Abstract - Keynote Speaker

“A Vision for K-12 Computer Science”

Pat Yongpradit, code.org, USA

Description: Pat Yongpradit is the Chief Academic Officer for Code.org, a non-profit organization dedicated to the mission that every student in every school deserves the opportunity to learn computer science. In this keynote he will lay out a modern vision for K-12 computer science and discuss how to get there. He will reflect on the reform efforts in the United States as well as across the world. How does computer science build computational thinking? What role can computational thinking play in other subjects? And how can teachers prepare to teach these new topics? Pat will discuss Code.org's holistic approach, which includes both policy and implementation, to increasing access to computer science around the world.

“Education Transformation – are schools prepared for the ever changing needs of industry?”

Don Carlson, Microsoft Asia Pacific

Description: The last century introduced a sea change in how business is conducted worldwide, with a profound ‘digital revolution’ transforming all aspects of commercial enterprise. New technologies and communication media have brought both opportunities and challenges, disrupting entire industries and instigating new ones that can maximise the abilities of digital technologies.

In this time of significant digital transformation reform in the business world, there is much discussion about parallels in the education sector. How are these contexts similar and how are they different? How will technology impact education and the skill sets of future students, particularly in the STEM areas? How are the education systems (both school and higher education) and employers addressing the education of students in the region to ensure Asia stays competitive with the rest of the world?

“Rethinking creativity for STEM teaching and computational thinking: introducing multi- and trans-disciplinary STEAM approaches in schools”

Zsolt Lavicza, Johannes Kepler University, Linz, Austria

Description: There is a growing emphasis for encouraging creative thinking in STEM education and with the rising need for introducing computational thinking in connection to these subjects, new teaching approaches needed to be developed. Activities focusing on the creative process, rather than concentrating on achieving only results for posed

problems, are being designed and trialled by innovative groups around the world. Often involving Arts, in a broader sense of design and creation, can be good a starting point for students to find their own interests in these subjects and follow their own way of learning (Burnard et al.,2016). Such creative activities often involve the development of collaborative problem-solving skills utilising students’ strengths in different areas that adds up at the group level (English et al., 2008). Furthermore, such activity designs and the opportunities offered by the availability of digital technologies inevitably afford new multi- and trans-disciplinary approaches for education. In my talk, I will introduce ideas and examples for STEM to STE-A-M (by the inclusion of Arts) transitions (Fenyvesi, 2016) and the opportunities they offer to new approaches in education. Examples will include STEAM projects with the Experience Workshop Movement; new educational opportunities offered by the GeoGebra software such as Augmented Reality, 3D Printing and mobile experiments; developing computational thinking through robotics and connecting digital and physical worlds with 4D Frame; and possibilities to detect and nurture creative thinking processes from Big Data.

Abstract - Special Presenter

“Evaluation of Computational Thinking: Reveal students’ misconceptions” (S,T,E,M / General) - Sponsored Presentation by Indiana University

Kyungbin Kwon, Indiana University, Bloomington, USA

Abstract: Accurate evaluation of computational thinking (CT) is the prerequisite of effective instruction for computer science education in K-12. The presentation, titled Evaluation of Computational Thinking: Reveal Students’ Misconceptions, suggests the evaluation framework of computational thinking. Developing Scratch programs requires computational problem-solving skills, including decomposition of tasks, logical reasoning, pattern recognition, abstraction, flow control and so on. By analyzing students’ Scratch programs, teachers can reveal students CT. However, teachers do not have enough guidance regarding the evaluation of Scratch program. The presentation proposes a conceptual framework to evaluate CT by analyzing Scratch programs. The definition and levels of CT components will be discussed. Examples representing the levels of CT will be presented. Teachers and researchers will be able to apply the evaluation framework to analyze Scratch programs, and the results will provide instructional insights to provide scaffolding and design instructions.

“Engineering the Future: Design for Young Students” (E/General)

Elissa Milto, Tufts University, Medford, Massachusetts, USA

Abstract: Participants will be introduced to Tuft’s Center for Engineering Education and Outreach (CEEO) and its Engineering Design for Young Students program, which follow two guiding philosophies: i. Kids can engineer and ii. Teachers as an dynamic part of the educational equation.

“Through the Lens of Computational Thinking: A Look at STEAM+C Education” (S,T,E,M / General)

Michele Roberts, Indiana University, Bloomington, USA

Abstract: Following a brief literature review and examination of relevant theoretical frameworks, this presentation positions computational thinking in a general way to encourage reflection within all STEAM disciplines. Computational thinking is then examined in detail from each STEAM lens, within high level, disciplinary concepts and with accompanying classroom activities. Special attention is given to assessing computational thinking by grade level competencies. By the end of this discussion, teachers will have gained a broadened perspective on computational thinking, as well as explored numerous assessable computational classroom activities. A subsequent hands-on session leverages this discussion through immediately usable classroom activities.

“Computational Thinking and STEM!” (S,T,E,M / General)

Edward Reeve, Utah State University, USA

Abstract: Abstract: Computational thinking is a problem-solving process that has a unique set of features. This presentation will look at its role in P-12 STEM Education with-in the following topics : Components of STEM and STEAM; Integrative P-12 STEM Education; Need for STEM Education; Introduction to Computational Thinking; The Need for Computational Thinking; Computational Thinking Practices (e.g., decomposition, pattern recognition, abstraction, and algorithms) and Big Ideas; The Role of Computational Thinking in STEM Education; and Computational Thinking in Practice.

