The 8th International Conference
for Science Educators and Teachers

ISET 2021

Contents

Welcome Message
President of Kasetsart University

Distinguished Guests, Ladies and Gentlemen,

Thank you for inviting me to participate in the official opening ceremony of the eighth International Conference for Science Educators and Teachers.

I have looked at your program and I am confident that this conference will help to advance science education. Thailand and Kasetsart University have recognized for a long time the importance of effective and innovative teaching. Your efforts to assist our students to learn and gain the knowledge needed to pursue careers needed by society far into the future is greatly appreciated.

This conference is important. Currently, the social distancing practices that we must follow during the COVID 19 epidemic has posed tremendous challenges to our education system. It has highlighted the widespread inequality of student access to educational technologies. These are challenges that this conference can address.

I believe that international collaboration will strengthen the network of institutions dedicated to improving science education, and it will promote innovation and creative of research that will be beneficial for the academic progress of the country and our region.

On behalf of Kasetsart University, I thank you for your dedication and contributions to science education. I wish you a successful and enlightening conference.

Thank you.

Chongrak

Dr. Chongrak Wachrinrat
President, Kasetsart University

Welcome Speech from the President of Science Education Association (Thailand) for the 8th ISET

Mr. President of Kasetsart University, keynote speakers, conference organizing committee, distinguished guesses, ladies and gentlemen; on behalf of Science Education Association (Thailand) I would like to welcome you all to the 8th International Conference for Science Educators and Teachers or the ISET 2021. This year our conference's theme is Global Challenges on Educational Quality: Effective and Innovative Teaching and Learning for all.

ISET is a yearly conference on science education and it was arranged successively from 2013 to 2019. Because of the global pandemic of covid-19, we need to skip the year 2020 conference. The virus outbreak have brought us so many new normal ways of life and that includes new normal procedures in education. Not only ISET conference but also normal face-to-face classrooms as well as scientific experiments in a laboratory are replaced by on line conference and on line teachings. It seem that on lines are the new normal major mean of education. I think that how to deliver good science educations to students is one of the challenges problem on education quality for science educators.

I would like to express my deep acknowledgement to Faculty of Education and Development Sciences, Kasetsart University at Kamphaeng Saen campus for her kind and excellent major host of ISET 2021. I also would like to pay my appreciation to Faculty of Education, Kasetsart University, Faculty of Education, Khon Kaen University, Ubon Ratchathani University, Rajaphat Phuket University and Science Education Center, Faculty of Science, Sinakharinwirot University for their co-hosts of the conference. Hardworking of every conference organizing committee to make the beautiful ISET 2021 become true is sincerely gratitude. Finally, I would like to pay a great thank to every single participant for his and her role of the conference. The conference never be completed without your participation.

Welcome again to the eighth International conference for Science Educators and Teachers, the first ISET online conference. I do believe that ISET 2021 will be a productive meeting for everyone.

Thank you

Nason Phonphok, Ph.D
President of Science Education Association (Thailand).

Conference Information

Conference Background

According to two academic meetings on science education in 2011, organized by Science Education Center, Srinakharinwirot University, the participants who were science educators, faculty members and experts from several universities and academic institutes in Thailand had discussed and exchanged ideas about the establishment of Science Education Association of Thailand. All participants are interested and realized the importance of establishment of the association. With the same direction of agreement, the association's goals and vision for development of science education are set.

Science Education Association (Thailand) commits to operate mainly for the sake of the commonwealth at both of national and international levels in order to improve science teaching and learning and to promote science literacy for all citizens. The committee of SEAT realize that researching and exchanging of experiences, knowledge and expertise among those who gets involved is a crucial path for the advancement of science education. Therefore, the International Conference for Science Educators and Teachers or ISET is set as one of regular main activities of SEAT.

The goal of ISET is to provide an opportunity for researchers, scholars, educational personnel and teachers from different countries to present their valuable researches, to exchange and discuss their experiences and point of views, and to initiate a strong network of cooperation.

