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Multidimensional Approaches to Stem-Steam-Steams Education in Mongolia; an Integrative Global Inquiry

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Abstract: *This study aims to determine the importance of Science, Technology, Engineering, Arts and Mathematics (STEAM) education – adding arts dimensions to traditional science fields, analyzing which factors are effective for its development in Mongolia. A survey was conducted on STEAM development in Mongolia in order to select best methodologies. Approximately 900 rural area boarding school teachers responded. 97 % of respondents expressed that STEAM today should be combined with traditional educational methods as its role is becoming increasingly significant for the future. They shared that STEAM plus meditation will be optimum. This research discusses STEAM education in Asia by examining how current educational reform efforts have affected boarding schools and revised their approaches. The results of this study suggest that STEAM educators need to reconsider, exploring more deeply positive impacts of Emotional and Social Learning (ESL) and spirituality, exploring how these have been applied elsewhere, adopting STEAM methodologies.*

KEYWORDS:-*STEM to Art, Spirituality, Integrated learning*

I. INTRODUCTION

Technological innovation in the modern age is only obtainable through the expertise of specialists with knowledge at the forefront of recent STEM research. Therefore, the role of STEM in developing countries is important because a country's economy is completely dependent on new developments from technology and science. STEM education is fairly globalized: Commonwealth countries follow trends in the United Kingdom while European and Asian countries tend to follow developments in the United States [1].However, the majority of technologies which developing countries need to reduce poverty, add value to natural resources and improve the efficiency of domestic industries, have already been invented and are widely used in high-income countries. The issue is that these technologies are not very prevalent in many developing countries. Consequently, the priority for STEM education requires developing engineering, technical and vocational skills rather than conducting state-of-the-art research and development[2]. Science and technology education can accelerate the development of a knowledge-based economy in developing countries. Information and Communication Technology (ICT) has developed rapidly and taken up significant roles in promoting aspects of quality education, such as the access and inclusion of learning opportunities, quality learning, and lifelong learning pathways [3].

There is a desire to keep pace with high-technology sectors in Asian countries [1]. In 2010 scholars in developed countries proposed that the teaching of science, technology, engineering and mathematics at secondary education level should be integrated into one subject under the guise of STEM and teachers of STEM would be able to teach any of the subjects [4]. The main motivation for an integrated STEM discipline at secondary school level was a response to vocational needs and economic aspirations [1]. However, this approach has

been criticized for lacking clarity and undermining technology training. Moreover, the individual components of STEM are based on different epistemological assumptions, and these differences should be respected [1], [5]. Globalization and the rapid development of ICT are transforming society. Consequently, STEM is necessary to meet demands for 21st-century workplaces [4]. There are a number of frameworks for 21st-century competences such as the assessment and teaching of 21st-century skills developed by companies in the world, 21st-century skills and competences for the new millennium learners developed by the Organization for Economic Cooperation and Development and the ICT competency framework for teachers developed by UNESCO [6]. Information literacy refers to the capacity to access information in an efficient and effective manner, as well as the ability to critically evaluate information. ICT literacy refers to more than technical skills and includes the use of digital technology, communications tools or networks to operate in a knowledge society. Technological literacy refers to the ability to use, understand and evaluate technology as well as applying it to develop solutions for particular problems. A new set of skills, are required for the 21st-century [6]. STEM education encourages innovation and stresses critical thinking and problem-solving abilities. Similarly, a country's economic development and stability are dependent on its ability to invent and develop new science and technology. Yet these skills do not yet address the full scope of the learner, nor their comprehensive role and responsibility within the society and cultures.

II. STEAM IN ASIA

East Asian countries such as China, South Korea, Japan, and Singapore have excelled in the fields of Science and Math education. At present, the mainstream STEAM education and training service institutions of technological advancement, developed and produced in these countries, have positioned them to be highly competitive in the global economy. These nations are highly interested in STEM education and systematically examine the strengths and weaknesses of their programs [7].

India has been working hard to develop STEM in their educational programs. In recent years, there is a major increase in the number of science and engineering degrees earned in India. India now has the largest number of STEM graduates in the world, putting the country on the right track for economic development. The Indian STEM Foundation strives to build up STEM education as described in their vision: "To create a world where young people are encouraged to celebrate fun and excitement of science and technology, and inspire them to take science and technology-based career paths to become tomorrow's much needed technology leaders". The United Nations has published findings that affirm that STEM education "can remove poverty and reduce inequality in developing countries" [8].

