

EXEMPLARY PRACTICES IN SEARCH FOR YOUTH SCIENCE AND MATHEMATICS RESEARCHERS (SERIES 4): ‘SEARCH FOR SEAMEO YOUNG SCIENTISTS’ (SSYS)

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Abstract

Science learning is at its best when questions, issues or authentic problems are posed that motivate students to find solutions through investigative research and inquiry-based learning. Literature also revealed the enormous benefits of informal and out-of-school learning experiences in stimulating and captivating students’ interest to learn science and mathematics especially when they work on authentic community problems. In this fourth series of the article on exemplary practices in SEARCH for youth researchers through blended learning, elaboration will be made on another sub-portal of SEARCH, entitled ‘Search for SEAMEO Young Scientists’ (SSYS) [<http://www.recsam.edu.my/ssys>]. The SSYS programme was founded in 1997 with organization of biennially held science congresses at SEAMEO RECSAM, a regional training centre for Science and Mathematics Education in Southeast Asia, that organized this youth scientific programme to showcase research findings among young researchers. SSYS serves as platform for exchange of ideas and presentation of investigative projects by student delegates who were coached and accompanied by teacher delegates from SEAMEO member countries and beyond. The event was also promoted through blended learning platforms since 2006 using Facebook social networking site and the closed forum of ‘Science Project/problem-based Activities in Incorporating Activities Management’ (SP3ACEMAN), a blended learning platform that was introduced in third series of the article in SEARCH for youth researchers. This article presents the authors’ experiences in organizing the SSYS congresses since 1997. A brief account of the types of research projects and the events in the congress will be elaborated with some highlighted projects that were archived in SP3ACEMAN forum site. Two model research projects that reflect experiential science and mathematics learning as well as the benefits derived will also be presented as case studies. Educational implications and future directions will likewise be explored.

Keywords: Learning beyond classroom; Authentic science and mathematics learning; Science congress

Introduction

The knowledge of science and technology is utilised everywhere and influences the quality of human's living every now and then. The recent information explosion and technological breakthroughs resulted by numerous efforts made through scientific researches and inventions on health and medicine, agriculture, as well as in Information and Communications Technology (ICT) have in fact impacted the life of many people in the society. However, some parts of the society with limited exposure particularly those with out-group membership of social and political communities still lack the basic literacy especially the understanding of the current controversial issues haunting human's existence. Among these issues include climate change, pollution and environmental degradation, positive and negative aspects of ICT, as well as technological fall out or conflict, to name a few. As a result, society's perceptions on these controversial issues are largely influenced by the prevailing perceptions dominant in their social and political communities whether they possess in-group or out-group membership. Every government must equip the citizens with scientific and technological literacy (STL) to meet the challenges of the 21st century. But the responsibility to increase the awareness and understanding of the population of the current as well as relevant issues and problems should not rest solely to the formal education sector.

Educational institutions could not fully carry out these tumultuous tasks. Hence Science and Mathematics Institutes or Centres are established in many countries to assist in educating the population through programme initiatives to complement formal science learning. This article reports the fourth of a series of some completed and on-going blended learning activities facilitated through the web-based learning portal entitled 'South East Asia Regional Capacity-enhancement Hub' (SEARCH) [<http://www.recsam.edu.my/search/index.html>]. Evidences of exemplary practices in SEARCH for youth researchers supported by blended learning activities will be illustrated on another sub-portal of SEARCH, entitled 'Search for SEAMEO Young Scientists' (SSYS) [<http://www.recsam.edu.my/ssys>]. The role of SEAMEO RECSAM as a regional training centre in promoting informal science learning through SSYS Congress will also be deliberated. Case studies are further elaborated on how the organization of biennially held SSYS events had directly or indirectly empowered students through scientific research projects that would lead to the development of scientific literacy in the Southeast Asian region (Mangao & Ng, 2014; Ng, 2010, 2012).

Research Questions

This paper seeks to answer the following questions:

- (1) What exemplary practices have been made by SEAMEO RECSAM as the organiser of the SSYS event in promoting science literacy in the Southeast Asian region?
- (2) What are the evidences of SSYS towards empowering students to acquire scientific and technological literacy through science and mathematics research projects?

Programme Brief, Activities and Exemplary Practices

Background of SEAMEO RECSAM's Search for SEAMEO Young Scientists (SSYS): An Initiative to Promote Science Literacy in the Region

The Southeast Asian Ministers of Education Organisation (SEAMEO) – Regional Centre for Education in Science and Mathematics (RECSAM) is one of the 21 centres established by SEAMEO and is located in Penang, Malaysia. SEAMEO RECSAM is mandated to enhance teachers' teaching competence through training as well as research and development (R&D) activities. RECSAM organizes the 'Search for SEAMEO Young Scientists' (SSYS) as a

regional congress to provide a platform for intellectual and social interactions among student researchers and educators in the Southeast Asian region and beyond. It is conducted in a form of science congress/fair or exhibition for the students to share ideas and experiences as well as disseminate information related to their scientific and mathematical research pursuits.