- The 1st ISET (2013) "Science Education in the Hi-speed World" Organized by Science Education Center, Srinakharinwirot University at Pattaya, Thailand (9-11 May, 2013)
- The 2nd ISET (2014) "Science Education for the 21st Century: Transforming Classrooms for The Next-Generation Learners" Organized by Faculty of Education, Thaksin University at Phuket, Thailand (16-18 July, 2014)
- The 3rd ISET (2015) "On the rise of ASEAN, Science Education Superpower" Organized by Faculty of Education and Faculty of Education and Development Sciences, Kasetsart University at Phuket, Thailand (17-19 July, 2015)
- The 4th ISET (2016) "Bridging the Gap, Moving to the Future" Organized by Faculty of Education, KhonKaen University at KhonKaen, Thailand (3-5 June, 2016)
- The 5th ISET (2017) "The integrated Science Teaching and Learning in the 21st Century" Organized by Phuket Rajabhat University at Phuket, Thailand (6-8 June, 2017)
- The 6th ISET (2018) " Strengthening science education: Collaboration for a brighter future" Organized by Science Education Center Faculty of Science Srinakharinwirot University at Bangkok, Thailand (7-9 May, 2018)
- The 7th ISET (2019) " Science education for global sustainability : Integration and innovation" Organized by faculty of science Srinakharinwirot university at Pattaya, Thailand (8-9 August 2019)

ISET 2021 Organizers

Kasetsart University

Science Education Association (Thailand)

Faculty of Science Srinakharinwirot University

Faculty of Education Khon Kaen University

Ubon Ratchathani University

Phuket Rajabhat University

Organizing Committee

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Editorial Board

Keynote Speakers

Professor Dr. Charles Henderson

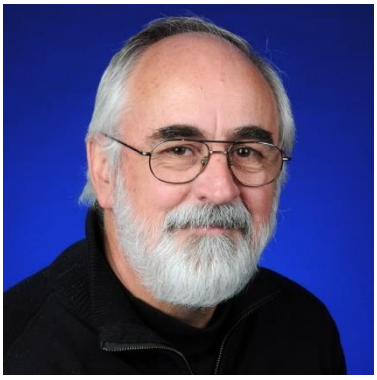
Professor at Western Michigan University (WMU)

Dr. Charles Henderson is a Professor at Western Michigan University (WMU), with a joint appointment between the Physics Department and the WMU Mallinson Institute for Science Education. He is the Director of the Mallinson Institute and co-Founder and co-Director of the WMU Center for Research on Instructional Change in Postsecondary Education (CRICPE). His research program focuses on understanding and promoting instructional change in higher education, with an emphasis on improving undergraduate STEM instruction. Dr. Henderson's work has been supported by over $9M in external grants and has resulted in many publications (see https://sites.google.com/view/chenderson). He is a Fulbright Scholar and a Fellow of the American Physical Society. Dr. Henderson is the senior editor for the journal Physical Review Physics Education Research and has served on two National Academy of Sciences Committees: Undergraduate Physics Education Research and Implementation, and Developing Indicators for Undergraduate STEM Education.

Good Ideas and Evidence are not Sufficient to Change Teaching Practices

Dr. Charles Henderson
Professor at Western Michigan University (WMU)

Researchers in undergraduate STEM education have shown that many aspects of teaching can be systematically studied and improved using scientific methods. There is now a convincing body of research showing that a wide variety of innovative programs and practices can consistently improve student learning and other desired outcomes when compared to traditional programs and practices. Like most fields, though, there is a substantial gap between the research-based knowledge about effective instruction and actual practices. Change agents in higher education typically attempt to bridge this gap by developing stronger evidence supporting the efficacy of innovative practices and telling more people about this evidence. In this presentation I will argue that this type of change strategy, focused on convincing individuals through rational arguments and data, is not sufficient to bring about sustained curricular change. I will introduce a framework of four core change strategies and discuss how curriculum developers and change agents can put more emphasis on change strategies that focus on environments and structures.



Professor P John Williams

Director of Graduate Studies in the School of Education at Curtin University in Perth, Western Australia

Dr. John Williams is a Professor of Education and the Director of Graduate Studies in the School of Education at Curtin University in Perth, Western Australia, where he teaches and supervises research students in STEM and technology education. Apart from Australia, he has worked and studied in a number of African and Indian Ocean countries and in New Zealand and the United States. His current research interests include STEM, mentoring beginning teachers, PCK and electronic assessment of performance. He regularly presents at international and national conferences, consults on Technology Education in a number of countries, and is a longstanding member of eight professional associations. He is the editor of the Australasian Journal of Technology Education, advisory editor of the International Journal of Technology and Design Education, series editor of the Springer Contemporary Issues in Technology Education and is on the editorial board of five other professional journals. He has authored or contributed to over 240 publications, and is elected to the International Technology and Engineering Education Association's Academy of Fellows for prominence in the profession.

