EDUCATION FOR SUSTAINABLE DEVELOPMENT: THE PRODUCTION OF TALENTED TEACHERS IN SCIENCE AND MATHEMATICS PROJECT

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ABSTRACT

The objective of this research in education for sustainable development is to find academic information for effective teaching and learning in the curriculum and to create educational sustainability. By using an exploratory research methodology, the surveyed data were compiled from science teachers who were students undertaking master's degree in the Production of Science and Mathematics Talented Teachers Project (PSMT) at a private university. The total of 28 participants in group interviews provided opinions by writing individual response on the study for sustainable development in four categories, consisting of 1) Curriculum management and instruction, 2) Participation of students, parents and communities; 3) Enhancement of culture and learning atmosphere; and 4) Development of teachers' and administrators' capabilities. The findings of the research revealed that the curriculum content improvement is required for learners to be able to apply their skills and experience into practice; the teaching and learning activities focus on giving students practical practice and opportunity to learn from actual objects in real situations; the appropriate individual teacher and staff development plans are to be considered; and culture and learning environment should be created to develop educational institutions and communities into a collaborative learning organization. The study concludes with results from this group of talented teachers' comments, which are important given academic information within education for sustainable development area as a substantial precedent and recommendations for future research.

Keywords: Education for Sustainable Development, Talented teachers, Science and mathematics teachers.

INTRODUCTION

With regards to the Sustainable Development Goals (SDG), the United Nations has launched its SDG since 2016 (UN, 2019), they are the blueprints planning to accomplish a better and sustainable development in future education for all. The ambitious set of seventeen Sustainable Development Goals is adopted to eliminate arduousness of a society as a whole by 2030. Though the people around the world are being closely acquainted with this 15-year SDG plan, but many of them especially who are in the education systems might not really know what they can do in practice and how to achieve when they are in their working environment and daily life.

The Sustainable Development Goals Report 2019 (ECOSOC, 2019) reveals that progress has been made for over past four years pertaining to a number of Sustainable Development Goals and their targets, and a number of actions have been undertaken by Governments and other stakeholders to respond to the 2030 Agenda more globally. However, the report also indicates

that progress has been on slow mode on many SDG, that the most vulnerable people and developing countries still suffer the most and that the global response has not yet been encouraged.

In Thailand, the ambitious action to achieve the Goals has been successfully at ASEAN (Association of Southeast Asian Nations) member countries level; according to the Sustainable Development Solutions Network (SDSN) implemented by Bertelsmann Stiftung, Thailand ranks 40th out of 162 countries surveyed on development progress relating to the UN's Sustainable Development Goals (SDGs) (Sachs et al., 2019). Its rank has been moving up 19 places from 2018. Thailand is presently the leader of the top five among ASEAN countries: Thailand 40th, Vietnam 54th, Singapore 66th, Malaysia 68th, and The Philippines 97th. The report also stated European countries, namely Denmark, Sweden, Finland, France and Austria, at the top of the global chart, while the last places lag in Madagascar, Nigeria, Congo, Chad and the Central African Republic.

Though the progress has been made in many countries in the past years, yet the advanced actions need to be identified. The country leaders need to usher with high speed the overall plans and actions within this decade how to achieve these Goals effectively by 2030 as set by UN-SDG (UN, 2015). In the meantime, many governments are under political and economic pressure to improve their performance to reach for higher rankings internationally.

The particular SDG Goal 4: Ensure inclusive and equitable quality education and promote lifelong learning opportunities for all; is the focal part of this study. Highly topical, climate change, unemployment rate, trade war and economic growth including quality education are the shared topics which draw the governments' attraction in the 21st century. Not to mention about the natural disasters that came around surprisingly such as the epidemic spreading into more than two hundred countries in various continents of the world (WorldOmeters, 2021), including those on most of front-page news of many countries over the blasts of bombs, guns shooting or terrorized actions. In search of a white knight, educational reformers now turn their attention to teachers, believing that if they could convince the best and the brightest graduates into the teaching profession, the quality of education would improve. But there was an argument that just having best and brightest teachers in schools might not help improve the quality of education automatically (WISE, 2020). On the other hands, if they could avoid global competition, designated teaching, baneful responsibility, but instead, all teachers should use their professional knowledge and skills in the best interests of their students (Gough, 2016).