Abstract - Special Presenter

“Digital Workforce Development for Thailand 4.0” (Thai speakers only)

Ratthasart Korrasud, Digital Society and Manpower Unit, Digital Economy Promotion Agency (DEPA), Thailand

Abstract: N/A

“Computer Science is everywhere, but is it for everyone?” (S,T, E, M / General)

Shaileen Crawford Pokress, Computer Science Education, Museum of Science, Boston, USA

Abstract: Computers are integral to our daily lives: healthcare, commerce, entertainment, and even the fabric of society depends upon technological infrastructure. Those who possess the skills to access, harness, and transform technology have the power to shape the future. To provide opportunity to all, education must empower all with technological literacy.

The Computer Science Education Initiative at the Museum of Science, Boston uses an integrative approach to K-12 computer science (CS) that promotes authentic exploration in science and other disciplines. In this presentation, Director of Computer Science Education Shay Pokress will share examples of the curriculum and tools that her team is developing, as well as the philosophy and theory behind the work. Based on a deep appreciation of the wisdom of teachers, the curriculum helps teachers introduce CS in subjects they already teach by using data science as an authentic application of computational thinking. This lowers the barrier to CS for schools by removing the need for additional teachers and also by alleviating the scheduling issues of stand-alone CS. Most importantly, it allows all students to become competent technologists, able to think broadly about innovation as they journey through a technology-saturated world.

“Using Mental Strategies as The Foundation for Computational Thinking (K-6)” (M / General)

Calvin Irons, ORIGO Education, Australia

Abstract: Computational thinking can begin in the primary grades through the development ofmental strategies for the four operations (addition, subtraction, multiplication and division). This session will outline a teaching sequence and describe strategies for each operation that are appropriate for students in grades K to 6.

Abstract - Workshops

Keynote Workshop

"Workshop connected to: Rethinking creativity for STEM teaching: introducing multi- and trans-disciplinary STEAM approaches in schools"

Zsolt Lavicza, Johannes Kepler University, Linz, Austria

Description: As outlined in my talk, technology is transforming learning environments and becoming part of learning in the 21st century, it is also important to experiment with connecting hands-on and digital modeling in the learning process and offer opportunities to transition from STEM to STEAM education. In this workshop, participants will be introduced to pedagogical frameworks through examples of arts- and robotics-related problem-solving activities, selected from the Experience Workshop International Math-Art Movement's portfolio as well as learning about examples to connect physical and digital learning environments with GeoGebra. We will work with 4D Frame, GeoGebra Augmented Reality, and introduction of 3D printing opportunities with GeoGebra will be outlined. Furthermore, we will look at how GeoGebra Graphing calculators can be used for formative and informative assessments.

Special Presenter Workshop

"Client-Focused Design for Young Students" (E/General)

Elissa Milto, Tufts University, USA

Abstract: This workshop will address having students designing for clients as they are introduced to engineering. Depending on the amount of time that we have, we will run through two or three design challenges. The context and clients for these challenges will come from a short story and a brief biography of a client. Our belief is that these providing a design context and client helps students gain experience working through the messiness of engineering design.

"Through the Lens of Computational Thinking: A Look at Classroom Activities" (S,T,E,M / General)

Michele Roberts, Indiana University Bloomington, USA

Abstract: Attendees first participate as a group in a fun, hands-on activity that couples computational thinking with problem based learning to develop viable Internet protocols. After an informal reflection on the group activity, participants are then invited to sit by grade bands and complete an assessable STEAM-C integrated computational activity that includes both plugged and unplugged lesson elements.

"Practical activities to develop Computational Thinking strategies (K to 6)" (M / General)

Calvin Irons, ORIGO Education, Australia

Abstract: There are many practical activities that can be used to encourage students to think when they compute. This session will engage participants in a variety of activities using concrete and pictorial materials as well as games to support the development of mental strategies and computational thinking.

"Authentic Computational Thinking with Data Science" (S, T, E, M / General)

Shaileen Crawford Pokress, Computer Science Education, Museum of Science, Boston, USA

Abstract: This workshop will demonstrate how to bring computer science into other content areas by using data science to explore questions, investigate phenomena, and explain ideas. Workshop participants will learn how to combine key ideas in computer science with modeling, simulation, and data analysis tools that are appropriate for students ages 12 and up. Participants will come away with an appreciation for integrative approaches to computer science, and a motivation for fostering computational thinking across the curriculum.

Abstract - Workshops

“Computational Thinking hands-on workshop based on STEM-Robotics” (S,T,E,M / General)

Tairo Nomura, Saitama University, Japan

Abstract: We’ve already proposed the STEM-Robotics Education based on both Japanese integrated learning experiences in schools and advanced robotics technology (i.e Nomura 2014). This workshop aims to demonstrate how to motivate students to learn “Computational Thinking” by using both hands-on activities and robotics topics to challenge several missions. Especially participants will try cheaper materials fit to public schools. We would like to discuss how can we promote this kind of lessons to schools widely, especially preparing learning environment, materials and teachers.

“Applying Digital Innovative Thinking and Coding in K-12” (S,T / P)

Mayuree Srikulwong, University of the Thai Chamber of Commerce, Thailand

Abstract: The workshop helps participants building computational thinking skills using an iPad app called Swift Playgrounds as well as discussing how to apply this subject into K-12 curriculum.