Technology and Engineering in STEM

Prof. P John Williams
Director of Graduate Studies in the School of Education at Curtin University in Perth, Western Australia

There is a tendency for Technology and Engineering (T&E) to get lost, or at least misrepresented, in STEM, for explicable reasons:

- T&E are less well established as curriculum subjects
- Fewer school teachers are trained in T&E
- The content of T&E is more ambiguous than Science and Mathematics
- The activities of T&E require workshop facilities, materials, tools and equipment.

Just like Science and Mathematics, the disciplines of Technology and Engineering are characterized by both content and process, and to focus on just one or the other is a misrepresentation. This presentation will focus on the essence of Technology and Engineering, and how that can be incorporated into integrated STEM projects.

Professor Dr. Gillian Roehrig

Professor of STEM Education at the University of Minnesota

Dr. Roehrig is a professor of STEM Education at the University of Minnesota. Her research explores issues of professional development for K-12 science teachers, with a focus on beginning teachers and implementation of integrated STEM learning environments. Her work in integrated STEM explores teachers' conceptions and implementation of STEM, curriculum development, and student learning in small groups during STEM lessons. She has received over $30 million in federal and state grants and published over 100 peer-reviewed journal articles and book chapters. She is a former board member of the National Association of Research in Science Teaching and former president of the Association for Science Teacher Education.

Measuring Integrated STEM Classroom Practices: The Development of a New Observation Protocol.

Professor Dr. Gillian Roehrig
University of Minnesota

Integrated STEM education is a global phenomenon with countries across the world engaged in efforts to engage students in interdisciplinary approaches to science learning. Yet, there is still no one accepted definition of integrated STEM instruction. There are some areas of agreement regarding integrated STEM: (a) the inclusion of an authentic, real-world context; (b) explicit connections between science, technology, engineering, and mathematics; (c) an understanding of different STEM career pathways; (d) intentional development of 21st century competencies; and (e) an emphasis on student-centered pedagogies. In spite of these agreed upon characteristics, the field lacks an observation protocol for observation of teaching of integrated STEM. Without a classroom observation protocol aligned with integrated STEM, the field cannot move forward and offer useful recommendations to promote integrated STEM in classrooms. This presentation focuses on the development of a K-12 integrated STEM Observation Protocol, including the results of an exploratory factor analysis that presents possible dimensions of integrated STEM.

Professor Dr. Samia Khan

Professor at the University of British Columbia, Canada

Dr. Samia Khan is a professor at the University of British Columbia, Canada. She was a public-school science teacher and a recipient for the Canadian Prime Minister's Award for Teaching Excellence in Science, Mathematics, and Technology. Dr. Khan completed her doctorate from the University of Massachusetts-Amherst, US before joining the University of British Columbia in Canada. She has since worked to understand how to improve STEM education and science teacher education using model-based teaching. Dr. Khan has also published on case study methodology and cross-case analysis and does research on educational technologies. She has taught in e-learning environments for over 15 years. Dr. Khan has been an editorial board member for major science education journals and led international research collaborations in Rwanda, Scotland, and Southeast Asian countries. Her work has been continuously funded by Canadian, American, and UK funding agencies. Khan was formerly a Chair of Education and Associate Dean of Research in the UK and regularly provided briefings to the government on STEM education.

Teaching Science as though the Future Depends on It

Professor Dr. Samia Khan
University of British Columbia, Canada

This talk is about science education because, I suggest, our future depends on it. The Pandemic is one of a myriad of complex problems that demands citizens engage in science. I propose that we can amplify this engagement and understanding of complex problems by using models within science education. In this keynote, I will discuss how we can teach people how to better reason with models. I will also share the latest research on model-based teaching in science teacher education. If we can better reason with models, we can gain critical understanding of socioscientific problems.