Educating people in these fields is going to bring tremendous growth to the nation's economy and help get people out of poverty. Robotic camps are popping up all over the world, not just in India, and they help encourage children's interest in STEM fields through fun activities. In addition, more and more women are emerging into STEM fields and breaking down some common gender barriers. STEM education is becoming more of a focus as our world becomes ever more digital. With the wonderful encouragement that children in developing parts of the world are getting, STEM education and the respective fields should continue improving [8].

III. STEM TO STEAM IN MONGOLIA

The fields of Science, Technology, Engineering and Mathematics (STEM) are being heavily encouraged in Mongolia. Mongolia is facing shortage in STEM education in universities and skilled workers in industry and telecommunications. A benefit of financing universities in Mongolia will be that more students will have STEM education in relative proximity to their homes instead of having to travel abroad for education. This allows more students to have the option of a good higher education. Also, since those students will be trained in their own countries, the skilled workers have an incentive to remain in their regions strengthening the skilled labor force, creating economic growth and contributing to national wellbeing. Students who earn these types of degrees are able to gain employment in information technology (IT), medicine, higher education and many other fields. Mongolian current development of STEM is important because many new jobs are being

created in the booming medicine, computer and IT industries worldwide. Educating people in these fields is going to bring tremendous growth to the nation's economy, contribute toward realizing ecological integrity and help get people out of poverty. Mongolia is going to promote STEAM in their educational programs to help bolster their economies and overall national well being.

During the 1990s, Mongolia experienced the transition to market economy. The county achieved rapid and successful transition to the democratic system and Mongolian education system has experienced a major transition from a centrally planned system to a decentralized system. It resulted in increased roles and responsibilities for local educational policies and schools. With such major changes, school managers and teachers in rural boarding schools have faced difficulties. The specific issues include a lack of quality teacher training, limited budget, and big gaps in education quality between rural and urban schools. In order to address the need for change in public schools in Mongolia, the government has allocated funds through policy implementations, especially for rural boarding schools. Mongolian boarding schools for nomadic herder families were: child-friendly, integrative close to the families and nature environment. There is needed unique STEAM development with specific vision in boarding schools.

IV. SURVEY ANALYSIS

This study utilizes the data from surveys conducted in rural areas of Mongolia on STEAM development. It assesses which factors are important for teachers. The survey used was developed by Mongolian education experts in the National University of Mongolia. The baseline survey collected data from 900 primary boarding school teachers from Selenge Province, Mongolia in 2020. The first part of the survey included demographic information of the school teachers, age, gender, and school location. The second part focused on teachers' perception on the current state of STEM development and STEAM teacher training on self development. The survey also explored their perception of skills and abilities to develop and use STEAM training materials. Examples of questions include "I feel professionally competent as STEAM teacher because I can develop and use online lessons in my teaching" and "I think my skills for STEAM should improve". The third part focused on teachers' perceptions of school STEAM building infrastructure, collaborative work, perceived benefits of the use of STEAM, and various aspects of use of STEAM in education. Examples of the questions are "I use STEAM to make students more interested in different subjects and lesson contents", and "Teachers have an opportunity to make decisions that are relevant for their own teaching"; "What is useful, successful STEAM building?"; "What is important for STEAM development in Mongolian boarding schools?"

Many of the teachers strongly agree that there's been increasing interest from educators and researchers in bringing meditation and yoga to school students, who are dealing with the usual stressors inside school, and as well as additional stress and trauma outside school. There is the example of the SriSri School in Dornod province, Mongolia; they showed excellent results during the National Mathematics Olympiad. An impressive finding of the study reveals that integrating meditation into a school's daily routine can improve the lives of students and the lives of children. Teachers in the survey say it would be better if the study and applications transversed are not directly linked to a specific field but are relevant across many fields. If they are multidimensional, they include knowledge, skills and attitudes; and if they are associated with higher order skills and behaviors, they enable people to cope with complex problems and unpredictable situations.

Some educators shared that many schools have jumped onto the idea of STEAM education involving Science, Technology, Engineering, Art and Math. The integration of these four areas is very important while it is argued that we must be careful not to amplify these areas of study, while putting less emphasis on other areas of the curriculum. People amplify STEM and put less attention on other areas of the curriculum which are also important. Thoughts offered include: "We have to develop STEM carefully in envisioning the development of boarding schools"; "Boarding schools have an advantage in that they have a friendly environment". "Meditation and nature can be integrated in their programs". "Boarding school teachers say that when combining meditation with STEAM, the students show significantly less stress and depression, and greater self-esteem, than nonparticipants in the study." Teachers in rural areas suggest that to

combine environmental technology and spiritual knowledge is important for every successful school in the future, while arguing that schools have their own visions of how to develop STEAM in their school.