Objectives of SSYS

The SSYS is envisioned as a worthy intellectual venture and an effective medium to promote lifelong scientific and mathematical values, interests, skills, attitudes and motivation among the youth. Specifically, SSYS aims to: (a) encourage research and development in science and mathematics among young learners in SEAMEO and Associate Member countries; (b) provide a forum for the exchange of ideas and experiences among students in SEAMEO and Associate Member countries; (c) provide a venue for intellectual and social interactions among students and educators; and (d) identify and give recognition to outstanding youth science and mathematics researchers.

The SSYS Themes

Each SSYS event year adopts a theme from which student research projects is based upon. From the 1st to the 4th SSYS congress the theme delved on interactions of Science, Technology, Environment and Society. From the 5th until the 9th SSYS congress, the theme focused on Education for Sustainable Development (ESD). The theme for each congress that is held biennially is listed in Table 1.

Table 1

SSYS Theme by Year

No	Year	Date Conducted	Theme
First	1997	20-22 October 1997	Conserving the Environment Through Youth Science Research
Second	1999	5-7 July 1999	Technology for Us
Third	2002	4-6 March 2002	Creating Intelligent Cities for the Harmonious Societies of the New Millennium
Fourth	2004	8-10 March 2004	Towards a Sustainable Future
Fifth	2006	6-10 March 2006	Sustainable Development for a Better World
Sixth	2008	3-6 March 2008	Sustainable Community Development Through Science and Mathematics
Seventh	2010	2-5 March 2010	Sustainable Solutions for the Local Community
Eighth	2012	6-9 March 2012	Beyond 2012: Greening the Environment for a Sustainable Future
Ninth	2014	3-7 March 2014	Disaster Risk Reduction (DRR) for Sustainable Development

The SSYS Student Researchers

The SSYS delegates were composed of officially enrolled secondary or pre-university students in the 15-19 age-groups from the SEAMEO and Associate member countries. They can join as official representative of their Ministries of Education or as fee-paying participants. The total number of student researchers participating in the SSYS since 1997 until 2014 is presented in Figure 1.

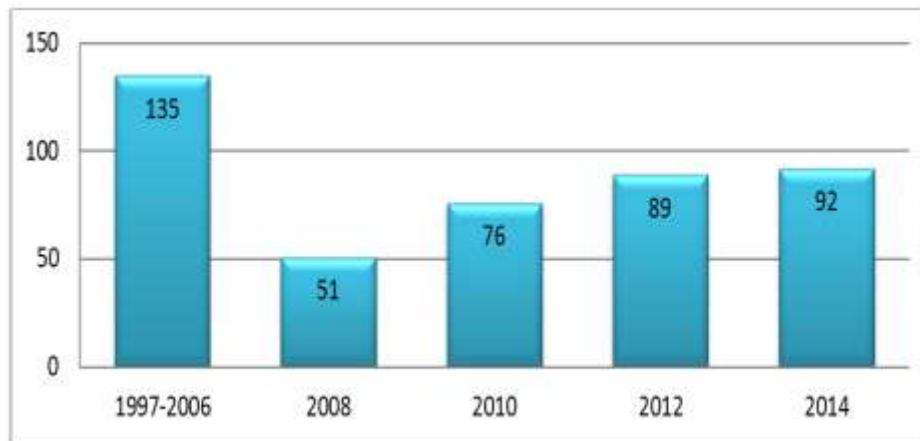


Figure 1. Number of students participating in the SSYS since 1997.

Number of Science and Mathematics Research Projects

The number of the research projects from each SEAMEO and Associate member countries from the 1st SSYS to the 9th SSYS is presented in Figure 2.

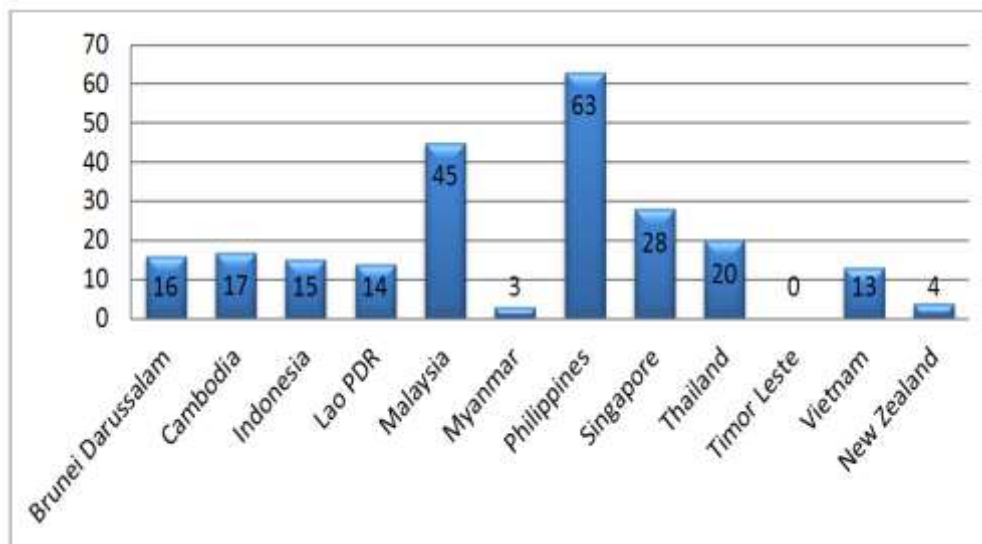


Figure 2. Total number of research projects by country since 1997 to 2014. (Ng, 2006, 2012; Ng, Sarmiento, Cheah, & Wahyudi, 2006)

The Field of Study, Nature of Research Design and Types of Research Samples

The students' research projects are related to the application and the integration of knowledge in Basic Science (Biology/Chemistry/Physics, General Science) and Mathematics with Technology, Environment or Health. The research design employed by the student researchers in the projects may be categorised as pure experimental, quasi-experimental (controlled/uncontrolled), and non-experimental or the observational and intervention studies (as shown in Figure 3).