“Unplugged programming” (T , P)

Technology Unit, Institute for the Promotion of Teaching Science and Technology (IPST), Bangkok

Abstract: The fun way to engage student and give a challenge to empower students’ thinking. Unplugged programming can be a prior activities to introducing the way to teach problem solving, and algorithmic thinking before start coding.

“Make & Code : Combine the magic of making with the power of codev a cross a variety of different products using Microsoft MakeCode” (S,T,E,M / P, MS, HS)

Supoet Srinutapong , Microsoft (Thailand)

Abstract: MakeCode is a free, open source platform for creating engaging computer science learning experiences that support a progression path into real-world programming with simulator, block editor and JavaScript editor

“Decoding the Messengers from the Early Universe” (S,T / HS, U)

Raksapol Thananuwong, Institute for the Promotion of Teaching Science and Technology (IPST), Bangkok and Saichol Sukkho, Janokrong School, Phitsanulok

Abstract: Particles generated from high-energy collisions at particle accelerator are thought to have the same characteristics as those constitute the early universe. By understanding the physics of these particles, we could understand the universe in its early phase, how it works today and how it will become in the future. One of many ways to capture and extract the information from highly energetic particles is by using a tool called particle detector and analytical method based on known physics theory. In the first part of this workshop, the participants will learn how to build one type of traditional particle detectors called a cloud chamber using provided material and then learn how to detect and analyze particles tracks detected by the chamber. In the second part, the participants will learn how a modern day particle detector works and how to analyze data from state-of-the-art particle detector at CERN using computer algorithm. Some basic particle physics which covers the learning outcomes in Physics Strand, Science Learning Area (revised B.E. 2560), Basic Education Core Curriculum B.E. 2551, will be discussed. Background knowledge about energy, momentum, electromagnetism and structure of matter is required to fully understand the discussions.

Abstract - Workshops

“Slurpee 4.0” (S,T,E,M / HS)

Channarong Poolperm, Phuriwat Jiratantipat and Phanomyong Kaewprachum, Institute for the Promotion of Teaching Science and Technology (IPST), Bangkok

Abstract: Most of Thai student like a frappe soft drink which are call slurpee and they buy a lot of them in summer. Base on this situation we use STEM-based lesson to make a slurpee without machine and electric supplies. This activities require knowledge in science and practice in mathematics technology and engineering design process. In this hands-on workshop, participants will applies science (colligative properties, heat transfer, and crystallization) mathematics (function) technology (education application) and engineering design process to design a tool for making slurpee. Moreover participants will challenges by limit of materials time and budget behind this situation. This activities are include scientific process skills, problem- solving, data analysis and scientific mind

“Science/Math Integration for a Sustainable Planet” (S,M / P)

Rebecca Monhardt, Loras College, Dubuque, Iowa, USA

Abstract: Effective STEM-based lessons for elementary grades can start with natural math/science integration to discover more about the world around us. This integration is critical in developing problem-based learning around real-world issues. Human ecology offers a wonderful opportunity to teach key life science concepts, such as carrying capacity in nature, natural resource use, and how humans are forever changing Earth’s landscape, habitats and biodiversity. At the same time, understanding human ecology concepts requires knowledge and practice in mathematical functions such as computation, measurement, graphical representation, statistical analysis and more. In this hands-on workshop, participants will participate in activities from Population Education that illustrate the science and math behind real-world issues. Presented strategies will include creating representational models with manipulatives, cooperative group problem-solving challenges, graphing and analysis, and role-playing simulations.

“Video Lesson Study on STEM Education” (S,T,E,M / General)

Tairo Nomura, Saitama University, Japan

Abstract: We’ve started collaborative research project about teacher training for STEM education between the Institute for the Promotion of Teaching Science and Technology (IPST) and Saitama University. Using recorded lesson video of STEM education conducted by actual teachers, this workshop demonstrates how to reflect its lesson from points of views of STEM education policy like integration approach, authentic learning, etc. among teacher group by using “Japanese style Lesson Study”. In this workshop, we will invite several collaborative teachers in our project to share their experiences and point out key points of STEM education.

“Introducing Coding to Young Children Using Ozobots” (T, M, E / P)

Rebecca Monhardt, Loras College, Dubuque, Iowa, USA

Abstract: Coding addresses many of the knowledge, skills, work habits and character traits associated with 21st century skills including problem solving, reasoning, perseverance, resilience and logical communication. Ozobots provide opportunities for students to learn about coding as they have fun working through challenges while developing skills for the Future. This workshop is an introduction to using Ozobots in the elementary classroom as a way of teaching young children about programming and is aimed at participants with little or no previous experience with these micro-robots. The session will follow this format: ENGAGE: Participants will learn what Ozobots do and how they work.

EXPLORE: Participants will work through various challenges using prepared exploration cards that scaffold them through increasingly more difficult tasks. Then, they will create their own programs for the Ozobots using markers and codes.

EXPLAIN: A rationale for teaching coding at an early age will be provided. Examples of teacher-created materials will be shared with participants as they consider possibilities for teaching coding with Ozobots in their own classrooms.

ELABORATE: Working in small groups, participants will develop Ozobot challenges they could use with their own students.

EVALUATE: Teams will share what they have developed and get feedback from the group.

Abstract - Workshops

“Science Education Research Institute for Southeast and South Asia (SERI-SESA)”

Description: This interactive workshop is open only to those who participate in the 17 October pre-conference workshop. Participants will continue their work with mentors on developing strong writing skills and identifying topics for writing articles in English for publication in peer-reviewed science education journals.