Professor Lilia Halim
Professor in Science Education at the Faculty of Education,
Universiti Kebangsaan Malaysia

Lilia Halim is a professor in Science Education at the Faculty of Education, Universiti Kebangsaan Malaysia. Her research interest and work revolves around promoting scientific literacy through three main research thrusts; a. Investigating and developing science teachers pedagogical content knowledge (PCK), b. propagating pedagogical model for promoting innovative thinking in science and now known as STEM education and c. exploring the role of nonformal science learning in the Malaysian context. Lilia was also involved in the roadmap planning for science and mathematics (2015-2020) for the Regional Science and Mathematics Centre (RECSAM) in Penang . In addition, she and the team from UKM was involved in the evaluation of the Malaysian education system that provided inputs to the Malaysian Education Blueprint 2013-2025. Lilia has also contributed to the resource pack on pedagogies for Girls in STEM as part of Malaysia/UNESCO –IBE Project, Strengthening STEM Curricula for Girls in Africa and Asia and the Pacific. In terms of publications, Lilia has written research articles in the science and mathematics journals and book chapters in publishers such as Kluwer, Springer, Routledge and Sense Publishers.

Science communicators as STEM educators: Theory and Practice

Professor Lilia Halim
Universiti Kebangsaan Malaysia

Informal STEM education acts as a complement to formal education in attracting students to participate in STEM fields. Previous studies have shown a positive effect on students who are engaged in informal STEM activities in terms of knowledge, attitude and interest in STEM and the desire to engage in STEM careers. This talk will present a theoretical and research-based evidence of what aspects of informal mentoring that help school students to learn STEM effectively. What competencies (knowledge, skills and attitudes) are needed to be effective STEM facilitators who may not be pedagogue skilled? This presentation will focus on the PCK for integrated instruction in formal and informal settings. Empirical findings related to PCK for integrated STEM in informal settings include content knowledge, psychomotor skills for handling materials and equipment for integrated STEM instruction, inquiry and problem-solving skills, and meta-reflective questioning techniques. In addition to knowledge and skills, disposition of the facilitators', such as advising and sharing, can contribute to lessening the gap between the students, the facilitators and the STEM disciplines and these dispositions are equally important to the effective implementation of integrated STEM activities especially in the context of an Asian culture.

Associate Professor Dr. Khajornsak Buarapha
Associate Professor of Education at the Institute for Innovative Learning (IL), Mahidol University, Thailand.

Dr. Khajornsak Buaraphan is an Associate Professor of Education at the Institute for Innovative Learning (IL), Mahidol University, Thailand. Dr. Khajornsak's area of expertise and interest includes: Pedagogical Content Knowledge (PCK), Technological Pedagogical and Content Knowledge (TPACK), Nature of Science (NOS), teacher education, multigrade teaching, metacognition, scientific argumentation and innovative ways of teaching and learning. He published more than 41 papers in refereed international journals and 21 proceedings. Dr. Khajornsak serves as Editorial Review Board for Journal of Science Teacher Education (JSTE) and reviewers for several international journals e.g. Teaching Education, Asia-Pacific Journal of Educational Research, Asia-Pacific Forum on Science Learning and Teaching and Internation Asia-Pacific al Journal of Learning. In 2021, Dr. Khajornsak has been appointed from the Cabinet to be the Executive Board of the Health Systems Research Institute (HSRI), Ministry of Public Health. He also serves the professional organization as the Committee of the Science Education Association of Thailand (SEAT)

Scientific argumentation in the educational context of Thailand

Khajornsak Buaraphan
Mahidol University, Institute for Innovative Learning

One important feature of scientific inquiry is scientific argumentation. There is a relationship between the level of scientific argumentation skill and scientific understanding. Science learners are, therefore, aimed to be able to utilize their scientific knowledge to generate scientific argumentation through cognitive processes and communicate with their peers and teacher. The author reviewed the literature related to scientific argumentation in the educational context of Thailand. There were 15 papers published between 2001 to 2018 directly related to scientific argumentation. Most of them (11 of 15) studied with the higher-secondary education (grades 10-12); only three of them studied with the lower-secondary education (grades 7-9); and one studied with assessment of scientific argumentation. The popular pedagogical approach used to promote scientific argumentation was the Socio-scientific Issue (SSI) (6 of 15), scientific inquiry (3 of 15), Science-Technology-Society (2 of 15), context-based learning (1 of 15), and cooperative learning (1 of 15) approaches. Some authors mixed more than one pedagogical approach to promote scientific argumentation as scientific inquiry plus cooperative learning approaches; while others tried to create their own pedagogical model. Anyway, all of them claimed that their chosen or created pedagogical approaches were significantly effective in helping the participants develop their scientific argumentation. Most of the studies tried to develop the participating students' scientific argumentation skill; however, some studies tried to study the relationship between the level of scientific argumentation and other research variables as conceptual understanding (4 of 15), reasoning ability (4 of 15), and scientific argumentation writing (1 of 15). At final, some gaps from the literature are identified and some suggestions are emerged for further study.