Figure 3. Project exhibits presented during the SSYS congress.

In terms of research samples, plants are frequently used as specimen in the science research projects together with other organic and inorganic substances as analysed and reported by Ng et al. (2006) as well as Sarmiento, Ng, Cheah, and Wahyudi (2006). Biological organisms and organic substances were frequently used as experimental samples for the fact that these are endemic to the community, inexpensive and familiar to the students. Mathematics and ICT-based projects include the use of algorithm, theorem and proof in solving problems, use of simple statistical tools in quasi-experimental research, create geometrical figures; use of optimization in a 2-dimensional structure to maximize the given space; application of Fibonacci sequence; utilizing computer modeling in wave refraction, digitizing software in getting values and shape file in Deutsche Gesellschaft fur Internationale Zusammenarbeit (GIZ) software; and using software to solve problems in geometry (Mangao & Foo, 2009).

Major Events in the SSYS Congress

The main highlight of the SSYS event is the presentation of scientific research findings of the students to their co-student researchers and to the panel of judges. The activities for the 3-day event usually include the following: (a) setting up of project exhibits; (b) a formal opening ceremony; (c) presentation of research projects to the public; (d) judging of project exhibits and interview by the judges; (e) science public forum; (f) public viewing of exhibits; (g) face-to-face and on-line networking session; as well as (h) awards presentation ceremony and cultural presentation.

SSYS Projects: Empowering Students' STL through Authentic Community Problems

Small-scale student research projects are means of involving young people in scientific inquiry process which will inculcate their appreciation and interest in science and eventually leads to acquisition of scientific literacy. The two case studies (one science and one mathematics) presented below exemplify authentic problem-based learning (PBL), project-based activity (PBA) and authentic community problem approaches which the young scientists have investigated that contributed to the development of scientific literacy.

Case 1: An Exploratory Study on Coral Assemblage Establishment and Artificial Reef Enhancement in the Municipal Waters of Anilao, Iloilo, Philippines through Coral Transplantation

Objectives of the Project

The student researchers investigated whether the two Genera of corals *Stylophora* (Figure 4) and *Acropora* (Figure 5) coral fragments will survive and grow when transplanted in concrete artificial and bamboo artificial reefs. In addition, their investigative projects were aimed at the following: (a) determine the percentage survival of corals in the two artificial reefs; (b)

determine coral transplant growth in terms of projected circular area; (c) compare coral transplant growths in different times within the 11-month period; and (d) determine water characteristics such as water temperature, salinity, transparency and suspended solids.



Figure 4. *Stylophora* coral fragments after transplantation.



Figure 5. *Acropora* coral fragments after transplantation.

Summary of the Research Project

This study determined the percent survival and growth of *Acropora* and *Stylophora* coral fragments transplanted on 75cm x75cm x75 cm concrete and bamboo artificial reefs (AR) from February to December 2011 as reported by Mangao et al. (2013). Percent survival of the transplanted corals after 11 months showed that *Acropora* transplants on concrete and bamboo artificial reefs decreased to 35% and 15% respectively. For *Stylophora* transplants, percent survival decreased to 65% in the concrete artificial reefs and 35% in the bamboo. Growth in terms of the projected circular area (PCA) was determined from the width and length of the coral transplants represented by the formula, $(PCA = [(\sqrt{\text{Length} \times \text{Width}})/2]^2)$ and was compared at the beginning, first mid, second mid and end of an 11-month period. Results revealed that Mean PCA of *Acropora* transplants on concrete AR remained almost the same ($53.2\text{cm}^2 - 59.7\text{cm}^2$) while those on the bamboo AR decreased with time ($40.8\text{cm}^2 - 25.5\text{cm}^2$). *Stylophora* transplants grew on both concrete ($63.2\text{cm}^2 - 121.6\text{cm}^2$) and bamboo ARs ($53.9\text{cm}^2 - 107.1\text{cm}^2$). Other findings included water temperature ranged from 29 °C to 32 °C, salinity was constant at 35ppt, water transparency ranged from 2.5cm-5.6cm, and suspended solids ranged from 0.067g/L-0.152g/L throughout the duration of the study. Finally, results of this experiment indicated that coral transplantation using *Acropora* and *Stylophora* fragments on concrete and bamboo artificial reefs is viable.

Case 2: An Application of an Electronic Counter to the Silk Thread Spinning (A Mathematics Research Project from Cambodia)

The project grew out of a problem in the community in the silk weaving industry in Cambodia and highlighted the concern about the wastage of silk thread during the weaving process. The objective of the project was to introduce a simple method to determine the length of silk thread as is needed during the weaving process by applying some mathematical equations and applied physics to solve the artisans' problems.

