financial resources and essentials (Goulden and D'Arcy, 2014). Nonetheless, modern-day poverty is understood as a complex, multi-dimensional set of issues (Gweshengwe and Hassan, 2020), introducing it in a relative manner rather than a single idea (Spicker, 2020). Intellectual and ethical poverty are the two main types of poverty that are related to education. Intellectual poverty is a state in which one lacks access to education, critical thinking skills, knowledge, and intellectual resources (Finger et al., 2003; Ivan, 2019). Ethical poverty refers to a state in which one lacks a strong moral compass, principles, and ethical values which are required to live in dignity, respect, and harmony with each other in a society (Barrientos et al., 2016; Schweiger, 2019).

Both intellectual and ethical poverty could be overcome by education. Mainly, intellectual poverty could be overcome by providing access to knowledge, quality education, critical thinking skills, information, and technology. However, ethical poverty could be overcome mainly by social development and commitment. Increasing the income of a person will increase his purchasing power and that will result in reducing poverty. In contrast, the ethical mindset of a person comes from the background and friends who are closely associated. Positive role models, mainly parents and teachers should become ethical in order to develop the ethical behaviors of the children. Those parents and teachers who are ethical will lead the socio-economic stability of a country. Hence, to overcome ethical poverty, the commitment of individuals, communities, and policymakers is crucial (Barrientos et al., 2016; Schweiger, 2019).

STEM is a teaching and learning process that combines Science, Technology, Engineering, and Mathematics and was an initiative by the United States National Science Foundation (NSF) in 1990 (Sanders, 2009). STEAM is the recent improvement of this aspect by adding arts to reduce the limitations of the STEM approach (Perales and Aróstegui, 2021). STEM education provides opportunities for students to enhance problem-solving skills, and to become innovators, critical thinkers, and technologically literate (Morrison, 2006; Stohlmann et al., 2011). STEM education helps to come out of the poverty cycle by working in higher-paying jobs. It also helps to reduce the gap in gender inequality by providing STEM education, especially for girls. Income, race, and gender are not considered limiting factors when it comes to STEM education. Furthermore, STEM education is more efficient when started at the early stages of education. Taking the initiative for STEM education at present itself will guarantee the building of more qualified people for the future job market and for the development of the nation (O'Rourke, 2021; Malan, 2023).

As the world is becoming more automated, most of the existing jobs are expected to be lost in near future. Hence, there is a high demand for STEM-educated people when recruiting for jobs (O'Rourke, 2021; Malan, 2023). Thus, it is important to be aware of the concepts of poverty and especially STEM/STEAM education as Sri Lankans.

This study expects to address the definition of poverty in general and the definition of STEM education. It is also expected to study the STEM education systems in the world and in Sri Lanka. Finally, it is aimed to propose the methods involved in overcoming poverty through STEM education in Sri Lanka.

2. METHODOLOGY

This study was carried out mainly through a literature survey and via personal communication. The publications used in this study were accessed via web search engines such as Google Scholar and ResearchGate. Furthermore, the Taylor and Francis Online database and abstracts and publications with open access in Springer and Science Direct were used. Keywords used in this study were “Poverty,” “Intellectual poverty”, “Ethical poverty”, “STEM education,” “STEAM education”, “UNESCO and STEM”, “STEM in the world”, “STEM in Finland”, “STEM in South Korea”, and “STEM in Sri Lanka”. Furthermore, the literature survey was conducted with the help of books, official websites on the internet, published newspaper articles online, and reports issued by government sectors (i.e. MoE, NSF, NIE, MoSTR, SLIC). The Ministry of Education, Sri

Lanka, provided detailed information on the current situation of STEM education in Sri Lanka. Also, the information on the impact of STEM education in overcoming poverty in rural farming communities in Sri Lanka was gathered from professionals at the Institute for Agro-technology and Rural Sciences, University of Colombo, Sri Lanka (UCIARS). In addition to this, various other data sources such as annual reports of the World Bank, OECD, and WIPO were also used.

The search was limited to English-language articles published between 2003-2023. All studies discovered throughout the search were evaluated independently for competency and inclusion. Following compliance with inclusion criteria, experimental research and data sources addressing the contribution of STEM education to poverty alleviation were integrated into the current study to provide strategies for overcoming poverty in Sri Lanka through STEM education.

Poverty

The general idea of poverty is a state in which one lacks financial resources such as socially acceptable amount of money and essentials including food, clothing, and shelter for a certain standard of living (Goulden and D'Arcy, 2014). Rather than this conventional representation of poverty, modern-day poverty is understood as a complex, multi-dimensional set of issues (Gweshengwe and Hassan, 2020). Hence, it has been introduced in a relative manner rather than a single idea (Spicker, 2020).