Keyword: Scientific argumentation, science teacher, pedagogical content knowledge (PCK), Thailand

Assistant Professor Dr. Purim Jarujamrus
Assistant Professor at the Department of Chemistry, Faculty of Science, Ubon Ratchathani University.

Dr. Jarujamrus is an Assistant Professor at the Department of Chemistry, Faculty of Science, Ubon Ratchathani University. He's recognized in Analytical Chemistry for his frontier research achievements which revolve around the development of paper and thread as substrates for low-cost microfluidics& sensors combined with the functional nanocomposites-based methodologies for environmental and food monitoring, diagnosis as well as the context of analytical chemistry education. He has authored more than 50 peer-reviewed journal papers and/patents (h-index: 15). He has also been acting as a reviewer to many high-impact of scientific journals in Analytical Chemistry as well as being invited to give a lecture and talk at many international and national conferences. Besides, he has been a chairman of the academic laboratory competition of the National Chemistry Olympiad in 2018. He has also been recognized with awards including the Young Researcher Award (2015), NorthEastern Science Park (NESP) Innovation award (2018), Ubon Ratchathani's staff honors and awards event for an excellently recognizable staff (2018), Research for patented award, Faculty of Science, Ubon Ratchathani University 2019 as well as awarded many research grants.

Current trends in analytical chemistry education by using paper and thread as low-cost experimental devices

Purim Jarujamrus, Saksri Supasorn and Sanoe Chairam
Ubon Ratchathani University

The laboratory experiment is among the key factors affecting the visualization and conceptualization of students of this topic and because of this it counts as one of the most effective ways to keep students engaged during the class. However, oftentimes certain experiments are not suited for the educational context due in part to limited access to sophisticated analytical instruments and laboratories as is the case in many schools and universities. Hence, simple experiments that require inexpensive laboratory facilities, consume little time, and are easy to conduct with cost-effective materials would be highly desirable. Therefore, this talk aims to demonstrate our recent development of analytical chemistry education by using paper and thread as low-cost experimental devices[1-3]. Our proposed low-cost experimental devices are low-cost, easy to fabricate& use, portable and mass production, less time-consuming in a laboratory experiment with minimized consumption of reagents & waste production which are following "Green Chemistry" principles, and suitable for various educational purposes. These could also be implemented to serve as an experimental into introductory chemistry laboratory courses, especially in developing countries. These proposed experimental devices are a new approach not only to enhance students' learning of various educational objectives, but also to present potential applications of proposed ones into all levels of chemistry from middle school through college classes.

ISET 2021 Program

ISET 2021 PROGRAM OVERVIEW		
Day 1 : 7 July 2021		
08.00-08.30	Registration	
08.30-09.00	Opening ceremony -Welcome speech from 1) The President of Kasetsart University 2) The Vice President of Kasetsart University, Kamphaeng Saen Campus 3) Dean of Faculty of Education and Development Science, Kasetsart University, Kamphaeng Saen Campus 4) The President of Science Education Association (Thailand)	
09.00-10.00	Plenary session: Prof. Charles Henderson	10:00 – 11:00 pm EDT
10.00-11.00	Keynote 1: Prof. Gillian Roehring	10:00 – 11:00 pm CDT
11.00-12.00	Keynote 2: Prof. John Williams	12:00 – 1:00 pm AWST
12.00-13.00	Lunch	
13.00-14.00	Concurrent session I	See detailed program
14.00-14.15	Break	
14.15-15.15	Concurrent session II	See detailed program
15.15-15.30	Break	
15.30-16.30	Poster session	See detailed program
Day 2: 8 July 2021		
09.00-10.00	Keynote 3: Prof. Samia Khan	7:00 – 8:00 pm PDT
10.00-11.00	Keynote 4: Prof. Khajornsak Buaraphan	
11.00-11.15	Break	
11.15-12.15	Concurrent session III	See detailed program
12.15-13.15	Lunch	
13.15-14.15	Concurrent session IV	See detailed program
14.15-14.30	Break	
14.30-15.30	SEAT committee meeting	
Day 3: 9 July 2021		
09.00-10.00	Keynote 5: Prof. Lilia Halim	9:00-10:00 am MYT
10.00-11.00	Keynote 6: Prof. Purim Jarujamrus	
11.00-11.15	Break	
11.15-12.15	Concurrent session V	See detailed program
12.15-13.30	Lunch	
13.30 – 14.30	Closing ceremony	

Online Conference Information

The 8th international Conference for Science Educators and Teachers will be held online through CISCO WebEx.