The Process of Silk Weaving

There are three important stages in making a product from silk. The first stage (Stage 1) is the "spinning process". During this stage, artisans set up the silk thread onto an eight-side instrument called the Rong Voeng (RV). The silk thread is transferred from the RV to a silk tube which is then attached to a two-foot bike. The bike is spun in order to make RV rotate along with the bike so that the silk thread is transferred from the RV to a silk tube. A silk tube is used to store silk thread for the second stage of silk product-making. The second stage (Stage 2) is called the "combining process". During this stage, artisans extend and combine the silk

from the tubes together by walking back and forth (in certain patterns) around pairs of bars and mount the silk threads onto a wooden board together. Each pair of bars is set at a distance apart from each other. Finally in Stage 3, the “weaving process”, artisans install the silk from the board onto the weaving saws according to categories (Figure 6).

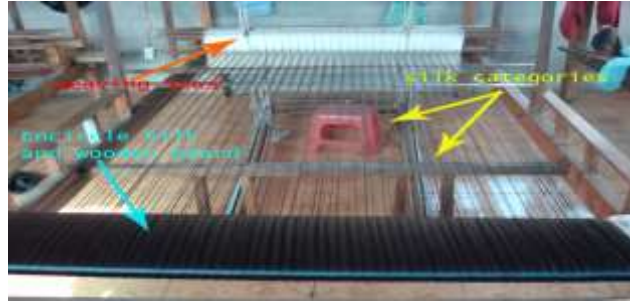


Figure 6. The silk threads encircle on wooden board in weaving process.

Representing the Combining Process by a Mathematical Equation

Stage 2 of the silk making process focuses on the combining process. The common problem at this stage is that the silk thread in some tubes is insufficient to reach their destination bar which requires artisans to add more some silk thread which is not easy in the middle of the process. Moreover, the added silk must be exactly the same in terms of colour. Another problem is that some silk tubes contain too much silk thread than needed and there is excess thread after reaching the destination bar. From the project team’s analysis, the problem may be due to the arrangement of the bars which are placed at a distance D apart from one another (Figure 7). To solve the problem, the team resolved to introduce a mathematical equation to represent the combining process which is then used to find D . Figure 7 is a diagrammatic representation that shows the way the silk threads are wound round the pairs of bars. The artisan starts walking from A to B along the bold black lines and then he/she walks back from B to A. The walk which starts from A to B and from B to A is counted as one time or one walk.

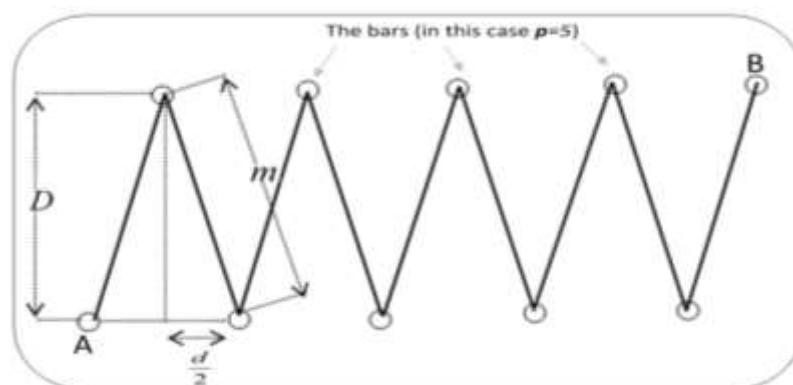


Figure 7. A representation of the combining process (Stage 2).

In Figure 7, p is the number of the pair of the bars used. Denote m as the length of silk from one bar to another. Using simple mathematics it can be shown that from A to B the length of silk is $m \times (2p - 1)$. If the artisan walks t times, the total length is $2m \times (2p - 1) \times t$. Assuming that the total length of the set of silk thread that have to be extended around the bars is the equal the length of the silk thread in one tube, then this length (L) can be derived as follows:

$$(E): L = 2m \times (2p - 1) \times t$$

So (E'): $L = 2 \left[\sqrt{D^2 + \left(\frac{d}{2}\right)^2} \times (2p-1) \times t \right]$ by applying Pythagorean Theorem $m = \sqrt{D^2 + \left(\frac{d}{2}\right)^2}$

And $m = \frac{L}{2(2p-1)t}$

Hence, the problem is reduced into another subsequent problem; to calculate L .

Method to Determine the Length of Silk Spun onto a Tube (L)

General Principle of the System

To determine L , an electronic circuit system (Figure 8) is designed to detect the rotation of RV and to transmit a signal to a counter.