Several types of poverty can be identified, and intellectual poverty and ethical poverty play a major role with respect to education. Intellectual poverty is a state in which one lacks access to education, critical thinking skills, knowledge, and intellectual resources. The reasons for intellectual poverty may be the difficulty of accessing educational opportunities or may be the hindering by social and economic barriers that prevent them from gaining knowledge and skills. Limited access to education and knowledge results in individuals who lack critical thinking skills, curiosity, and creativity. This will result in difficulty in understanding and directing the complexities of society and will limit the ability of an individual to actively participate in the development of society (Finger et al., 2003; Ivan, 2019).

Ethical poverty refers to a state in which one lacks a strong moral compass, principles, and ethical values which are required to live in dignity, respect, and harmony with each other in a society. Ethical poverty will result in a lack of honesty, respect, and fairness towards others. Unwillingness or inability to understand others' perspectives, needs, and well-being will create problems like corruption, injustice, discrimination, unethical judgments, exploitation, and environmental degradation (Barrientos et al., 2016; Schweiger, 2019).

Both the above-mentioned intellectual and ethical poverty could be overcome by education. Especially, intellectual poverty could be overcome by providing access to knowledge, quality education, critical thinking skills, information, and technology.

Besides, increasing the income of a person will increase his purchasing power and that will result in reducing his poverty. However, ethical poverty could be overcome mainly by social development and commitment. The ethical mindset of a person comes from the background and friends who are closely associated. Positive role models, mainly parents and teachers should become ethical in order to develop the ethical behaviors of the children. Those parents and teachers who are ethical will lead the socio-economic stability of a country because socio-economic stability would not take place without ethics. Hence, to overcome ethical poverty, the commitment of individuals, communities, and policymakers is crucial (Barrientos et al., 2016; Schweiger, 2019).

It is also important to consider the correlation between intellectual and ethical poverty where the occurrence of ethical poverty may be due to the result of intellectual poverty. For example, poor access to education may result in a lack of ethical behaviors of a person (Schweiger, 2019).

STEM Education

STEM education was initially called Science, Mathematics, Engineering, and Technology (SMET) and was an initiative as STEM by the United States National Science Foundation (NSF) in 1990 (Sanders,

2009). STEAM is the recent improvement of this aspect by adding arts to reduce the limitations of the STEM approach (Perales and Aróstegui, 2021). Besides, STEM is a teaching and learning process that combines Science, Technology, Engineering, and Mathematics. Rather than teaching the above subjects separately, STEM education focuses more on an integrated teaching of those subjects by interacting with the real world.

In general, STEM education provides opportunities for students to enhance problem-solving skills, and to become innovators, critical thinkers, and technologically literate (Morrison, 2006; Stohlmann et al., 2011). It was mainly established due to growing concerns that many students would fall behind or be unable to keep up in the highly competitive global economy driven by the growing need for STEM-related skills and abilities (Vasquez, 2015).

The integrated approach of STEM education could be achieved by several methods. They are multidisciplinary, interdisciplinary, transdisciplinary, and neo-disciplinary approaches. The multidisciplinary approach uses a common theme, and the subjects may be taught separately. The interdisciplinary approach uses a shared concept making the disciplines blur, while the transdisciplinary approach seeks to fully dissolve the boundaries between the conventional disciplines. The neo-disciplinary approach creates new categories of skills and knowledge networks disregarding the traditional subject boundaries (Boon Ng, 2019).

The integration of Artificial Intelligence (AI) into STEM education enhances the teaching and learning process. Due to the rapid advancement of STEM education, the integration of AI methods into STEM has been considered. AI-related subject streams such as Data Analytics, Decision trees, Machine Learning, and Neural Networks have been used to prepare high school teachers in the United States for the integration of AI methods into the STEM classroom (Lee and Perret, 2022).

Moreover, STEM education focuses on every individual relating it to the students' learning style, interests, and preferences. It emphasizes collaboration, communication, research, problem-solving, critical thinking, and creativity. Those factors are becoming essential in the future job market. Since the world is becoming more automated, most of the existing jobs are expected to be lost. Hence, there is a high demand for STEM-educated people when recruiting for jobs (O'Rourke, 2021; Malan, 2023).

STEM in the World

STEM policies and programmes differ from country to country. Some are intended to promote a positive image of science while others aim to increase public engagement with the knowledge of science. For example, national STEM policies addressing unmet labor market demand for STEM skills (e.g., United Kingdom), national science and technology policies and plans (e.g., Japan), and national policies focused on quality education and emerging industry development (e.g., Brazil) (Freeman et al., 2019).

Freeman et al. (2019) describe the participation of students in STEM disciplines also varies by country. For the period of 2011 to 2015, the participation was highest in countries such as Finland, Germany, United Kingdom, South Korea, China, as well as Singapore. Comparatively, it was low in United States and Australia (Table 1).