CISCO WebEx can be downloaded on computer or on your mobile device from https://www.webex.com/downloads.html

You can join the whole conference through the link below.

The 8th international Conference for Science Educators and Teachers Hosted by Faculty of Education and Development Sciences Kasetsart University https://ku-edu.webex.com/ku-edu/j.php?MTID=mcfcbd74959d1bd66ce6ae4cd2b61872a Wednesday, Jul 7, 2021 8:00 am | 12 hours | (UTC+07:00) Bangkok, Hanoi, Jakarta Meeting number: 184 557 4760 Password: iset2021

*We encourage all presenters to try testing CISCO WebEx by joining the simulated conference on the 5th and 6th of July, 2021 between 8:00am – 16:00pm Indochina Time through the same link above.

**There will be the main online conference room for ceremony, Plenary session, and Keynote sessions with 3 breakout sessions for oral presentation (Room A, Room B, and Room C)

***For **POSTER** presenters, please submit your 10-minute presentation video, and PowerPoint slide or Poster files to iset2021krabi@gmail.com by 5th of July, 2021. The videos and slides will be posted at https://drive.google.com/drive/folders/1jQE3ouWdyHMfzdKUyA-V9tOEzMLhRKne?usp=sharing

Presentation Schedules

Date: July 7, 2021
Concurrent Session I
Time: 13.00 - 14.00 GMT

No	Topic	Time	Page
	Oral session I-A Chairperson: Navara Seetee Strand 1: School science teaching and learning		
A01	The Effects of Gamification in Scientific Thinking Online Test Bank for Ninth Grade Students *Sirintra Ardhan, Tussatrin Wannagatesiri, and Witat Fakcharoenphol*	13.00-13.15	26
A02	Developing Creative Problem Solving Assessmenton Water Crises for Elementary School Students *Chompunut Kaewjairak, Kulthida Nukultham and Tussatrin Wannagatesiri*	13.15-14.30	27
A03	The Development of Phenomenon-based Learning in Teaching Plant Life for Grade 7 Students *Salinthip Promyong and Khajornsak Buaraphan*	13.30-13.45	28
	Oral session I-B Chairperson: Akarat Tanak Strand 5: Thinking skills in science education		
B01	The Development of Active Learning Model for Developing Grade 7 Students' Learning Achievement and Critical Thinking Skills in Science Subject *Khwankamon Chiangwiriya and Khajornsak Buaraphan*	13.00-13.15	29
B02	The Development the System Thinking Ability Assessment on the Chemistry Courses for Secondary School Students *Sunisa Thapseang and Kulthida Nugultham*	13.15-14.30	30
B03	Perceptions of Grade 11 Students toward Creativity and Critical Thinking Skills through STEM Activity *Tharuesean Prasoplarb and Chatree Faikhamta*	13.30-13.45	31
	Oral session I-C Chairperson: Pattamaporn Pimthong Strand 1: School science teaching and learning Strand 10: Online and ICT in Science Teaching and Learning		
C01	Fourth Grade Students' Ability to Engage in Scientific Argumentation in Health-Related Issues *Darunee Plao and Ladapa Ladachart*	13.00-13.15	32
C02	Developing the ICT embedded Geo Literacy Learning Model for Developing Grade 9 Students' 21st Century Skills *Pantip Donknanpai and Jirutthitikan Pimvichai*	13.15-14.30	33

C03	Effects of TPACK-Problem-Based Learning in Developing Grade 10 Students' Learning Achievement and Problem Solving Skills on Function Matters *Maneerat Srichan and Khajornsak Buaraphan*	13.30-13.45	34
C04	Promoting Attitude toward STEM of High School Student through STEM Partnership for Design-based Learning in PM 2.5 Crisis Songchai Ugsonkid, Tassaneewon Lertcharoenrit, Sutasinee Kityakarn, Ratiporn Munprom and Pattamaporn Pimthong	13.45-14.00	35