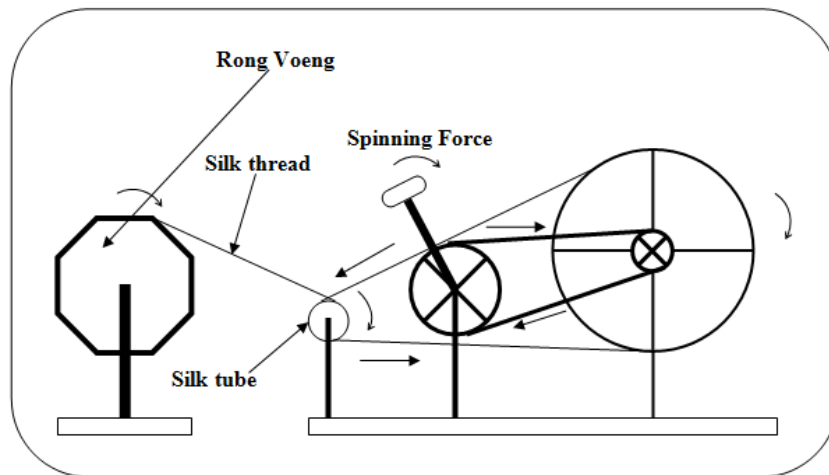


Figure 8. Diagrammatic representation of the spinning process.

Two electronic sensors were set-up. The first sensor was used to count the number of turns that the RV makes while the second was used to nullify the counting in critical cases when the silk thread is unexpectedly cut while the RV is rotating. Thus L can be obtained by multiplying the number of turns RV has rotated [$T_{(RV)}$] with the perimeter of RV [$P_{(RV)}$].

$$L = P_{(RV)} \times T_{(RV)}$$

$$\text{So } m = \frac{L}{2(2p-1)t} = \frac{P_{(RV)} \times T_{(RV)}}{2(2p-1)t}$$

After m is known then D is calculated

$$D = \sqrt{m^2 - \left(\frac{d}{2}\right)^2}$$

Verifying the Solution

The accuracy of the system was tested in three cases using 100 meters of silk threads each. In Case 1, a one-hundred-meter silk thread was tested with no discontinuous point on silk threads. Case 2 dealt with one-hundred-meter silk threads with one discontinuous point while Case 3 was with two discontinuous points along the silk threads. Denote N to be the number of turns the silk thread is transferred to the RV. The perimeter of the RV is $P_{(RV)} = 1.44$ m. The results of the experiment are presented in the following Table 1.

Table 1
The Experimental Results

Silk	Case 1		Case 2		Case 3	
	Counter Value	Deviation	Counter Value	Deviation	Counter Value	Deviation
Silk 1	69 N = 99.36m	-0.64m	69 N = 99.36m	-0.64m	71 N = 102.24m	+2.24m
Silk 2	70 N = 100.8m	+0.8m	70 N = 100.8m	+0.8m	69 N = 100.8m	+0.8m
Silk 3	69 N = 99.36m	-0.64m	70 N = 100.8m	+0.8m	69 N = 100.8m	+0.8m
Silk 4	69 N = 99.36m	-0.64m	68 N = 97.92m	-2.08m	70 N = 100.8m	+0.8m
Silk 5	69 N = 99.36m	-0.64m	70 N = 100.8m	+0.8m	69 N = 99.36m	-0.64m

The experimental results show that in all cases the length of the silk using counter without any discontinuous point or with 1 or 2 discontinuous points is nearly the same as the exact length. The deviation is between -0.64m and +0.8 m ($0.8+0.64=1.44=P_{(RV)}$).

Learning Insights from the Case Studies

The two projects highlighted in this paper exemplify a number of benefits that they bring to the student researchers such as the following as reported by Mangao and Cheah (2013):

- Problem Formulation and Project-based Learning Using an Authentic Community Problem
- Development of Inquiry Skills and Scientific Thinking
- Development of Mathematical Modelling Skills
- Development of Analytical Skills and Higher-Order Thinking Skills
- Interdisciplinary Learning

RECSAM's *SEARCH*Portal: An Initiative for Public Access to Science Education and as Science Education Resources for Science Teaching and Learning

To be of service to the wider public and with the aim of enhancing scientific and technological literacy (STL) in Southeast Asia and beyond, RECSAM has embarked on an initiative to create a special project to archive student research projects and made available on-line via a web-based learning hub or e-portal called "South East Asia Regional Capacity-enhancement Hub (SEARCH)" [URL: <http://www.recsam.edu.my/search/>] in collaboration with public and educational partners as reported by Ng and Nyunt (2010) as well as Ng and Baharulnizam (2013). This on-line learning hub is hyperlinked to six sub-portals with two of these portals serve as a repository of the archives of student research projects made available on-line and maybe used as resources by science and mathematics teachers. The six sub-portals (shown in Figure 9) are: (1) Search for SEAMEO Young Scientists (SSYS), (2) MAgnificent Advancement for Young Scientists (MAAYS.net), (3) Science Project/problem/programme-based Activities InCorporating Experiment MANagement (SP³ACEMAN), (4) Science Across the World (SAW), (5) Special Projects/programmes to Promote ESD and EFA (SpecP2E2), and (6) Educational Partners with Links to International Institutions (EdPartl²).



Figure 9. SEARCH index page with links to SSYS sub-portal, closed and open forums.

SEARCH portal serves as clearing house with links to relevant sites under this e-learning hub. Discussions could be facilitated through open forums [including FB and eLMS] (Figure 10) and closed forum site (Figure 11) of another sub-portal ‘Science Project/problem/ programme-based Activities InCorporating Experiment MANagement (SP³ACEMAN) [URL: <http://sp3aceman.net>](Figure 12). Both forum sites are available freely on-line and all public members are welcome to register in the forums to share resources uploaded onto the forum sites (Figure 13) and participate in the discussions.