Table 1: Percentage of Students Enrolled in STEM Tertiary Education Programs According to UNESCO, 2018 and OECD, 2017 (both sexes, 2011-2015). [Source: Freeman et al. (2019)]

Country	2011 (%)	2012 (%)	2013 (%)	2014 (%)		2015 (%)
Finland	53	53	52	53		54
South Korea	47	47	48	48		47
Singapore	49	47	-	-		-
Germany	-	-	46	46		46
United Kingdom	41	41	45	46		44
France	-	42	38	38		42
India	-	43	37	38		38
Australia	-	-	-	-		37
Japan	-	-	-	-		37
United States	32	32	36	36		36

According to the above data, Finland and South Korea rank first and second. In general, both countries are well-known for their education systems. Program for International Student Assessment (PISA) is an important tool for measuring education systems worldwide. Both countries obtain higher ranks in this assessment frequently. Hence, it is important to look at them in a descriptive way.

Finland is a country which has reformed their education system successfully in 1970. This system is mainly composed of equity, equal education and resources, effective evaluation, and trained teachers. Collaboration and communication are highly valued, and educators use different methods to create a collaborative environment for the students. They use methods such as blogs, social media, group work, and learning café. Personal blogs have been considered useful in getting to know the personality of each student and the educators use that information to equitably group the students in their classes (Su et al., 2017). This education system rejects any educational curriculum that includes standardized tests and educators design each school's curriculum as a group (Dickinson, 2019).

In the case of South Korea, the Korea Foundation for the Advancement of Science and Creativity (KOFAC) helps to establish STEAM education in the country. Those include reinforcing the capabilities of teachers, promoting interactive and exploratory activities for students, developing and distributing content, and institutionalizing and building infrastructure. According to a study conducted by KOFAC, the preference for science among the students who participated in STEAM classes was higher than the students who did not participate. Those activities help to increase curiosity, interest, and belief in science, and students show their willingness to perform science-related tasks, embrace the values of science, and wish to pursue a career in science (Hong, 2017; Hong, 2021).

According to the latest data, most likely to graduate in a STEM field are Malaysia and Tunisia (Figure 1) (UNESCO Institute for Statistics). Other countries with STEM graduates are United Arab Emirates, Germany, Belarus, India, and South Korea. However, U.S. and Brazil have a fewer number of STEM graduates (Buchholz, 2023).

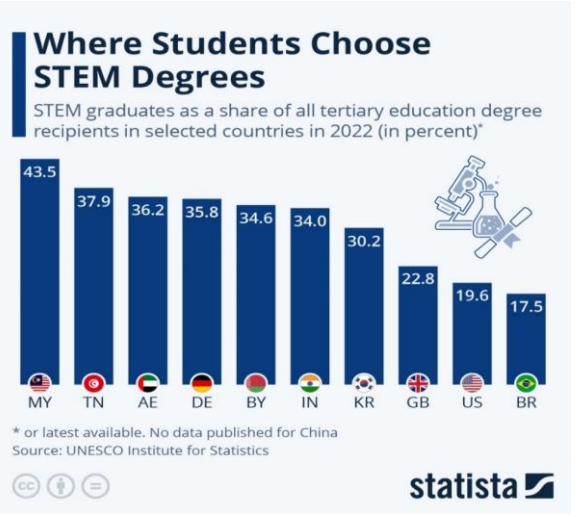

Figure 1: **STEM graduates as a share of all tertiary education degree recipients in selected countries in 2022. [Source: UNESCO Institute for Statistics]**

The United Nations Educational, Scientific and Cultural Organization (UNESCO) has identified that building capacity in STEM especially in Africa and from a gender perspective, is crucial to transform knowledge into resilience ownership to promote sustainable development. They have initiated mentorship programmes in STEM through scientific camps of excellence for secondary school girls since 2014 (UNESCO - STEM in Kenya). The UNESCO offices in Harare and Brazzaville have been equipped with 3D printers and have the facilities needed to conduct workshops utilizing online resources (UNESCO - The UNESCO Section for Innovation). Micro science experiment projects have been conducted for primary and secondary school students, and university students in countries like South Africa, Cameroon, and Norway (UNESCO - Global Micro science Experiments).

STEM in Sri Lanka

The Sri Lankan education system is well-known for its high literacy rate and provides free education for every citizen up to the university level. The conventional teacher-centered and exam-based educational model is the foundation of the current Sri Lankan educational system. However, there were problems regarding whether this system is capable of producing the

expected requirements for the future (The Sunday Times, 2021). Even more of a concern is many young people are studying for jobs that will not exist or will be gradually affected by automation in upcoming years. According to the data in 2019, the number of undergraduates enrolled in STEM and non-STEM courses varied among state universities, indicating 49% of students enrolled in STEM courses, while 51% enrolled in non-STEM courses. It was also obvious that the number of STEM graduates was less than non-STEM graduates in the years 2011-21 (Figure 2) (Subasinghe et al., 2023).

