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REVIEW ARTICLE

MySTREAM: EMPOWERING 21ST CENTURY SKILLS THROUGH TRANSDISCIPLINARY AND SUSTAINABILITY TECHNIQUES

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ABSTRACT

Sustainability Education (SE), Education for Sustainable Development (ESD) and Education for Sustainability (ES) are the terms commonly used to describe the practice of teaching for sustainability. SE requires participatory teaching and learning methods that motivate and empower students to change their behaviour and play role in embracing concept of sustainable development. SE promotes competencies like critical thinking, imagining future scenarios and making decisions in a collaborative way. These competencies can also be applied for sustainable research since education and research are interrelated. To develop SE, it may be relevant to address the sustainable development in the curriculum or syllabus. The three pillars of sustainable development; environmental, economic and social might be used and adapted in academic and research disciplines. There is no specific pedagogy for SE, but there are several elements that can be adapted in the teaching environment such as critical reflection, systemic thinking and analysis, participatory learning, thinking creatively for future scenarios and collaborative learning. For instance, transdisciplinary research in assessing environmental performance of pollutants can be practised by extending the research including the impact pathway of the pollutants on economic growth, society well-being (human health) and awareness level of community. Transdisciplinary research not only look at one specific discipline, rather than look at the issue from a holistic perspective by establishing the linkage between environmental aspect with social and economic aspects. Transdisciplinary research also requires triple helix effort by strengthening government-academia-community relationship. This will help to inculcate different stakeholders with a sense of duty towards safeguarding human health and environmental stewardship. Thus, the SE can be established through transdisciplinary research which integrate and move beyond discipline-specific approaches to address a common problem.

KEYWORDS

Sustainability, 21st century skills, pedagogy, transdisciplinary, quality education.

1. INTRODUCTION

MySTREAM is an educational approach that uses Science, Technology, Religion, Engineering, Art and Mathematics to produce 21st century students, researchers, educators and leaders. Instead of focusing on standardized test scores, the MySTREAM program emphasizes on honoring learning processes that emphasize 21st century skills including communication, exploration, understanding, applications, creation, synthesis, collaboration, critical thinking, problem solving, creativity and innovation. The MySTREAM approach inspires the younger generation to think and act like scientists, build like engineers, design like technologists, create contexts like a mathematician, create and creativity like an artist and most importantly believe in a single divine concept and personal identity.

In line with the emergence of the Fourth Industrial Revolution agenda, MySTREAM placed demands on integrated knowledge and application of knowledge innovation to transform learning habits according to the Education 4.0 framework. There is a need for education transformation by empowering education to develop innovation as targeted under Education 4.0. MySTREAM emphasizes aspects of modern learning and teaching in line with the urge of the 21st century through the transfer of knowledge in the field and involves intervention activities rather than basic theory in the classroom.

Sustainable Education, Education for Sustainable Development and Education for Sustainability are commonly used terms to describe teaching practices for environmental sustainability. Sustainable education requires participatory teaching and learning methods that encourage and empower students to change their behavior and play a role in fostering sustainable development concepts [1]. Sustainability education involves competencies such as critical thinking, imagining future scenarios and collaborative decision making [2]. This ability can also be used for sustainable research because education and research are interrelated. Sustainability education should be developed and introduced in the curriculum or syllabus so that it is relevant to the current environmental situation that must be maintained and maintained to achieve sustainable development goals (SDGs). The three main pillars of sustainable development are environmental, economic and social that can be used and adapted in academic and research fields.

Figure 1 shows the elements of the teaching environment involved in capacity building in different categories and levels. Student involvement in the MySTREAM program was conducted through field activities based on Guided Learning theory [3]. A series of community-based learning for sustainability education has been conducted for school students since 2014 by the SEMrg Research Group led by Marlia Mohd Hanafiah from the Faculty of Science and Technology, UKM. Therefore, this study aims to

strengthen education and sustainability science for school students and evaluate how community-based programs such as MySTREAM reflect 21st century skills.

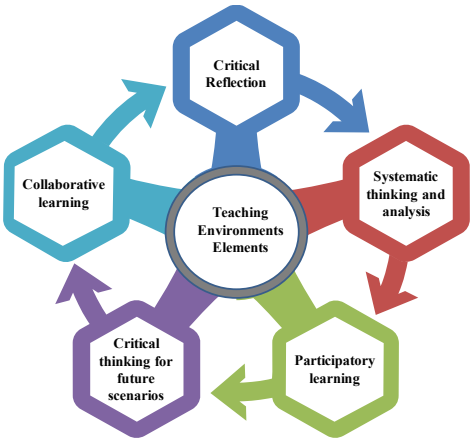

Figure 1: Elements in teaching environment

2. CONCEPTUAL FRAMEWORK OF MySTREAM

MySTREAM stands for Science, Technology, Religion, Engineering, Art and Mathematics (Figure 2). To integrate art and science, STEM (Science, Technology, Engineering and Mathematics) approaches need to be combined with art to translate holistic education. However, the integration of art into STEM is not sufficient. Another important aspect is that the faith or belief that is established in religion also needs to be integrated into STEM. The MySTREAM program also covers sustainability education by integrating sustainability and cross-disciplinary activities.