Date: July 7, 2021
Concurrent Session II
Time: 14.15 - 15.15 GMT

No	Topic	Time	Page
	Oral session II-A Chairperson: Tepkanya Promkatkeaw Strand 1: School science teaching and learning		
A04	Learning Approaches Enhancing Students' Ability in Constructing Scientific Explanation: A Meta-Analysis Study *Piriya Wannathai, Chaninan Pruekpramool and Chanyah Dahsah*	14.15-14.30	36
A05	Effects of STSE Teaching Model in the Acid-Base Balance Topic for Enhancing Grade 11 Students' Learning Achievement and Problem-Solving Skill *Ratanaphun Utmeemang and Khajornsak Buaraphan*	14.30-14.45	37
A06	Development of Do It Yourself (DIY) Hands-On Activities on Earth Structure and Dynamics for Enhancing Eighth Grade Students' Design Ability *Chotika Srikamthai, Witat Fakcharoenphol, and Tussatrin Wannagatesiri*	14.45-15.00	38
	Oral session II-B Chairperson: Jeerawan Ketsing Strand 4: Assessment of student learning in science		
B04	An Evaluation of 8th Grade Students' Infographics about Human Respiratory System *Pattamaporn Kaewkhongkha, Witat Fakcharoenphol, Tussatrin Wannagatesiri and Nantarat Kruea-In*	14.15-14.30	39
B05	Scientific Explanation Assessment for Science Student Teachers *Tawan Chaiwon, Kulthida Nukultham, Tussatrin Wannagatesiri*	14.30-14.45	40
B06	Exploring Scientific Media Literacy Skills and Self-efficacy of Seventh Grade Students in Samutprakarn Province *Korakoch Tangcharoenlap, and Theerapong Sangpradit*	14.45-15.00	41

	Oral session II-C Chairperson: Jiraporn Tupsai Strand 7: Teacher education and professional development Strand 1: School science teaching and learning		
C05	Pre-service Science Teachers' Experience of and Attitude towardsTeaching Science by Drama *Aganit Seepootorn, Siriporn Kruatong, Tussatrin Wannagatesiri, Thanyanan Sripanlom, Pruek Prongsamrong*	14.15-14.30	42
C06	Teachers' Pedagogical Beliefs on Teaching Science: the Key Frontierin the Quest to Implement Inquiry-based Lessons Effectively *Witchayada Nawanidbumrung, Sara Samiphak and Noriyuki Inoue*	14.30-14.45	43
C07	Examining Thai Science Teachers' Perceptions of Technological Pedagogical Content Knowledge (TPACK) in Opportunity Expansion Schools *Chotikun Rinla and Thitiya Bongkotphet*	14.45-15.00	44

Date: July 7, 2021

Poster Session
Time: 15.30 – 16.30 GMT

Date: July 8, 2021
Concurrent Session III
Time: 11.15 - 12.15 GMT

No	Topic	Time	Page
	Oral session III-A Chairperson: Chaninan Pruekpramool Strand 1: School science teaching and learning		
A07	Exploring Grade 10 Thai Students' Scientific Explanation about Ecological Balance *Wittawas Inyasri, Tussatrin Wannagatesiri, Kulthida Nugultham and Nantarat Kruea-In Kruea-In*	11.15-11.30	45
A08	Development of Game Based Learning Activities in Biodiversity Enhancing Fourth Grade Students' Algorithms Design Skills *Salinthip Bunloet, Kulthida Nugultham and Nantarat Kruea-In*	11.30-11.45	46
A09	Development of Active Online Learning Activities for Enhancing Grade 4 Students' Learning Achievement of Living Things *Kamonchanok Ploytubtim, Kulthida Nugultham and Nantarat Kruea-In*	11.45-12.00	47
	Oral session III-B Chairperson: Pairoh Sohsomboon Strand 6: STEM education Strand 8: Non-formal and informal science learning		
B07	Using Metacognitive-based STEM Education for Developing Grade 11 Students' Learning Achievement and Metacognition in Acid and Base *Piyaporn Na Lampang and Khajornsak Buaraphan*	11.15-11.30	48
B08	Effects of STEM Activities Integrated with "Phu Thai" Local Context to Develop Grade 11 Students' Learning Achievement and Local Culture Conservation *Phacharawan Meenongwha and Khajornsak Buaraphan*	11.30-11.45	49
B09	The Development of STEM for Developing Grade 8 Students' Learning Achievement and Creative Thinking in Prism and Cylindrical Topic *Ratchadaporn Panyanual and Jirutthitikan Pimvichai*	11.45-12.00	50
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B16	Indigenous Knowledge of Bulan Kite in the Deep South of Thailand for Teaching Meaningful Physics Concepts *Roseleena Anantanukulwong, Surasak Chiangga and Pongprapan Pongsophon*	11.45-12.00	67