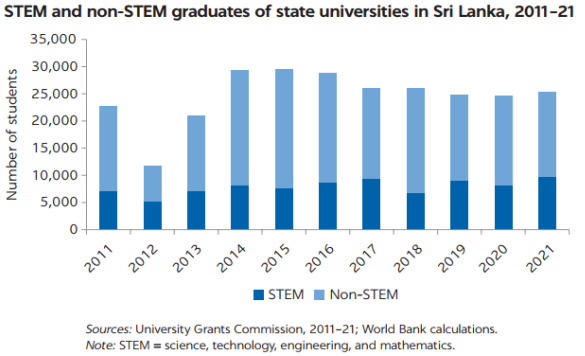

Figure 2: STEM and non-STEM graduates of state universities in Sri Lanka, 2011-21. (According to University Grants Commission, 2011-21; World Bank calculations) [Source: Subasinghe et al., 2023]

At present, STEM education in Sri Lanka has been shifted to the STEAM education system as in other countries (The Sunday Times, 2023). The "Arts" in STEAM introduces empathy, ethical values, social sciences, culture, and soft skills, and gives an added value to a human being. Since STEM disciplines all consist of logical thinking, the "A" in STEAM produces more ethical and humanistic people (Aktürk and Demircan, 2017; Başaran and Erol, 2023). The launching of the STEAM education system to the schools was officially done on 31st of March 2023, and it has been done through the cooperative effort of the Ministry of Education (MoE), National Science Foundation (NSF), and National Institute of Education (NIE), Sri Lanka (MoE, 2023; NSF, 2023).

In Sri Lanka, STEM education plays a beneficial role in enhancing teacher support for technological innovation, integrating technology into the teaching of science and mathematics, and strengthening school science and mathematics laboratories. Likewise, science clubs encourage students to publish science-related articles for local media outlets, drawing from their own observations, experiences, and analyses. Professional development programs such as the "Vidunetha" program guide school children in conducting research projects following scientific methodology and encourage them to conduct research projects (MoSTR, 2023). The Department of Science in NIE is also working on strengthening the STEM initiatives in Sri Lanka (NIE, 2023).

The National Invention and Innovation Competition which is called "Sahasak Nimavum" is held annually by the Sri Lankan Inventors Commission (SLIC) to encourage the creation of inventions in Sri Lankan citizens. Young inventor clubs, incubation centers, and patent support are also among the services of this commission. Young inventor clubs are extremely helpful for the introduction of an innovative culture among students and to popularize it among Sri Lankans. Moreover, SLIC has established two incubators at the National Engineering Research and Development Center (NERDC) and the University of Jaffna (SLIC, 2023).

Overcoming Poverty through STEM Education

Development of Industries through STEM Education

STEM-related industries have ongoing advancements and result in higher profits. Many industries which are based on science and technology are highly advantageous for people who have a STEM background. Some industries related to STEM are manufacturing, biotechnology, software development companies, and food and beverages. Hence, STEM education provides massive opportunities for starting industries (Henry, 2022).

In addition, more industries such as consulting firms, robotics, and online education platforms, green energy development companies, big data analytics companies, AI research labs, and clean energy production plants can also be started with the knowledge of STEM education. Robotics is a popular industry nowadays due to its automated solutions to common problems.

These industries develop and launch robotic products, services, and applications. Similarly, AI research labs explore and develop new technologies related to AI. They create new products and services with the help of AI (Nick, 2023).

In Sri Lanka, the University of Colombo started an Institute for Agro-technology and Rural Sciences (UCIARS) at Weligatta, Hambantota. Subjects such as Biotechnology were introduced to the rural farming community successfully through a Bachelor of Agro-tech degree. With science and technology knowledge, farmers were able to increase their income by improving their cultivations, resulting in a higher social status in the community (Vidanapathirana et al., 2012; Vidanapathirana et al., 2015). Similar efforts could be made in other industries by providing STEM education to people who are passionate about learning new technologies. That would be helpful for the development of skills, knowledge on equipment usage, and technology usage. As a result, people would be able to build new industries, increase income, and come out of the poverty cycle.

Research and Development through STEM Education

Research and development (R&D) are among the main objectives of STEM education. It connects students, teachers, universities, non-profit organizations, and private sector companies to participate in high-quality, student-driven research and development programmes. The lack of research collaboration in STEM fields was a barrier to STEM education (Ejiwale, 2013; Haruna, 2015). Hence, the recent development of this aspect is the introduction of incubators/cells.