Figure 10. Open forums of SEARCH portal accessible from eLMS [<http://www.recsam.edu.my/search/Forums.html>] and FB [<https://www.Facebook.com/groups/188900397742/>].

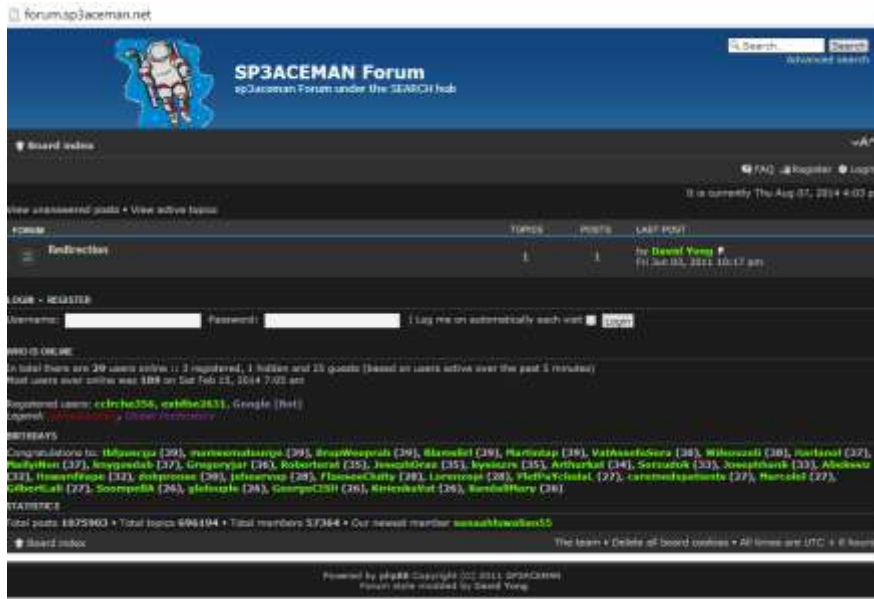


Figure 11. The closed forum site of SP³ACEMAN e-portal [http://forum. sp3aceman.net]



Figure 12. Print screen of the SP³ACEMAN e-portal with highlights in the announcement scroller on the latest events on 7/8/2014.

GENERAL INTRODUCTION AND REFERENCE RESOURCE		TOPICS	POSTS	LAST POST
	Input on PBA/PBL Support Tool and Evaluation Rubric	37	63	by Ishnicazu Tue Nov 15, 2011 8:28 am
	Archival Records of 'Search for SEAMEO Young Scientists' (SSYS) Congress Reports and Research Projects	0	74	by Jalipillo Mon Nov 14, 2011 7:50 pm
	Networking/Events/Announcements, Publications and Success stories	13	19	by alcazhan Fri Nov 18, 2011 4:17 pm
SHARING OF RESOURCE FOR TOPIC OF INTERESTS		TOPICS	POSTS	LAST POST
	Astronomy/Astrophysics and Space Science Moderator: Moderators	9	20	by Ryan9565 Thu Nov 10, 2011 4:17 pm
	Climate Change and Environmental Issues Moderator: Moderators	14	38	by ezgrace Sun Nov 20, 2011 7:06 pm
	Health Science and Nutrition Moderator: Moderators	11	23	by Jalipillo Mon Nov 14, 2011 7:51 pm
	Values-based Water Education Moderator: Moderators	10	20	by chun956 Mon Nov 14, 2011 4:27 pm
	Other Science Related Topics via Interdisciplinary/Cross-curricular Approaches Moderator: Moderators	14	21	by chun956 Mon Nov 14, 2011 4:28 pm
	Other Mathematics Related Topics via Interdisciplinary/Cross-curricular Approaches Moderator: Moderators	5	9	by Jalipillo Mon Nov 14, 2011 7:52 pm
	Science/mathematics, Culture and Indigenous knowledge Moderator: Moderators	4	5	by shaharung Thu Nov 10, 2011 10:38 am
	Ideas and Resource Centre Moderator: Moderators	9	39	by ezgrace Sun Nov 20, 2011 7:17 pm
	Brain Teasers and Brainstorming for Experimentation Moderator: Moderators	0	11	by shaharung Thu Nov 10, 2011 9:00 am
	The Lounge Moderator: Moderators	23	30	by ezgrace Sun Nov 20, 2011 7:20 pm

Figure 13. Print screen of topics of interests in SP³ACEMAN e-forum including archival records of SSYS reports/research projects uploaded and other sub-portals hyperlinked to SEARCH portal. [<http://forum.sp3aceman.maays.net/viewtopic.php?f=70&t=55>]

Conclusion

In the 21st century, ICT played an important role in the development of knowledge in students researching and doing interactive activities over the Internet. There is an increased emphasis on students' technological skills and their ability to access online learning resources as well as developing their higher order thinking skills (HOT), scientific and social skills in the ways of communication, research and project work. In the era of advanced technology, a learning environment that supports teaching strategies integrating pedagogy with ICT is also important for educators who wish to embed an e-learning portal in the fields of science and mathematics education.