Mentors: Dr. Julie Luft, University of Georgia; Dr. Bhaskar Upadhyay, University of Minnesota; Dr. Narendra Deshmukh, Homi Bhabha Centre for Science Education, Mumbai; Dr. Sami Kahn, Ohio University; Dr. Kusalin Musikul, IPST, Bangkok.

Abstract - Sponsor Workshop

“Increase Student Engagement, Motivation and Confidence in Mathematics” (M / P)

Scott Smith, MATIFIC, Australia

Abstract: The importance of STEM subjects is of collective concern for educators globally. Increasing student engagement, motivation and most of all overcoming mathematics anxiety, are fundamental to primary school teaching today.

In this workshop, participants will gain an understanding of the Matific pedagogy, which includes a fundamental focus on hands-on problem-solving and critical thinking. In this hands-on demonstration, participants will see how teaching using gamified mathematics not only increases student engagement in tasks but encourages motivation in mathematics more generally. Participants will see how the use of technology gives educators instant reports on student achievement and how individualized reporting can lead to early intervention in areas where students are struggling. Finally, the use of digital student groups lets teachers differentiate amongst different achievement levels without causing mathematical anxiety in students who are struggling.

“Building local capacity through strengthening professional learning communities (PLC)” (Thai speakers only)

Kessara Amornvuthivorn, Chevron Enjoy Science Project, Thailand

Abstract: To align with the PLC initiative recently promoted by the Minister of Education, the Chevron Enjoy Science program is focused on engaging faculties of education of the regional universities, mentors, administrators, school leaders and master teachers to support science and math teachers adopting the concept of the professional learning community approach with a focus on enhancing teacher practices for improved student learning. This approach has been well received for the past 25 years, and shown to be an effective strategy to improve school culture through collaborative learning by teachers and administrators (Feger and Arruda, 2008). In the recently report published by The National Center on Education and the Economy (2016), Jensen and colleagues report that professional learning is central to high-performing education systems such as Shanghai, Hong Kong, Singapore and British Columbia. It is a mechanism to ensure that teachers, administrators and mentors regularly collaborate in order to help teachers to improve their classroom delivery for an enhanced teaching and learning.

The workshop is aimed at Thai educators who are interested to learn how to conduct a structured PLC meeting using an open-class approach. The workshop uses a simulation of the PLC meeting cycle including 3 steps of lesson planning, classroom delivery with an observation by PLC members, and a reflection by the teacher who delivers the class as well as the planning group and the participating PLC members. A well-designed STEM learning activity on machine assessment applying science concept to design and implement a working solution will be introduced to lower secondary students. Workshop participants will be introduced the PLC meeting protocol and learn to focus their observation on specific instructional strategies implemented for this STEM learning activity. They will practice on sharing their input with the group in a constructive approach during the reflection after the class delivery.

Abstract - Research Paper

"The Effect of Phenomenon-Based Learning on STEM Skills: Perspective of Science Teachers in the United States" (S / MS, HS, U)

Chanon Kampiwtha, University of Wisconsin Oshkosh, USA

Abstract: STEM skills have become an important issue. Many countries are preparing students to meet this future need by providing effective education. Phenomenon-Based Learning is an approach that relies on real-world phenomena. The issues from Phenomenon-based approach will be naturally anchored in authentic phenomena, in which learners can apply knowledge and skills across borders between different subjects to solve their problems.

The purpose of this research study is to investigate the perception of science teachers in the United States on STEM skills and Phenomenon-Based Learning approach through two research questions: How do USA science teachers value STEM skills? and What is the impact of Phenomenon-Based Learning on STEM skills? The participants are 15 science teachers in USA. The data were collected by survey and interview questions. The result from interview and survey consistently show that the teachers see the value of STEM skills, and also realize the importance of developing these skills for students. Meanwhile, the result from the perception of the teachers on Phenomenon-Based Learning shows that Phenomenon- Based Learning can support students' learning and enhance STEM skills.

"Computer Science in Secondary School STEM Education" (T / MS,HS)

Anurak Khophadung, Phukhieo School, Thailand and

Eric Brunsell, University of Wisconsin Oshkosh, USA

Abstract: Science, technology, engineering, and mathematics disciplines are equally essential in terms of the STEM integration. Many STEM courses, especially math and science are mainly focused on contents, while technology is mostly integrated to the learning as supported learning tools or computer-aided learning. Computer science (CS), referring to the technology discipline, is likely to foster to STEM education, which provides a range of implementation from basic knowledge of computing to crucial core of CS. This research study is proposed to investigate the ways of promoting CS to secondary STEM education, and teachers' needs in order to implement the integrated learning. The study surveys were focused on college students' experience and perceptions, and science and math teachers' perceptions of ideas in promoting CS in middle and high school STEM education. There were 42 participants, accounting for 20 science and math teachers, and 12 computer science students. The findings indicate that teachers have different experiences about CS, and most of them would need ideas and concepts, education, training, and instruction. Many teachers and students justify that having CS experience in secondary school are very important for getting interested and moving forward to STEM fields, encouraged by their computer science involvement at a younger age.