The initiation for this programme was taken mainly by universities around the world and those university incubators help to build university entrepreneurs by providing mentorship, funding, resources, and assistance. Those university incubators are able to reduce the gap between academia and the business world by facilitating university students to start up their own small businesses through R&D (Hassan, 2020). In other words, this “cell” concept is to work with companies to develop a product that could provide more benefits to the people. Hence, R&D should develop into a technology or release a product in order to benefit society.

In Sri Lanka, the University of Colombo also has a cell called “Colombo Science and Technology Cell”. The main objective of this cell is to encourage and support Sri Lanka's manufacturing, service, and agricultural sectors through knowledge and technology transfer, scientific services, innovation, and research and development. It has developed many commercial products in Sri Lanka such as Bioclean and Mosguard (Colombo Science and Technology Cell).

According to the Intellectual Property Statistical Country Profile published by the World Intellectual Property Organization (WIPO) in 2022, Sri Lanka ranks 23rd in Asia and there were only 260 patent applications (WIPO, 2022). Hence, there is an urgent need to increase the number of innovations produced within the country. STEAM education is a great solution for that which has integrated solutions to produce an innovation culture within the country. Then, that innovation-oriented line will go up to patent levels making the country move forward.

Farmers through STEM Education

There are a number of modern technologies available in the agriculture sector to increase crop productivity and food security. Technologies such as AI and robotics play a major role in agriculture as well as in other fields. Hence, the current-day farmer is a person who is well-equipped with those new technologies. They are more like agribusinessmen who use agri-tech to enhance product quality, increase yields, and optimize production. Thus, farming has become more related to agribusiness at present (Meers, 2021).

Sri Lanka is an agricultural country, blessed with nourishing good soil, rain, and sunlight. Especially, the rural farming community has played an important role in the national economy. However, Sri Lankan farmers do not maximize their profits from agricultural products, owing to a lack of up-to-date knowledge and information. Therefore, the introduction of a new education method would be a great solution in this regard. This will result in effective knowledge, information, and technology

transfer to the farmers (Vidanapathirana et al., 2012; Vidanapathirana et al., 2015).

UCIARS at Waligatta, Hambantota has become a major institute that provides massive benefits for people who are seeking to develop their agriculture-related skills. By learning different aspects like tissue culture, biotechnology, and agriculture, young people in the farming community can build their own small businesses and become small entrepreneurs. Three programmes were introduced while promoting STEM education for the rural farming community and those include the e-Degree program with ICT, University-Farmers collaborative New Tec Transfer, and Rural Entrepreneur Development (RED) for SMEs.

There are many opportunities in the agriculture field in Sri Lanka such as compost, agricultural products (e.g., spices, fruits – banana, mangos), coconut products, and other value-added products. Developing those fields will require the import of only a few products and the majority could be produced within the country. Hence, the existing human and natural resources, blended with new technology will be helpful to alleviate the poverty in Sri Lanka.

SME Entrepreneurs through STEM Education

Small and Medium Enterprises (SMEs) play a crucial role in economies, especially in developing countries (Pandya, 2012). The development of SMEs helps to overcome poverty mainly by excluding the dependent mentality. In a country like Sri Lanka, most people have dependent-mentality-related issues. Rather than depending on loans, it is important to build their own SMEs using their skills. To overcome poverty, people in a country need to have purchasing power. That will enable them to develop their own SMEs. Since Sri Lanka have less purchasing power, this development could not be seen at present. With the help of the government in agriculture, the purchasing power of the farmers will increase and SME entrepreneurs in the farming community will arise. For example, those who have graduated with BTech degree have their own companies that could employ several people in those companies.

Sri Lankan SMEs account for over 75% of the total enterprises in the country, offering 45% of employment and contributing to 52% of the country's Gross Domestic Product (GDP). Hence, Sri Lankan SMEs play an important role in the development in the national economy. However, there are challenges in this regard in Sri Lanka such as a reduced level of science-based technological innovation, limited skills of human resources with less commitment, lack of broad-based scientific knowledge, poor implementation of policies, etc. (Piyumal et al., 2021). Hence, by overcoming those challenges, most of the problems at present SME entrepreneurs will be reduced.

3. COMPREHENSIVE EVALUATION

The first industrial revolution of the 18th century introduced the steam engine, while the second in the 19th century introduced electricity and mass production. The third in the 20th century introduced semiconductors, computing, and the use of the internet. Likewise, the current 21st century has already introduced massive, sophisticated technologies making this century move towards a digital revolution and fusion of technologies. The physical, digital, and biological subject matter has become blurred making the lines between them disappear. More unthinkable innovations in the fields of robotics, AI, 3D printers, autonomous vehicles, quantum computing, and nanotechnology are making rapid progress at present. This has made the importance of STEM education rise to meet future demands (Boon Ng, 2019).