From the aforementioned rationale, this exploratory research aims to find academic information from the participants who are the high competence teacher students in the special scholarship project for effective teaching and learning in the curriculum that will enable graduates to become school teachers and create educational sustainability for learners through the teaching of mathematics and science. The Production of Science and Mathematics Talented Teachers (PSMT) refers to the mentioned special scholarship project that emphasizes the production of physics, chemistry, biology, mathematics and computers teachers with talent in education in Thailand.

In phase 1 and phase 2 of the PSMT Project, those groups of teachers were highly knowledgeable and able to extend knowledge into the special science schools holding International Science Olympiads which identified the school's academic leader in improving and enhancing the quality of teaching and learning in science, mathematics and computer (IPST, 2021). In recognition of the important role of Education for Sustainable Development (ESD), Suryadhep Teachers College of Rangsit University, one of the academic institutes

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provided education program for PSMT project, aims to explore the academic information from the project participants in order to use the information obtained in the pedagogical management and create the concept of the stakeholders in educational management for sustainable development.

BACKGROUND AND LITERATURE REVIEW

In the provision of education for the successful development of global citizenship, the development of global citizenship can be divided into four concepts: 1) Curriculum and instructional management, 2) Participation of students, parents and communities, 3) Enhancing the culture and learning atmosphere, and 4) the development of teachers and administrators' potential (Pratumsuwan, 2019). This study, therefore, seeks the data in accordance with the aforementioned four concepts and combines them with previous research and summarizes them as guidelines for the management of education for sustainable development to be in line with the Education Sustainable Development (ESD) for 2030. Distinctively, ESD focuses on education at all levels to support the achievement of the Sustainable Development Goals (SDG) (UN, 2015), whereas to achieve the objectives and values of SDG, multi-stakeholders in education have to promote and strengthen all activities in education to accerelate the sustainable development. To build sustainable world through education, the policy-makers, institutional leaders, learners, parents, educators, youth and communities are the important elements of the global target groups which can do strengthening ESD to contribute to achieve the SDG (UNESCO, 2020). To achieve the goals, the five priority action areas are seriously considered, they comprise 1) Advancing Policy, 2) Transforming learning environments, 3) Building capacities of educators, 4) Empowering and mobilizing youth, and 5) Accelerating local level actions (GAP, 2021). The other main areas synthesized from previous related research and international experts, three main areas of challenges many developing countries have faced in supporting teacher development are the weak subject content and pedagogical knowledge, and classroom skills; the poor quality pre- and in-service teacher training, and inadequate standards, certification and accreditation procedures; and the lack of ongoing support from head teachers, schools and districts.

Despite the considerable progress on education development and educational sustainability over the past years, the Education Commission (2016) suggests how to advance the teachers and their work improvement, by referring to previous research and progressive countries, the actual mechanism are 1) Quality of support to teacher development, 2) Teaching methods and learning materials that are sufficient and aligned to the context, and 3) Strengthening systems for recruiting, managing and engaging teachers (GPE, 2019).

From a synthesis of the research studies in ESD, the holistic of teaching and learning approaches enhance the cognitive, social and behavioral aspects of learning, despite the transformational in curriculum and pedagogical both internal and external collaborative teaching, it provides quality education in a description of behavioral dimensions of learning and it also encompasses learning content and outcomes, pedagogy, attitude change, and learning environment (Hermann and Bossle, 2020; Filho and Dahms, 2018; Hoffmann and Siege, 2018; Vladimirova and Le Blanc, 2015; Wals, 2012; Arbuthnott, 2009).