"STEM Education in Thailand: Learn from the past look to the future" (S,T,E,M / General)

Wanchai Noiwong, Institute for the Promotion of Teaching Science and Technology (IPST), Bangkok

Abstract: STEM Education has been implemented in Thailand for several years. The government by the Ministry of Education played a main role in driving STEM education in school settings. To develop teacher knowledge on STEM education, various teacher professional development programs have been developed by many institutions. However, different perspectives on STEM education have been found in the training programs. From the best of our knowledge, research about the effectiveness of teacher training programs on STEM education in Thailand has not been found. In this presentation the systematic review of teacher professional development programs will be presented. The results might inform further research about development of teacher professional programs to enhance students' learning for policy makers and practitioners elsewhere.

"Key elements of teaching Computational Thinking" (S,T,E,M / General)

Tairo Nomura, Saitama University, Japan

Abstract: Recently teaching "Computational Thinking" is focused strongly in STEM education worldwide, and the Japanese government has also decided to start teaching "Computational Thinking" in the national curriculum from elementary to senior high in 2020. Teachers and schools have been already challenging many practices, in many cases using laptop or tablet, and also often robot kits for hands-on activity. Because of this trend, now other teachers and schools that want to start teaching "Computational Thinking" worry about the cost to set up the learning environment. This paper shows the basic instructional design model of how to teach "Computational Thinking" especially in elementary-level schools based on integrative-approach STEM education policy, and the idea of preparation of the learning environment, with reasonable materials especially even including hands-on activity.

Abstract - Research Paper

"Understanding students reasoning about waves" (S / General)

Radhika Deshmukh, Swati Wankhade and Narendra D. Deshmukh, Shri Shivaji Multipurpose College, India

Abstract: Research has shown that students have tremendous difficulties in developing qualitative understanding about waves. The aim of this research is to investigate different approaches to understand basic concepts of waves. In this study we used a survey method and standardized 4-tier multiple choice test on waves. The sample consists of 80 students, who learned wave motion unit at Grade 11. We also performed experiments on waves where our focus was on problem solving, conceptual understanding and computational skills. From their confidence rating we observed that students got an understanding of basic concepts of waves and also learned various aspects of computational skills and were able to give correct scientific reasoning for the answers. During the hands-on task students learned with graphs, and visualized image problems related to waves. Our results suggest that visualizing the waves with graphs, images, and curves is a promising approach to develop deeper understanding of the concept of waves and enhance computational skills among students.

"Reflecting on Computational Thinking Studies in Secondary Education" (S,T,E / HS)

Debby Erce Sondakh, University Kebangsaan, Malaysia

Abstract: It has been over a decade since Computational Thinking (CT) was proposed as essential problem-solving skills for digital citizens. Since then, efforts have been conducted to bring CT skills into all educational levels. This paper reports the review of CT studies in secondary education, particularly the upper level. This study considers the informal program, which is an out-of-school program, as CT skills promoting practices that have grown lately. The informal program includes workshop, bootcamp, and outreach program that teach CT using programming, game-based programming, and unplugged approaches. Subsequently, algorithm, logical thinking, abstraction, debugging, and problem decomposition, still come out as the most common skills passed on to the pupils. This fact indicates that questions for expanding new studies for fostering CT skills are open, specifically the ones that point out to non-cognitive skills.

"Change? Bring it on: Introducing STEM Education to Indonesian Teachers through Hands-On Activities" (M / P, MS, HS)

Gusti Ayu Russasmita Sri Padmi and Wahyudi, SEAMEO QITEP in Mathematics, Indonesia

Abstract: As the promising competencies expected from 21st century workforce, STEM has been a major buzzword in international education these last few years. Indonesia is no exception, especially considering at STEM program embarked on by the Ministry and its supporting institutions. However, the effort to introduce STEM education tend to meet significant obstacles; one of them being teachers' hesitance to move on from traditional teaching and learning. As one institution for teachers' professional development in Indonesia, SEAMEO QITEP in Mathematics attempts to diminish the teachers' hesitance by bridging them to the new concept of STEM with hands-on activities. Thirty teachers from diverse regions in Indonesia participated in a professional development session where they were being introduced to various STEM hands-on activities using everyday objects. This paper reports the implementation of the activities and teachers' responses.

"Development of Intelligent web-based instruction using adaptive navigation on flowchart" (S, T / HS)

Sattarat Srikasee and Songsak Songsanit, Rajabhat Maha Sarakham University, Buriram

Abstract: Computational thinking has become an increasingly popular notion in K-12 and college level education. Programming is also one of the most used approaches to promote it worldwide. Similarly, flowcharts are useful in writing a program or algorithm. In this paper, we present an Intelligent Tutoring System using Adaptive Navigation Support. According to the level of student knowledge, this system was focused on Adaptive Navigation Support to generate lessons for them and the system automatically adjusted a suitable learning path and learning status for student. This prototype was designed for Flowchart unit in Basic Programming course. The experiment result showed that Intelligent Web-based instruction and Adaptive Navigation approaches can help student learning, reduce time consuming study and opened an opportunity in constructing the conceptual knowledge by oneself.