When looking at the world, the quality as well as the student participation in STEM education varies from country to country. Countries like Finland, South Korea, and Malaysia have successfully implemented STEM education systems with different policies relevant to each country. In Sri Lanka also the launching of the STEAM education system to schools was officially done in 2023. As a result, students would be able to choose their preferred STEM field in the university and would be able to find their preferred career in the future. STEM graduates will engage in STEM careers which they have studied for a long period of time in their education. This will also prevent graduates from engaging in other fields when it comes to career choices. Besides, there is also a need to increase the awareness of the concepts of

poverty and STEM/STEAM education among Sri Lankans. With the awareness and knowledge of new technologies, the involvement of the younger generation in the agricultural and industrial sectors will increase. That would be more beneficial to the socio-economic development of the nation.

At present, there is very little involvement of the younger generation in the agricultural industry. Due to their low socio-economic level, they lack self-confidence as farmers. Changes in attitude toward the agriculture sector are therefore desperately needed, as it is a very economically viable, entrepreneurial-oriented, and high social status-gaining industry. Hence, the introduction of a new education system for farmers where they can enroll while engaging in cultivation is required (Vidanapathirana et al., 2012). STEM education would be a great solution in this regard.

With STEM education, creators and entrepreneurial youth could be developed. They would be able to work hard while taking risks and earn a significant amount of money. This will bring them out of the poverty cycle by increasing their purchasing power. It is important to produce ethical, compassionate, sympathetic, and positive-attitude people through STEM education. That is why it has changed from STEM to STEAM. The "Art" factor will be responsible in this case reducing the limitations arising from the logical thinking in STEM factors (Aktürk and Demircan, 2017; Başaran and Erol, 2023). Hence, the people stepping into society with a STEAM background would be more responsible, knowledgeable, and ethical. They would gain the respect that they need and will lead to the socio-economic stability of the country.

Our country, Sri Lanka, has many resources including human resources that could be utilized for socio-economic development. Industries developed through science and technology provide employment at all levels. When industries are developed, many sectors such as medicine, engineering, IT, legal, management, and even labor force will benefit. There is also the possibility to increase the export market, adding value to socio-economic development. Having experience in other countries, this is how a country could develop. It is a win-win situation for the country.

4. CONCLUSION

This study has examined and reviewed literature, research, and other supportive reports, and personal communication regarding the impact of STEM education in overcoming poverty. As Sri Lankans, it is necessary to be aware of the concepts of poverty and especially STEM/STEAM education because those are becoming more important in socio-economic development at present as well as in the future. The review indicates that the definition of poverty is a state in which one lacks financial resources and essentials; however, modern-day poverty is understood as a complex, multi-dimensional set of issues, introducing it in a relative manner rather than a single idea. The definition of STEM education is a teaching and learning process that combines Science, Technology, Engineering, and Mathematics and STEAM is the recent inclusion of Arts.

Countries like Finland, South Korea, and Malaysia have successfully implemented STEM education systems and the launching of the STEAM education system to the schools of Sri Lanka has been done in 2023. Empowering industries, Research and Development (R&D), farmers, and Small and Medium Enterprises (SMEs) with STEM education would be helpful in overcoming poverty in Sri Lanka.

The key outcomes of the study are:

1. Understand the definition of poverty in general.
2. Understand the definition of STEM education.
3. Study the STEM education systems in the world and Sri Lanka.
4. Identify the methods involved in overcoming poverty through STEM education in Sri Lanka.
    a. Application of STEM knowledge in skills development
    b. Knowledge on equipment usage for skills development
    c. Application of technology in SME development
    d. Removal of ethical poverty for socio-economic development
    e. Increased purchasing power

f. Establishment of a society for development of health, wealth, and happiness

5. ACKNOWLEDGMENT

The Department of Plant Sciences of the University of Colombo is acknowledged for facilitating the ongoing projects. The authors are grateful to the Ministry of Education, Sri Lanka and to the Institute for Agrotechnology and Rural Sciences of the University of Colombo (UCIARS) for the important information.

6. REFERENCES

Aktürk, A. A., & Demircan, O. (2017). A review of studies on STEM and STEAM education in early childhood. *Ahi Evran Üniversitesi Kırşehir Eğitim Fakültesi Dergisi (KEFAD)*, *18*(2), pp.757-776.

Barrientos, A., A-G. Abdulai, D. et al. (2016). Why Assist People Living in Poverty? The ethics of poverty reduction, Innocenti Working Paper 2016-27, UNICEF Office of Research, Florence.

Başaran, M., & Erol, M. (2023). Recognizing aesthetics in nature with STEM and STEAM education. *Research in Science & Technological Education*, *41*(1),pp. 326-342.