RESEARCH METHODOLOGY

This exploratory research presents the results of the academic information for effective teaching and learning in the curriculum that will enable graduates to become school teachers and create educational sustainability for learners through the teaching of mathematics and science. The data collection was gathered by combining the evidence from previous research

studies on the relevant issues and the data collected from participants of the Master's degree in teaching science program at Rangsit University in the academic year 2017-2018. Group interviews conducted with 28 participants, the interviewees gave individually their opinions in writing about their perception and expectation on the Education for Sustainable Development topic on "what factors that contribute to sustainable development for future science and mathematics teachers would be".

From a synthesis of the research evidence combined with their answers, the results would be categorized into four issues consisting of 1) curricular and teaching management, 2) participation of students, parents, and communities, 3) strengthening the learning culture and atmosphere, and 4) developing the potential of teachers and administrators. In combination with participants' interview response, the evidence of previous research on sustainability studies on a number of topics, and consultations with three experts, an expert focus group meeting was conducted to consider the results of the content analysis. Consideration is given to obtain the conclusion of the research.

RESEARCH RESULTS AND DISCUSSION

The results of this research are presented from content analysis derived from interviews and group meeting of experts. The research findings are classified into four concepts in sustainability development, namely 1) Curriculum management and instruction, 2) Participation of students, parents and communities, 3) Enhancement of learning atmosphere, and 4) Development of teachers' and administrators' capabilities in the following order:

1. Curriculum Management and Instruction

The results showed that Curriculum Management and Instruction should focus on practice rather than memorizing; for instances, experiments should be conducted by learners in order to try on their own; the experiments with content consistent with the curriculum; learners should have searching ability to find related information for the lessons they learn for a better understanding; learners can apply these skills to higher education and use them in daily life and work. Learners will be able to plan their future and create critical thinking by using it as brain-tease to train their brains to think systematically so that they can solve problems. Teachers create a situation for students to learn and adapt to it since a good adaptation to the environment contributes to self-development.

In this curriculum management and instruction issue, the findings suggested that new teaching techniques should be appropriate with the subject contents, such as STEM (Science, Technology, Engineering, and Mathematics). Teaching with successful examples, scientists or prominent people who have successfully solved social and environmental problems by showing learners with documentaries, this will guide students with lifelong learning skills as well.

Teachers consider individual differences and encourage learners to find their talents or special abilities.The last point is to study from real social and environmental conditions with field trips to promote sustainable development in the environment. The research findings are consistent with Ngourungsi's notion that sustainability studies can only happen when good management involves in course administration, teacher competency development, and providing opportunities for larners who lack opportunities and stay outside the education system. As for the course administration, whether it is basic, vocational, or higher education, it should stress on a curriculum that has a complete learning content, reducing global warming, cultural diversity of the world's population. In addition, according to Ungkanawin's discussion, updating textbooks in accordance with the curriculum, teachers training to gain knowledge and skills in accordance with their instsruction, improving the classroom

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environment including the laboratory, and teaching equipment in accordance with the lesson and curriculum are also addressed (Hermann and Bossle, 2020; Filho and Dahms, 2018; Ngourungsi, 2016; Ungkanawin, 2017).

2. Participation of Students, Parents and Communities

Integrated classroom teaching provides socio-economic and environmental context linkages, it seeks to link the content taught about society and the environment, which will be one of the contributing factors to the success of sustainable development for students, communities and the nation. Moreover, raising awareness of environmental conservation while pointing out the negative impacts of environmental destruction or disasters, the suitable projects are considered as beneficial to the public and can encourage students to think critically and apply the knowledge gained from the lessons to their daily lives. Learners will learn from real practice at the same time allowing students build their own body of knowledge. Besides, building a network of partners to foster parent and community collaboration will help build educational plans for schools. Emphasis is placed on creating educational plans with the same goal of providing education for sustainable development, starting from communities near schools (Sterlling & Huckle, 2014).