V. STEAM PLUS MEDITATION (SPIRITUALITY)

With stress levels down, achievement has markedly improved, particularly among students who have been doing the worst academically. Grades rose dramatically, compared with those who weren't in the program. In the study, twice as many students in what are being called "Quiet Time Schools" have become good in mathematics and natural science, compared with students in similar schools where the program doesn't exist, and the gap is greater in math. While "Quiet Time" is no panacea, it's a game-changer for many students who otherwise might have become dropouts. That's reason enough to make meditation a school staple, and not just in "Quiet Time Schools" in the USA [9].

The challenge in education today is to effectively teach students of diverse ability and differing rates of learning. Teachers are expected to teach in a way that enables pupils to learn science and mathematics concepts while acquiring process skills, positive attitudes and values and problem-solving skills [10].

For developing brains, meditation has as much as, or perhaps even more promise than it has for adults. Some schools have started implementing meditation into their daily schedules, with good effect. One district in San Francisco started a twice daily meditation program in some of its high-risk schools – and saw suspensions decrease, while GPAs and attendance increased. Studies have confirmed the cognitive and emotional benefits of meditation for school children, but more work will probably need to be done.Participation in school level biology, chemistry, physics and mathematics reflects students' change in attitudes, especially regarding interest, self-efficacy and ability, with gender playing an important role [11].

Technology functions to bring us comfort. Meditation also is a technology that brings about inner comfort. Technology is not anti-spiritual but it is up to individuals how it is used. If one is obsessed with it, it takes a toll on health. It must be understood that you want to use technology for your comfort. Use it but do not let it use you [12].

The Sri Sri Ravi Shankar Vidya Mandir Trust (SSRVM) is committed to providing a world class, holistic education to students across various age groups and diverse fields of study. The SSRVM uses '5 Aspects of Education founded by Gurudev Sri SriRavishankarJi. In accordance with the 5 elements in nature these become the 5 aspects of education. These are: CONCEPT as solid as the Earth; ATTITUDE like that of Water that takes the shape of its container; INFORMATION which is readiness to receive from all sources like the Air around us; IMAGINATION which is enthused by Fire; and FREEDOM in the mind like the Space that is all pervading. All the activities in SSRVM are based on these 5 aspects. Any curriculum is effective only when it is implemented in the right way. Their approach is simple; child-centric, experiential and interactive. Day to day activities are designed such that they kindle in each child a curiosity to know. This is done by engaging them in lessons rather enforcing rote learning. According SSRTV the 5 Aspects of Education help to strengthen the body, mind and emotions, and create a sense of belonging with the whole world. This paradigm helps to prepare children to live with a smile in this ever-changing world, equipping them with all the necessary skills, information and wisdom to be worthy global citizens. The focus is not only on academics but an all round development of the child [13].Some teachers indicate that science education programs should include the total community, with an integrated scope, encompassing social, economic, political, psychological and cultural aspects.

Asian countries have a long history with combining a singular integrated educational and spirituality approach. In the world, science and technology are growing very quickly but scientific and technological development require the development of science education. Science education, in general, provides good standards and discipline for people, leading as well to cultural development. While industrialized countries are giving emphasis to science education, some non-industrial countries are not succeeding, because of deficiencies regarding such things as good quality curriculum, inadequate resources, and other deficits. It is necessary

to equip the children with modern tools, and the moral and spiritual strength needed to face the challenges of the modern world.

The elements of STEM are areas of study that embrace future job growth and economic wellbeing, as well as cultural and spiritual integrity, as the acronym is extended to STEAM to include the arts. Integrating meditation is a further dimension of STEAM. Before bringing meditation into a STEAM program, it is useful to collectively decide on a definition for STEAM. Does this include the science of character, mental, emotional and psychological development? It is the process of students doing, thinking and connecting throughout the entire curriculum. Future STEAM classrooms will be integrated in physical, psychological and pedagogical ways. This multi-dimensional curriculum shift could be a long-term goal and may vary among schools. It is expected that schools will be required to make curricular changes in order to prepare students for the knowledge society, and in addition it may be necessary to redefine what should be included in the core secondary school curriculum [6].