Boon Ng, S. (2019). Exploring STEM competences for the 21st century – UNESCO.

Buchholz, K. (2023). Where Students Choose STEM Degrees. Statista,Mar 2023. Available at: https://www.statista.com/chart/22927/share-and-total-number-of-stem-graduates-by-country/ [Accessed: 05 November 2023].

Colombo Science and Technology Cell. Available at: https://cell.cmb.ac.lk/ [Accessed: 12 November 2023].

Dickinson, K. (2019). Standardized tests: Finland's education system vs. the U.S. Big think,Feb. 2019. Available at: https://bigthink.com/the-present/standardized-testing/ [Accessed: 03 Dec. 2023].

Ejiwale, J. A. (2013). Barriers to successful implementation of STEM education. *J. of Education and Learning (EduLearn)*, *7*(2), pp.63-74.

Finger, Joseph, M. et al. (2003). *Poor people's knowledge: Promoting intellectual property in developing countries (English)*. Washington, D.C.: World Bank Group.

Freeman, B., Marginson, S. et al. (2019). An international view of STEM education. In *STEM Education 2.0*,pp. 350-363, Brill.

Goulden, C., & D'Arcy, C. (2014). *A definition of poverty*. York: Joseph Rowntree Foundation.

Gweshengwe, B., & Hassan, N. H. (2020). Defining the characteristics of poverty and their implications for poverty analysis. *Cogent Social Sciences*, *6*(1), p.1768669.

Haruna, U. I. (2015). The Need for an Effective Collaboration across Science, Technology, Engineering & Mathematics (STEM) Fields for a Meaningful Technological Development in Nigeria. *J. of Education and Practice*, *6*(25), pp.16-21.

Hassan, N. A. (2020). University business incubators as a tool for accelerating entrepreneurship: theoretical perspective. *Review of Economics and Political Science*, (ahead-of-print).

Henry. (2022). What STEM related businesses can you start? The engineering knowledge,Oct 2022. Available at: https://www.theengineeringknowledge.com/what-stem-related-businesses-can-you-start/#:~:text=What%20STEM_Related%20Businesses%20Can%20You%20Start%3F%201%20Manufacturing,Food%20and%20Beverage%20...%206%20Final%20Thoughts%20 [Accessed: 12 November 2023].

Hong, O. (2017). STEAM education in Korea: Current policies and future directions. *Science and Technology Trends Policy Trajectories and Initiatives in STEM Education*, *8*(2), pp.92-102.

Hong, O. (2021). STEM/STEAM education research in South Korea. In *STEM education from Asia*,pp. 211-227. Routledge.

Ivan, V. (2019). Intellectual poverty in Sri Lanka. Sri Lanka Guardian,Feb. 2019, Available at: http://www.srilankaguardian.org/2019/02/intellectual-poverty-in-sri-lanka.html [Accessed: 03 Dec. 2023].

Lee, I., & Perret, B. (2022). Preparing High School Teachers to Integrate AI Methods into STEM

Classrooms. In *Proceedings of the AAAI Conference on Artificial Intelligence*,36(11),pp. 12783-12791.

Malan, H. (2023). Three talent trends that will shape STEM in 2023. Forbes.Feb. 2023. Available at: https://www.forbes.com/sites/forbeshumanresourcescouncil/2023/02/06/three-talent-trends-that-will-shape-stem-in-2023/?sh=2a0351623882 [Accessed: 03 Dec. 2023].

Meers, L. (2021). The STEM in agriculture. Careers with STEM, Nov 2021. Available at: https://careerswithstem.com.au/the-stem-in-agriculture/#gsc.tab=0 [Accessed: 12 November 2023].

MoE (2023). STEM education method implemented in 96 countries in the world is included in the education system of this country. Available at: https://moe.gov.lk/2023/03/stem-education-method-implemented-in-96-countries-in-the-world-is-included-in-the-education-system-of-this-country/ [Accessed: 24 Dec. 2023].

Morrison, J. (2006). Attributes of STEM education: The student, the school, the classroom. *TIES (Teaching Institute for Excellence in STEM)*, *20*(2), p.7.

MoSTR (2023). Education and Science Popularization. Available at: https://mostr.gov.lk/web/index.php?option=com_content&view=article&id=31&Itemid=154&lang=en#continuing-professional-development [Accessed: 24 Dec. 2023].

Nick, C. 10+ Best & Profitable Stem Business Ideas [2023]. Newfoundrz, 07 August 2023. Available at: https://www.newfoundr.com/business-ideas/stem [Accessed: 12 November 2023].

NIE (2023). Department of Science. Available at: https://www.nie.ac.lk/departments/department-of-science/ [Accessed: 24 Dec. 2023].