Figure 2: MySTREAM logo

The concept of MySTREAM was introduced to students and the community using a pendulum to explain the concepts of energy transfer such as kinetic energy, gravity, mechanical energy and potential (Figure 3). As shown in Figure 3, no movement is involved at the highest swing point. At this point, it only has gravity. However, when it decreases as the speed increases, the potential energy is converted to kinetic energy. At the bottom, energy refers to kinetic energy because of its highest speed. As it turned to the other side, its height increased. In this new position, the pendulum loses kinetic energy and regains gravity. The pendulum is positioned at the top of its swing and thus exhibits a continuous pattern of energy transfer. Assume the pendulum (mass ball, m) is suspended by a long string L drawn so that the ball is the height H <L above the lowest point. When it is released from the rest position, how quickly it returns to the bottom can be measured through Equation 1:

$$E_i = mgH + (0) = (0) + 1/2mv^2 = E_f \quad (1)$$

$$v = \sqrt{2gH}$$

Equation 1 explains that in a vertical position, the pendulum reaches the largest kinetic energy and the least potential because of its greatest velocity and closest to the Earth at this time (based on conservative gravity). On the contrary, the pendulum has less kinetic energy and the highest potential at the highest position due to zero speed and the farthest position from the Earth at this time. If the amplitude is limited to small changes, the time (T) taken for the complete cycle is:

$$T \approx 2\pi\sqrt{L/g} \quad (2)$$

Where the longitudinal g is the acceleration of gravitational space. For small changes, the swing duration is approximately the same for different size changes indicating that the duration is independent of amplitude.

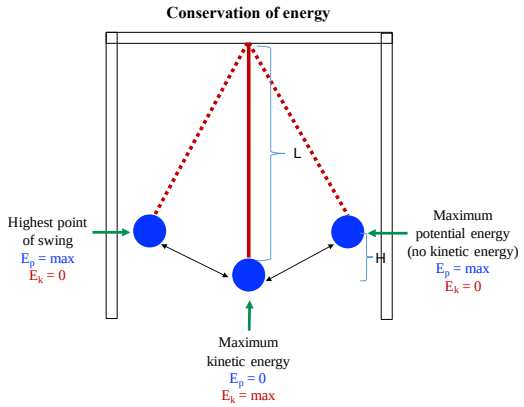

Figure 3: Energy conversion concept

Interview surveys (face-to-face studies) were conducted to obtain feedback from participants regarding MySTREAM activities. This survey method was used to target specific respondents (students and teachers). The results of this survey were used to explore respondents' responses to gather more in-depth information about sustainability education in the 21st century through the transition of STEM to STREAM learning. In this review, respondents' attitudes and behaviors towards activities performed under MySTREAM were observed and analyzed.

3. INTERVENTION RESULTS

3.1 Sustainability education in 21st century skills through community-based learning

The MySTREAM program was introduced in 2016 during the environmental sustainability program (MyKAS) held in Rembau District, Negeri Sembilan, Malaysia. It involves 500 high school students from 20 schools in Rembau District. Recently, in November 2018, the MySTREAM program was introduced to around 1,200 students during the SEMARAK@Society program, a community-based program organized by the Faculty of Science and Technology, UKM (Figure 4). Based on the survey conducted, it was found that the majority of respondents (> 90%) understood the need to integrate arts and religion in teaching STEM to reflect the 21st century skills to provide our future generation with important fundamentals such as critical thinking, smart risk assessment, involvement in experiential learning, continuous problem solving, teamwork and creative and innovative. The impact of MySTREAM has positively impacted the community by promoting greater awareness of the importance of knowledge on environmental sustainability and the transdisciplinary approach to 21st century skills and learning [4]. The results of the MySTREAM program intervention also revealed new scientific knowledge on the concept of sustainability and Education 4.0 gained by participants.

Figure 4: MySTREAM hands-on program

The MySTREAM Program contributes to increasing students' and community's understanding and awareness to achieve sustainability through skills and knowledge. The findings from this science-based

program translate the efforts of SMEs in general and FST in particular to contribute to community-based programs through teaching, learning, research, campus operations and governance. In order to achieve sustainability excellence, MySTREAM also contributes to effective outcomes as shown in Table 1.

Table 1: Outputs from MySTREAM intervention

No.	Output
1	Facilitates active participation of the University community in promoting STREAM approaches, through formal and informal approaches.
2	Build a culture of environmental citizenship in the University and the local community.
3	Together with researchers, undergraduates and graduates who serve as facilitators to ensure the involvement of all levels of community-based programmatic expertise.
4	Active marketing courses and programs offered by the Faculty of Science and Technology (FST), UKM as one of the best research universities in Malaysia.
5	Actively promotes the FST initiatives and ensures that the faculty is properly recognized for all its efforts.

4. CONCLUSIONS

In conclusion, the MySTREAM program introduced through sustainability education, focuses on transdisciplinary knowledge for 21st century learning. This community-based program can integrate art and science through participatory teaching and learning methods that motivate and empower students to change behaviors and play a role in understanding sustainable development concepts. At the end of the activity, the MySTREAM program is able to teach students to look at issues from a holistic perspective by establishing relationships between various aspects and disciplines. The results of the intervention indicate that there is no specific pedagogy for advanced education, but there are some elements that can be adapted to the teaching environment such as critical reflection, thinking and systemic analysis, participatory learning, creative thinking for future scenarios and collaborative learning. For example, transdisciplinary research in assessing environmental pollution can be carried out by engaging in environmental pollution impact research on economic growth, community well-being (human health) and community awareness level. Transdisciplinary research not only looks at one specific discipline but examines issues from a holistic perspective by establishing a link between environmental and social aspects. Transdisciplinary research also requires the efforts of various stakeholders to strengthen academic-community-government relations. This will help to instil a sense of responsibility by various stakeholders towards improving human health and environmental quality. Thus, advanced education can be implemented through transdisciplinary research and education that integrates and moves beyond disciplined approaches to addressing environmental issues in the 21st century.

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