The findings are consistent with Siritharangsri's and Eramus's ideas that sustainability education must be learned in normal or vocational programs to understand local roots of the religion and culture including healthy behavior, global knowledge, being global citizen with honest career and peace, they can lead to higher student achievement. In addition, participation of all sectors is required in the public and private sectors, local government organizations, religious institutions, and enterprises. Participation means joint thinking, joint planning, joint decision making, and joint working, including sharing responsibility, to participate in monitoring, evaluation, problem solving and appreciation (Erasmus, 2020; Siritarangsri, 2012). This concept is also in line with Kaewyai (2017) and Iwaniec et al. (2014) who stated that the sustainable development goals in the 21st century are happiness, peaceful and justice society which supported innovation for human being in changing world. Another characteristic is balance or in other words to make human activities in line with the laws of nature, which if educational institutions can cooperate at all stages, it will definitely benefit the community and society at the same time, teachers and students will have a real understanding of teaching and learning together.

3. Enhancement of Culture and Learning Atmosphere

Science teaching should include projects and activities that result in cultivating both teachers and students to be educated people to continuously seek for knowledge. They have ability to use a systematic search method developed from scientific process, scientific attitude and scientific process skills. The details of these three skills are outlined in the related research according to the participants' suggestions as follows:

1- Scientific Process

Scientific method consists of five steps of the scientific process as follows: Step 1, set the problem; Step 2, collect data; Step 3, Specify hypotheses; Step 4, Experiment and prove; and Step 5, Summarize results, and then projects and activities will result in the development of scientific process skills.

2- Scientific Attitude

Science attitude is a fundamental element in the pursuit of scientific knowledge that allows access to science and technology principles. And it is one of the important things to be

cultivated as a regulator of thought, action and decision-making in scientific practice. Enhancing culture and learning atmosphere will create a body of knowledge in educational institutions and will be a role model to the community and society around. It will also develop those who are not in the education system and lack opportunities to have equality and reduce inequality. By providing education to learners who are in non-formal education to have opportunity to learn, teaching regularly and continuously can be transmitted by using appropriate technology to create a learning society structured with science attitude (Arbuthnott, 2009; Ngaoraysi, 2016).

3- Scientific Process Skills

Scientific process skills consist: observation, measurement, classification, quantification, inferring, predicting, relationships, communication, data interpretation, variables controlling, operational definitions, hypothesizing, and experimenting. Based on science process skills, teachers are encouraged to use specific skills that can be transferred, highly accepted in many fields of science, and reflect the behavior of scientists; these skills are described as the ability used by scientists used during their work, and the competencies displayed in solving scientific problems. The findings from the participants' comments are consistent with Padilla (1990) who described years ago that teachers needed to select curricula which emphasized science process skills. In addition, they needed to capitalize on opportunities in the activities normally done in the classroom. While not an easy solution to implement, it remains the best available at this time because of the lack of emphasis of process skills in most materials. Recommendations from the results provided to supporting enhancement of culture learning atmosphere in classroom teaching, teachers should certainly have most of the science process skills.

A set of these intellectual scientific skills are basic and integrated processes for science teachers to apply to improve their culture and learning environment.

4. Development of Teachers' and Administrators' Capabilities

The findings revealed that an important factor in creating and developing sustainability in education is the development of the potential of teachers and administrators. Teachers must extremely develop themselves in terms of experience, knowledge and teaching. As critical thinking and problem solving skills can develop the knowledge and ability of the instructor. Teachers are dedicated to continually raising their capabilities in both work and life skills for the quality of students and for the sustainable development of the educational system. Administrators must promote teachers teaching through self-improvement. There is always something new to learn to create a learning process for students. Therefore, knowledge is not only available in the classroom; students learn the lessons closely, realize the importance of energy conservation and love their homeland. The teacher potential development is in line with Ngourungsi's concept that teachers and learners should be developed to be competent in various fields such as analytical thinking, desirable future planning, decision making in harmony with others and the environment, developing a body of knowledge related to phenomena and changes in the world (Ngourungsi, 2016). In terms of changing in teachers' attitudes in ESD, the research found that the development of changes in teacher behavior, especially in teaching management, was associated with negative attitudes and work behaviors. Working too hard will result in failure, thus development should be a specific individual development and must support facilities, especially technology. Several factors in addition to attitude influence behavior include contextual support, social norms, action difficulty, and habitual behavior. Thus, if attitude change is to translate into altered behavior, education must extend beyond attitudes to assist people to act in ways consistent with their

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values. Therefore, educational institutions must analyze and formulate individual development plans appropriately (Arbuthnott, 2008).