Abstract - Research Paper

“Socio- scientific issues on STEM education” (S / General)

Ronaldo Reyes, Department of Education Tabaco, Philippines

Abstract: One of the 21st century skills that needs to be developed among the STEM learners is the inquiry skills. This mandate indicate that there is a need to upgrade science instruction and this can be achieved with the use of various innovative approaches in teaching, one of which is the use of Students Answering their Own Question (SAOQ) vis-à-vis Socio-scientific based Instruction (SSBI). This research was conducted to determine the potential of SAOQ Approach vis-à-vis SSBI in enhancing science inquiry skills of the students. The Quasi-experimental research, utilizing the pretest-posttest design was adopted in this study. Two intact classes of Grade 9 STEM curriculum of Tabaco NHS served as the research participants. Grade 9- Dalton class served as the experimental while the Grade 9- Lavoisier class served as the control. It can be claimed that there was a significant improvement from the pretest to the posttest in the group where the intervention was implemented. A significant difference existed between the two groups favoring the experimental group. Further, the inquiry skills developed among the learners were providing explanations based on evidence, communicating, and justifying explanations. Results of the study underscore that using the SAOQ vis-à-vis SSBI in STEM teaching facilitate the development of the inquiry skills in understanding science concepts

“GeoGebra in Mathematics Teaching: What Did Teachers Do to Implement the Use of GeoGebra in Instruction?” (T, M / P, MS,HS)

Sasiwan Maluangnont and Sutharot Nilrod, The institute for the promotion of teaching science and technology (IPST), Bangkok

Abstract: “GeoGebra in Mathematics Teaching: What Did Teachers Do to Implement the Use of GeoGebra in Instruction?” is a presentation of a small research study on supporting teachers to use and implement GeoGebra in mathematics instruction. Participants of the study were mathematics teachers who attended the training on basic use of GeoGebra. The training started with providing teachers opportunities to learn the basic use of the program including the use of geometry tools, algebra tools, and statistics tools. They were also provided an example of using algebra tools in GeoGebra to create simple instructional materials on graphs of exponential and logarithmic functions. Teachers were then allowed to use GeoGebra to create instructional materials for their mathematics instruction. After the training, teachers were able to use GeoGebra to create instructional materials in various mathematical contents from primary to upper secondary levels. Teachers could apply the geometry tools in GeoGebra to create the instructional materials not only for teaching primary students about 2-D figures but also for teaching lower secondary students about parallel lines. In addition, teacher could apply the geometry tools in GeoGebra to create the instructional materials for teaching upper secondary students about graphs of trigonometric functions.

“Learning by doing pedagogy in school education to enhance computational thinking: challenges and Strategies” (HS/ General)

Narendra Dadarao Deshmukh, Tata Institute of Fundamental Research, Mumbai, India

Abstract: The science and engineering practices at school level usually focus on learning by doing (LBD) approach, where the use of mathematics and computational thinking is crucial along with problem-solving skills. Engaging in the full range of scientific practices helps students understand how scientific knowledge develops and gives them an appreciation of the wide range of approaches that are used to investigate, model, and explain the world. In this case study seven facilitators were interviewed, who are practicing LBD approach to inculcate problem solving skills, mathematics and other technical skills. Also experimental, computation, theoretical skills – applicable to a broad spectrum of problems from more than 15-20 years and are well known for their work and contribution are working at different places of Maharashtra, India. All facilitators mentioned that learners acquire many skills through LBD approach, such as: out of box thinking skills, conceptual understanding skills, observations, questioning, measurement, computational skills, making hypothesis, finding options and solutions, creativity, presentation, scientific attitude etc. Therefore, there is a need to motivate school teachers for using learning by doing approach to enhance computational thinking among students in regular class.

Abstract - ED Talk

"Integrating Computational Thinking Skills in Science Lessons using Scratch" (S,T / MS)

Nurun Najah Ellias and Tracy Mensan, The National University of Malaysia

Abstract: It is based on a belief that CT should be seen as an essential skill in one's repertoire in this 21st century living, especially in the context of increasingly complex problem solving and computing (Wing 2006). Even though the idea of CT is promoted and made famous by Jeannette Wing, a computer scientist in 2006, this thought process should not be restricted to computer science per se (Perkovic et al. 2010). In this era of digital revolution, it is also important for everyone to equip themselves with CT skills as future jobs demand for knowledgeable and highly-skilled workers to deal with machines and robotics automations where programming and coding skills are required (Zafir Khan 2018; Schwab 2016). Hence, integrating CT concepts and skills via Scratch programming across STEM-related subjects, particularly in science, would give greater impacts on the existing science teaching and learning approaches, thus preparing today's generation for a better future.

"Developing Blended Thinking Intelligence to future ready STEM Education" (S,T,E,M / General)

Raymond Tsoi, National Institute of Education, Singapore

Abstract: Developing Blended Thinking Intelligence to future ready STEM Education Blended Thinking Intelligence focuses on blending cognitive, social and corporate processes in thinking to effectively "future ready" STEM Education. This holistic approach emphasizes a range of essential skills and dynamic processes to make sense of the fundamentals of STEM Education for future readiness. Inevitably the norm is learning skills or processes in STEM Education as a stand alone and usually more inclined towards cognitive aspects. This is insufficient and lacks meaningfulness and relevance, especially if there is inadequate strategic direction to advance STEM Education for a certain purpose. A critical thinking exemplar will be used to showcase the practical workings of Blended Thinking Intelligence on how to blend the cognitive (Critical thinking graphic organizer), the social (cooperative learning) and the corporate (decision making strategy including information gathering) to future ready STEM Education.