Implication and Limitation

SSYS is envisioned as a worthy scientific, technological and educational venture that enables young student scientists to investigate real-life problems in their communities and employ various research designs and other innovative methodologies to solve pressing local or community problems. Student research links the school and the public through the utilization of the resources available in the community. The e-portal "Southeast Asia Regional Capacity-enhancement Hub" (SEARCH) provides public access to informal science education and serves as instructional resources for science and mathematics teachers. The SEARCH web-based portal provides the opportunity for educators through blended mode to learn the different themes and issues towards building networks for knowledge-exchange and peer learning in public science and mathematics education in the region and beyond (Azian, Devadason, Ng, & Wahyudi, 2010). More information about the SSYS and the organization of the event, e.g. the most recent 9th SSYS on March 2014 were disseminated through the SSYS official website [<http://www.recsam.edu.my/ssys>]. Social networking site such as the 'Search for SEAMEO Young Scientist' (SSYS) Facebook group was also formed for more networking activities apart from the SP³ACEMAN closed forum. These activities were supported by many science/mathematics teachers and all teachers who are non-SSYS delegates are welcome to join the group [<https://www.facebook.com/groups/188900397742/>].

In conjunction with the organization of the 8th SSYS (6th to 9th March 2014) and 9thSSYS Regional Congress (3rd to 7th March 2014), SP³ACEMAN and other SEARCH team members had also participated in the e-forums on ‘Green innovation and creative lifestyle’ (Figure 14) and ‘*DRR for Sustainable Development*’ (Figure 15) respectively [posted on announcement stroller <<http://sp3aceman.net>> (Figure 12) and e-forum ‘Announcement on Events/Competitions’ <<http://forum.sp3aceman.net/viewtopic.php?f=70&t=56>> (Figure 16)]. Various networking activities and e-learning initiatives (through Intel Webinar and Facebook as e-platforms) as enrichment for further discussions on investigative science and mathematics education (URLs: <https://www.facebook.com/events/307174492671091/> and <https://www.facebook.com/events/1401275593457278/>) respectively were also conducted. More updates of the activities were posted onto the website (URL: <http://www.recsam.edu.my/search>) and e-forum of SP³ACEMAN.



Figure 14. The SSYS 2012 forum entitled ‘Green innovation and creative lifestyle’ was broadcasted via webinar and information disseminated in FB.



Figure 15. The SSYS 2014 forum entitled ‘DRR for sustainable development’ was broadcasted via webinar and skype. This information was disseminated in FB for open invitation involving public.

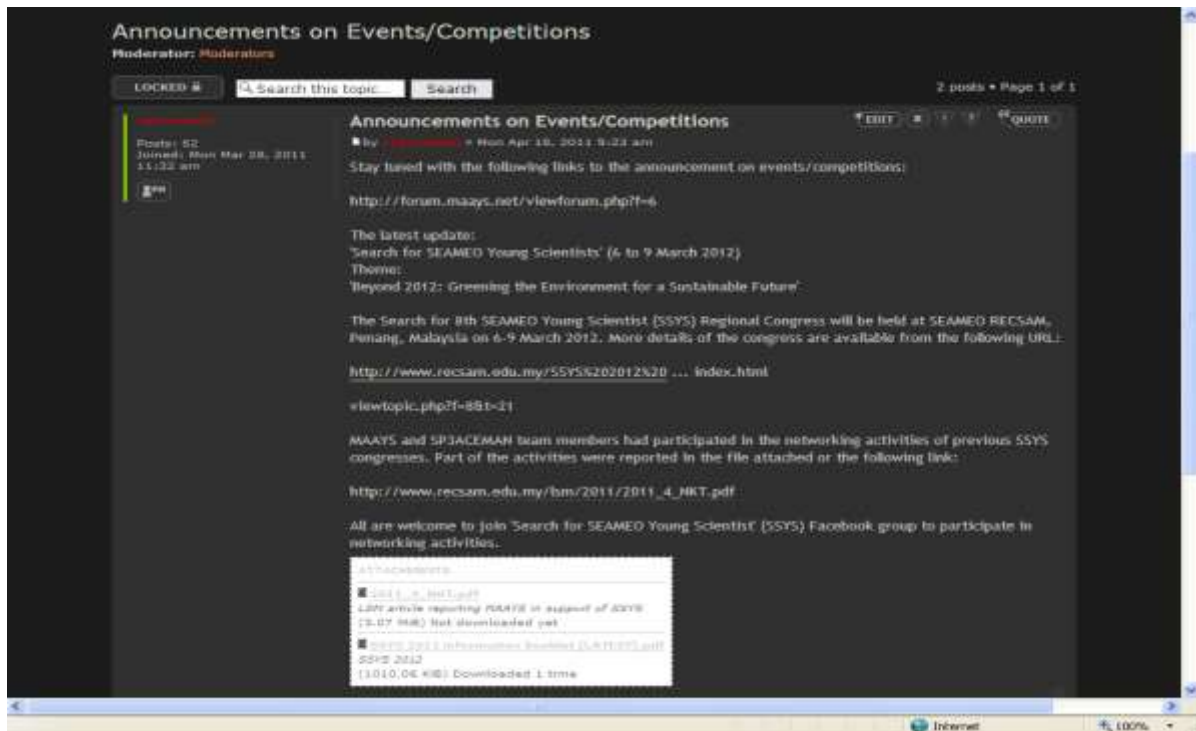


Figure 16. Print screen of e-forum 'Announcements on Events/Competitions'.