STEAM teaching is not straightforward, there are many alternative versions of STEM. There are also several cultural challenges that countries face when implementing long-term improvements in STEM, and moving to STEAM. This research argues that possibility moving from STEAM to STEAM plus meditation and spirituality (STEAMS).

VI. RESULTS AND DISCUSSION

This research suggests that perhaps teachers can find some ways to connect even in traditional pedagogical contexts. They may including STEM assessments that go beyond the test to a collaborative approach. There is a program of STEAM where students who having included meditation call themselves "STEAMS", STEAM +Spirituality. Most teachers who replied to the survey offered for this particular study, say that they are not preparing students for the specific skill sets of a particular career; rather with the universal skills needed to work in any career. In order to build these attributes into lessons, the appropriate tools must be determined. What are these tools, attributes and methodologies? And what are the the qualities needed as we build our STEM and STEAM programs? How do we build these attributes into lessons and where are the appropriate tools discerned?

The STEM to STEAM movement has been taking root over the past several years and is surging forward as a positive mode of action to truly meet the needs of a 21st century economy. STEM alone misses several key components that many employers, educators, and parents have voiced as critical for our children to thrive in the present and rapidly approaching future [14].

As we think of careers, a STEAM program must help students determine a career pathway and find passions that engage them. This is keeping in mind that the goal is to build a STEM plus meditation culture, in that this has been seen to most intensely benefit the students. The optimum outcome addresses the needs of schools in designing integrative STEM-STEAM-STEAMS units that improve students' examination results while concurrently fostering their creative and collaborative authentic problem-solving capacities. Negotiating equitable subject representation where the science, mathematics, and technology teachers can accept meditation has been seen to enhance their subject areas.

Promoting technology-supported collaborative learning to prepare learners for the twenty-first-century workplaces when they are doing STEM, is the subject of this inquiry. In the future it is necessary that educational polices include teacher development, supplemental education, curricula, and testing and assessment tools. Developing countries like Mongolia, as they adopt or modify STEM education should consider traditional educational ways and their vision. For instance, STEAM in boarding schools may have their own traditional vision and implementation for unique creative outcomes. As these examples illustrate, there is a great deal of variability with respect to STEM policy objectives, and these variations in part reflect different economic, cultural and social contexts. Some policies seek to promote a positive image of science while others aim to increase public engagement with and knowledge of science, through increasing scientific literacy and understanding of the scientific method.

Policies aimed at the education sectors frequently focus on strategies to enhance student engagement in STEM. Policy may focus on some or all aspects of increasing participation and performance in school-based mathematics and STEM-disciplines. Policy may be aimed specifically at encouraging transition into the STEM labor-market. STEM curriculum may establish mechanisms for co-ordination across STEM-spirituality. STEAM curriculum may articulate long-term objectives, and also prioritize the shift from the adoption of foreign technologies to indigenous technological innovation with their traditional vision.

Some schools have acknowledged the emerging importance of meditation and inter-disciplinarily, including collaborations involving scholars from the humanities, arts and social sciences disciplines.

STEM education is becoming more of a focus as our world becomes ever more digital. STEM education and the respective fields should continue improving collaborations and multidimensional integrative expressions. The long term, and immediate goals are to provide students with modern tools, as well as the moral and spiritual strength needed to face the challenges of the modern world, and thus to evolve into society as conscious global citizens. By encouraging students to develop and maintain interest in STEM subjects, we prepare the next generation of researchers, engineers, scientists and programmers to meet the growing demands for qualified STEM professionals and prepare future professionals in all fields.

There are several cultural challenges that countries face when implementing long-term improvements in STEM. There is a need to extend the comparative analytic work of this study to pursue research that identifies the particular links between STEAM education, and the nature and needs of emerging work futures. We also need to understand better the links between STEAM education, research, and the economic wealth of a country and wellbeing of its citizens, along with their spirituality integrity and development. There is a need to more closely examine the relative roles of mainstream and vocational education in supporting STEAM, and the relationship between the varieties of work in STEAM in different economies, and the training needs that this implies. It might be said that STEAM educators can gain many insights that could help to solve negative issues through STEAM development for the 21st century, tackling such phenomena as stress, conflict resolution, nonviolent communications, etc.

This study proposes future research questions inquiring into better understanding the links between STEAM education, research, meditation and the economic wealth of a country and wellbeing of humanity. As all these fields and multidisciplinary approaches are refined in the educational ecology. Students and educators at the frontiers of the STEAMS nexus are brought to more profound and dynamics understanding and experiences of ourselves as integral cooperative expressions of nature, itself.

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