"NASA's impact craters: a guided inquiry STEM activity"

Duangkhae Srikun, Usa Jeenjenkit, Weerawut Tiankao and Wanlop Khongna, Mahidol Wittayanusorn School, Thailand

Abstract: This guided inquiry module was developed from NASA's impact craters activity. Before starting, students have learned about scientific investigation and literature search. In the first week, after the introduction of the theme, students worked in groups to propose a scientific question with the aim to derive a relationship between two variables. Each group investigated different independent variables such as size, speed, mass of the meteorite, angle of the impact, and the type of surface. In the second week, each group gave presentations of their experimental design with details on materials and methods. This sharing session produced many interesting solutions such as measuring the area of ejecta using digital images, dropping the ball using an electromagnetic coil, modeling the size of crater using quick-setting plaster of Paris. In the third week, students assembled their experimental set up and collected data. In addition to the normal class period, students were able to use the room during break time. In the fourth week, students shared their findings in a mocked conference on crater studies. Through this inquiry module, students have learned the concept of force and energy, created their own experimental design though an engineering process, used technology to collect data, and applied mathematics to analyze and interpret data.

"Deconstructing + Reconstructing Assessments in STEM" (S,T,E / MS)

Skype presentation

Eric A Walters, Marymount School of New York, USA

Abstract: Best-selling author and educator Alan November once posed this question: "What's going to get kids more excited about learning, telling them they have a test on Friday, or saying, "You're debating British students on Friday'?" Moreover, how often do students ask: "Will this be on the test?" or "Is this going to count?" As teaching and learning continues its paradigm shift to being student centered, new pedagogical models require new tools for assessment. Furthermore, traditional pedagogical models also cry out for new assessment models as well.

In this presentation, we will explore how we have deconstructed and reconstructed traditional assessments in STEM to a framework where students represent their knowledge in ways that are meaningful to them while receiving authentic, robust and holistic feedback in projects such as Toy Design (Engineering), Weekend Weather (Atmospheric Science) and ThunderGolf! (Honors Physics). You'll hear students and teachers discuss the benefits and challenges of new assessment models and we will also discuss how to implement such a model in your classroom or school.

Abstract - ED Talk

"Girls and CODE: Celebrating Success" (T / HS) Skype presentation

Eric A Walters, Marymount School of New York, USA

Abstract: According to the National Girls' Collaborative Project, in 2011, women received only 18.2% of the bachelor's degrees. This number has been slowly decreasing over the past decade. The members of CODE, Marymount School of New York's coding club, sought to address this problem by developing a program to recognize girls' achievements in code. As a result, the National Computer Science Honor Society (cshonorsociety.org) was born. The vision of this student-led organization: nothing less than recognizing the full potential of girls and coding.

In this presentation, student leaders will review the development and formation of the Society, including the writing and editing of the Constitution; website development; as well as chapter and student membership requirements. Students will also discuss the application process, possible chapter activities and their long-term goal and commitment to celebrating every girl's success in coding as a motivating force in driving more girls to major in computer science.

"Primary School Mathematics: A Key to Individual and National Growth" (M / P)

Shimon Schocken, MATIFIC, Australia

Abstract: Education in general, and mathematical education in particular, has been facing numerous challenges in recent years. One of the leading factors is the growing expectation from the educational system to train an increasingly large number of students towards an evolving world of science and technology. These changes reflect world-wide in an attempt to keep up with international standards, leading to a redefinition of learning objectives and a massive rewriting of national curricula. As expected, it is much easier to rewrite a curriculum than to assimilate those changes in systems of mass education. In this context, the penetration of technology offers promising opportunities. Yet, many technological resources don't offer much more than the digitization of textbooks and traditional worksheets. In this lecture, I will exemplify the potential of technological resources. I will enumerate ten key pedagogical principles in mathematical education, and demonstrate through specific examples, how technology can help applying those principles in systems of mass education.

"Report of Thailand-Japan STEM Education Project" (S,T,E,M / General)

Rie Atagi, The institute for the promotion of teaching science and technology (IPST), Bangkok

Abstract: This is a report of Thailand-Japan collaborative project on STEM education. IPST and Saitama University have been conducting a study on how to support teachers to carry STEM teacher training into practice. The project has been ongoing for three years, each year sending about 10 Thai teachers to Japan: Initial training is provided by STEM Education Research Center at Saitama University for ten days in Japan funded by JST's Sakura Science Plan. The workshop is provided by Prof. Nomura using programming of robots. IPST organizes the follow-up school visits to see how the training is reflected in their lessons. The format of training is a lesson study since actual classroom teaching should be counted as an outcome of teacher training. This session will report the findings of this ongoing project: What difficulties they face in conducting STEM education, what supports are needed and how we can make sustainable professional development programs.

"GeoGebra Resources - a Social Network for STEM Teachers" (S,T,E,M / General)

Markus Hohenwarter, Johannes Kepler University, Austria

Abstract: The open educational resources platform www.geogebra.org includes more than 1 million free activities and books for learning and teaching mathematics and other STEM subjects. We will present the results and consequences of a PhD project at Johannes Kepler University Linz, Austria, which investigated the question how expert users currently try to find good quality materials in this large repository. One important conclusion was the central role of "good authors" which has subsequently led to the introduction of social networking features on the GeoGebra resources platform. For example, it is now possible to follow other authors and get notified through a newsfeed and email notifications whenever they share new public resources. Furthermore, we will discuss current developments and future plans for topic maps and gamification to improve the organization of resources and nurture the motivation of community members to share free educational resources.