RECOMMENDATION

Additional suggestions from this Sustainability Development study, the researcher would like to propose issues for future research studies as follows:

1. Teaching science and mathematics subjects that will affect sustainability studies should focus on adapting the content of the curriculum to be relevant to daily life and to the overall socio-economic condition, activities teaching focus on giving learners practical practice, and visiting the actual situation. For educational institutions, they should have plans or guidelines for activities teaching as well as for adjusting teaching behaviors and using educational innovations that are suitable for the subjects, either in science or mathematics, such as using problem-based teaching methods (PBL), using STEM teaching methods, etc. Especially, workshops should be condidered including knowledge and experiences sharing.
2. Teaching and learning activities for sustainable development should be analyzed in the general context of educational institutions. Nevertheless, the community and surrounding society have enough information to formulate development guidelines and work plans, but care should be taken to formulate because it is difficult to make teachers and practitioners think that it is not feasible and a barrier to work. A practical program is recommended to encourage teachers to have a positive attitude towards change and development, and to provide individual feedback to teachers and practitioners. Additionally, individual human resource development plans will further promote educational sustainability.
3. Determining rules and guidelines will be another important factor in ESD because it will allow the organization to have guidelines and goals to work together, not just for each individual. An incentive system or awarding for both social motivation and monetary incentives are introduced such as the outstanding teaching award in promoting sustainability. Social motivation promotes willingness to work, awareness of the obligation and all of which can be linked to the creation of academic works of teachers as well.
4. The recommendation is to take into account that the creation of ESD through participation of schools, teachers, students, parents and communities cooperation will result in the understanding of all stakeholders having awareness, values and attitudes. The shared sustainability which will cause the characteristics of all involved people to be global citizens is in line with the research of Pratumsuwan (2019) that teaching and learning management engaged with the community will cause change and create a body of knowledge, skills, values and attitudes of learners and have the characteristics of being a good citizen. The details of building cooperation include steps starting from educational institutions to organize a community with stakeholders in the community, to come up with ideas and set guidelines, to decide on activities plan for action together to solve problems, contextual change and personal behavior management plans. Regarding the performance assessment that shows successful and good results, it should be honored, rewarded and taken to develop lessons and good practice.
5. This recommends a future research to find a guideline for the performance of the school administrators in determining the vision and work plan, including important

characteristics, and to study the factors that will contribute to the efficiency and effectiveness of ESD in school context in accordance with the government policy.

CONCLUSION

ESD has double implications: Education for Sustainable Development and Sustainable development in education and research. This research implication addresses only studies that contribute to Education for Sustainable Development within the PSMT project which produces science and mathematics talented teachers. The scope of this research for ESD consists of 4 issues: 1) Curriculum management and instruction, 2) Participation of students, parents and communities; 3) Enhancement of culture and learning atmosphere; and 4) Development of teachers' and administrators' capabilities. This study points out the importance of management and participation of communities and society, and creating teaching and learning atmosphere which plays important role in ESD curriculum at different levels of education, whether it is basic education, vocational or higher education. The competencies development of teachers and learners on analytical thinking and future imagination in teaching activities is an important part of choosing the right teaching innovations, or teaching techniques suitable for sustainable education in a particular country. The related research results showed that the use of problem-based teaching (PBL) technique was appropriate and consistent with the results of this research.

In the management of teacher and administrators competencies development, educational institutions should focus on the preparation of appropriate personnel development plans on an individual basis in order to develop personnel's knowledge. Skills and good attitudes towards the development of education towards sustainability for social community engagement should be emphasized so that all stakeholders have developed to the point of being a good member of society to coexist with others. Developing a body of knowledge about phenomena and changes in the world, in addition, the education system must focus on those who are outside the system and those who lack educational opportunities, thereby supporting equality in education and building sustainability.

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