NSF (2023). STEAM Education and propelling into future. Available at: https://www.nsf.ac.lk/index.php/component/content/article/37-department-activities/385-steam-education-and-propelling-into future?Itemid=101#:~:text=With%20this%20aim%20a%20national%20programme%20to%20introduce,the%20Hon.%20Minister%20of%20Education%20Dr%20Susil%20Premajayantha. [Accessed: 24 Dec. 2023].

O'Rourke, B. (2021). Growing gap in STEM supply and demand. The Harvard Gazette, Nov. 2021. Available at: https://news.harvard.edu/gazette/story/2021/11/increasing-access-and-opportunity-in-stem-crucial-say-experts/ [Accessed: 03 Dec. 2023].

Pandya, V.M. (2012). The Comparative analysis of development of SMEs in developed and developing countries. In: *Conference on Business and Management,* Sept 2012. Thailand.

Perales, F. J., & Aróstegui, J. L. (2021). The STEAM approach: Implementation and educational, social and economic consequences. *Arts Education Policy Review*, pp.1-9.

Piyumal, K. T. R., Samarakoon, K. W., & Hirimburegama, K. (2021). A revisit of National Science & Technology Policy for the development of small and medium enterprises in Sri Lanka. *KDU J. of Multidisciplinary Studies (KJMS), 3(2)*: pp.89-102.

Sanders, M. (2009). Integrative STEM education: primer. *The Technology Teacher*, *68*(4), pp.20-26.

Schweiger, G. (2019). Ethics, poverty and children's vulnerability. *Ethics and social welfare*, *13*(3), pp.288-301.

SLIC (2023). National Inventions and Innovations Competition. Available at: https://slic.gov.lk/sn2023/ [Accessed: 24 Dec. 2023].

Spicker, P. (2020). Poverty. In *The Poverty of Nations*,pp. 15-34, Policy Press.

Stohlmann, M., Moore, T. J. et al. (2011). Impressions of a middle grades STEM integration program: Educators share lessons learned from the implementation of a middle grades STEM curriculum model. *Middle School J.*, *43*(1), pp.32-40.

Su, H. F. H., Ledbetter, N. et al. (2017). Finland: An exemplary STEM educational system. *Transformations*, *3*(1), p.4.

Subasinghe, S., Sosale, S. et al. (2023). Enhancing STEM Education and Careers in Sri Lanka. World Bank Group.

The Sunday Times, (05 Dec. 2021). STEM education to get a boost next year: State Minister. Available at: https://www.sundaytimes.lk/211205/education/stem-education-to-get-a-boost-next-year-state-minister-464216.html [Accessed: 07 November 2023].

The Sunday Times, (02 Apr 2023). STEAM to be added to school education system: Edu Min. Available at: https://www.sundaytimes.lk/230402/education/steam-to-be-added-to-school-education-system-edu-min-515907.html#:~:text=Education%20Minister%20Susil%20Premajayantha%20says%20that%20the%20new,understand%20subject%20theories%20and%20principles%20through%20simple%20activities. [Accessed: 24 December 2023].

UNESCO Institute for Statistics. Available at: http://data.uis.unesco.org/index.aspx?queryid=163# [Accessed: 05 November 2023].

UNESCO - Global Micro science Experiments. Available at: https://www.unesco.org/en/basic-sciences-engineering/stem [Accessed: 04 November 2023].

UNESCO - STEM in Kenya: Digital Programme Launch, 2020. Available at: https://www.unesco.org/en/articles/stem-kenya-digital-programme-launch [Accessed: 04 November 2023].

UNESCO - The UNESCO Section for Innovation and Capacity Building in Science and Engineering compiles online STEM education resources available for inclusive distance learning in response to COVID-19. Available at: https://en.unesco.org/sites/default/files/unesco_stem_education_courses_online_0.pdf [Accessed: 04 November 2023].

Vasquez, J. A. (2015). STEM--Beyond the Acronym. *Educational Leadership*, *72*(4), pp.10-15.

Vidanapathirana, N. P., Hirimburegama, K. et al. (2012). Impact of online agro-technology diploma program and its future perspectives for improving socio-economic well-being of farmers in Sri Lanka. In *Exploring the Abyss of Inequalities:Proc. of 4th Int. Conf. on Well-Being in the Information Society-WIS 2012Finland, Aug*. pp. 68-82 Springer Berlin Heidelberg.

Vidanapathirana, N. P., Hirimburegama, K. et al. (2015). Socio economic development of farmers through ICT-based education and rural entrepreneurship development: case study in Sri Lanka. In Proc. *EDULEARN15* pp. 4327-4333,IATED.

WIPO (2022). Intellectual property statistical country profile Available at: https://www.wipo.int/edocs/statistics-country-profile/en/lk.pdf [Accessed: 24 Dec. 2023].