Though the objectives of the SSYS have been achieved, the authors felt that much more things need to be done. For example, due to the financial constraints, the number of research projects presented in the congress is still wanting as well as the need to monitor the quality of projects through effective coaching and archival record systems.

Recommendations and Future Direction

There is a need for the Ministries of Education to encourage and provide more support to the science and/or mathematics teachers so that students will have more opportunities for research activities. There is a need for stronger partnership and close collaboration among the schools with industries, institutions of higher learning, private organisations and government agencies to tap expertise and technical assistance. Research project which cater for sustainable development could be refined and expanded to a wider scale especially when its viability and efficiency is ascertained to enhance further its value or utility. . A special section was allocated for sharing of SSYS related articles, publication series and special issues (Figure 17) as well as archival records of students' research projects presented in the SSYS congresses (Figure 18) accessible through SP3ACEMAN e-forums, a better learning management system to archive research projects through the SEARCH portal needs to be installed. It is hoped that the storing and retrieval of research projects for instructional purposes by science and mathematics teachers could be better enhanced, hence indirectly assist in solving the problems of plagiarism through on-line tracking system.

More promotional activities will be conducted in various workshops to invite participation of PBL/PBA with dissemination of learning output through SSYS blended learning platforms hyperlinked to SEARCH portal. Other research evidence (that were disseminated using the forum sites) will also be reported in the subsequent series to illustrate how inquiry-based activities, thinking skills could be promoted towards Education for Sustainable Development (ESD) and Education for All (EFA) through e-learning activities supported by interactive blended learning environments with evidences of students' enhanced capabilities and skills.

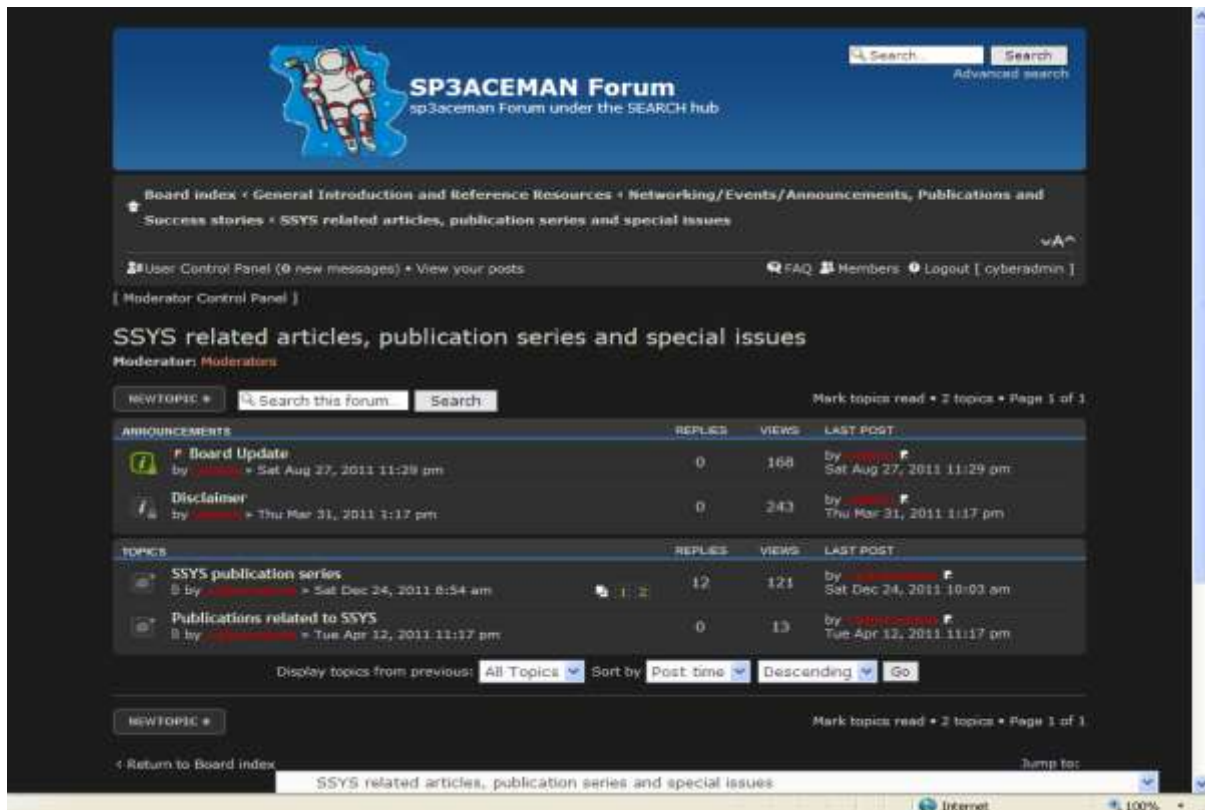


Figure 17. A special section was allocated for sharing of SSYS related articles, publication series and special issues. [URL: <http://forum.sp3aceman.net/viewtopic.php?f=10&t=45>]



Figure 18. Archival records of students' research projects presented in the SSYS congresses. [URL: <http://forum.sp3aceman.net/viewforum.php?f=4>]

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