Abstract - ED Talk

“GeoGebra Augmented Reality App for Mathematics & Modeling” (S,T,E,M / General)

Markus Hohenwarter, Johannes Kepler University, Austria

Abstract: Current technological innovations such as wireless mobile devices and virtual or augmented reality provide additional opportunities for developing novel learning and teaching environments. Augmented reality enables users to perceive the real world extended by virtual elements. In order to exploit the potential of augmented reality in mathematics education, GeoGebra has developed a novel augmented reality mobile application. This application allows exploring computer generated 3D math objects that are placed in real world environments, while students can walk around them and interactively investigate them from any perspective. In this manner GeoGebra provides possibilities to complement and enrich mathematics education in both classroom settings and outside of school.

A symposium of Thai STEM research:
super premium students Master of Education research reports

Conducted by P John Williams, Curtin University, Australia

STEM at Curtin University and the MEd Super Premium Program

PART 1 – a focus on teachers

"The principles of STEM activities for Thai teachers"

Phetsirin Tunkham , The Institute for the Promotion of Teaching Science and Technology (IPST), Bangkok

Abstract: This research contributes elements to develop STEM activities that builds on previous STEM research and provides principles which form the basis of effective STEM activities for Thai teachers. The study consists of three major steps of developing STEM activities. First, understanding STEM education, teachers should have basic knowledge of STEM education including STEM perspectives and integration methods before developing STEM activities. Second, designing STEM activities, teachers should set the goals, select grade level and content, specify timing and form STEM collaboration. Third, an implementation of STEM activities, teachers should understand STEM characteristics including student-centred approach, group work activities and real-world connections and select an appropriate instructional model. This study also provides challenges and suggestion from previous research in the last section.

"The STEM policy and its impact on teachers' practice in Thailand"

Hataichanok Chanachai, Phimai Wittaya School

Abstract: The impact of globalisation poses a range of challenges for the Thai education system to reform. Holding old beliefs and traditional pedagogy may not be appropriate to educate and prepare students for the present world. The current policy of implementing STEM education in Thailand aims to improve the quality of education as well as increase national economic competitiveness. Discussions of STEM in Thailand often focus on one variable, such as the impacts of STEM on students, without taking the effect on policy development and on teachers into account. This study is aimed to 1) collect and analyse the key aspects of Thailand STEM policy, 2) extract the impact of policy on teachers' practice, and 3) evaluate the policy. The study divided into five sections to build a more thorough understanding of STEM education in Thailand. The first section outlines the current situation and the clarification of STEM education in Thailand. The next section will be focused on the STEM education and Thailand's need, then STEM policies. The fourth section will focus on the impacts on teachers' practice (STEM implementation, integration of four disciplines based on real-world situation, activity-based learning and assessment focused) and will highlight some of the gaps in policies, including teachers' freedom, timetable and teachers' confidence. The evaluation and concerns of STEM policy will also be described in the last section.

PART 2 – a focus on students

"Integrating a STEM approach into high school biology classes"

Thanakorn Atjanawat, Suankularb Wittayalai School, Bangkok

Abstract: Many countries have embarked on efforts to promote STEM education in order to foster STEM-literate students in a competitive global economic climate. STEM helps students integrate and apply knowledge from various disciplines to solve real-world problems, and also increase their interest in STEM related fields. However, the lack of understanding about STEM implementation in science disciplines, particularly in biology is still problematic for many secondary level teachers. Unlike physics or chemistry, in which science teachers can see a strong connection with other STEM disciplines, biology teachers have difficulty seeing this connection. Consequently, it is challenging to introduce a STEM learning approach into high school biology classrooms, resulting in a reluctance among biology teachers to integrate STEM disciplines into their classes. The purpose of this review is to examine the means in which teachers can implement a STEM approach in biology lessons, as well as the key characteristics of designing an integrated biology learning unit.

"The characteristics of STEM learning environment: Students' and teachers' perceptions of learning environments"

Jaroonpong Cholsin, Phayaophithayakhom school, Phayao

Abstract: Studies of learning environments indicate that there is an association between students' and teachers' perceptions of learning environments and student outcomes. It is crucial for teachers, educators and curricula developers to monitor and assess the perceptions of learning environments, particular in STEM in order to create effective learning environments and to improve learning outcomes as well as teaching practices. This literature review is about teachers and students perceptions of classroom learning environments which are related to STEM teaching and learning to describe the characteristics of effective STEM learning environments. It conceptualizes an effective STEM learning environment and outlines issues that teachers need to take into consideration, when designing and teaching STEM program. The key characteristics of STEM learning environments include Meaningful integration, Personal Experience, Realistic problems, Collaborative learning environment, Technology- oriented learning environment, Constructivist approach, and Clear assessment. Furthermore, the study suggests that evidence from practical research studies into students' and teachers' perceptions of the STEM learning environment are needed. In addition, research into assessment practice needs to be considered in the design and implementation of an effective STEM learning environment.

"A review and guideline to promote students' positive attitudes toward STEM in Thailand"

Jaturong Lertchuwongsa, Phuketwittayalai school, Phuket

Abstract: The objectives of this presentation are to review the literature of STEM education and aspects of students' attitudes toward STEM, and provide suggestion to encourage Students positive attitudes toward STEM. Also, there are STEM review attitudes in theory, assessment, related variables, and teaching approaches to promote students' attitudes. In school, while STEM can be taught with project-based learning, especially teaching with robotics, to dramatically increase students' positive attitudes toward STEM, there is no clear evidence to show impact on students' academic outcomes becoming teachers concern of its worthy of energy and time investment. Therefore, the 5E model is another choice of teaching methods that can promote students conceptual understanding in STEM as well as students' positive attitudes toward STEM.