Oral Presentation Abstracts

A01 The Effects of Gamification in Scientific Thinking Online Test Bank for Ninth Grade Students

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Abstract

The purpose of this research is 1) to develop a gamification in scientific-thinking-online-test-bank, 2) to compare scientific thinking skills before and after the use of the gamification in scientific-thinking-online-test-bank, and 3) to study satisfaction gamification in scientific-thinking-online-test-bank. The sample group was all 36 K-9 students from a small-sized school in Ayutthaya, Thailand. The research instruments consisted of 1) gamification in scientific-thinking-online-test-bank, 2) an online scientific thinking assessment, and 3) Likert scale satisfaction questionnaire on the use of gamification in scientific-thinking-online-test-bank. The gamification in scientific-thinking-online-test-bank lasted 8 weeks covering Living creatures, Substances and properties of substances and Energy. The scientific thinking scores between before and after the lesson of students with both scores were compared using dependent sample t-test. The results of the researchwere as follows: 1) the average scientific thinking score after the use of gamification in scientific-thinking-online-test-bank is significantly higher (t (12) = 6.92, p < .001) and 2) the satisfaction the gamification in scientific-thinking-online-test-bank is at Very satisfied level.

Keywords: Scientific thinking, Gamification, Scientific thinking online test bank

A02. Developing Creative Problem Solving Assessmenton Water Crises for Elementary School Students

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Abstract

The purpose of this research was to develop and implement the assessment of creative problem solving (CPS) test and rubric score based on Treffinger's citation. The CPS test consisted of seven open- ended questions on water crises, following the concept of CPS Version 6.1™ citation: understanding the challenge (constructing opportunities, exploring data and framing problems), generating ideas, preparing for action (developing solutions andbuilding acceptance) and planning your approach (appraising tasks and designing process). It was implemented in a STEM project classroom of the 12 fifth and sixth grade students in smallpublic elementary school in Western Thailand. The students' solutions were analyzed based onthe supposed and reasoned solutions using the CPS rubric score. The reliability coefficient (Cronbach's alpha) of the CPS test was 0.715. The results demonstrated that the students can solvethe problems under the given situations creatively with science concepts and understanding ofproblem solving which sketch model supporting the solution from the use of moderate-high level in engineering design processes.

Keywords: Creative problem solving, Assessment, Rubric score, STEM education

A03. The Development of Phenomenon-based Learning in Teaching Plant Life for Grade 7 Students

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Abstract

The Phenomenon-based Learning (PhBL) is proposed as a teaching method for enhancing learners' meaningful learning in science. PhBL utilizes a real-life phenomenon as the starting point in learning and aims to help learners gain deep understanding by linking the proposed phenomenon with learners' prior experiences. However, from the intensive review of literature related to PhBL in Thailand, there is a limited understanding in using PhBL as a pedagogy in teaching Plant Life for Grade 7 students. This article aimed to: a) provide a synthesis of PhBL teaching steps for teaching the Plant Life topic for Grade 7 students; b) write PhBL lesson plans on Plant Life; and c) check the quality of the PhBL lesson plans. From the synthesis of literature, the PhBL teaching steps were consisted of seven teaching steps: 1) Review previous knowledge, 2) Present the phenomenon, 3) Select phenomena, 4) Observe the phenomenon, 5) Learn from the phenomenon, 6) Comment and criticize, and 7) Evaluate and reflect. The authors created nine PhBL lesson plans on Plant Life for Grade 7 students that took 20 teaching hours. The phenomenon used in the lesson plan was the growth of plants in the natural context around students. Then, five experts were asked to validate the quality of the PhBL lesson plans. The experts' evaluation was calculated for the Index of Item-Objective-Congruence (IOC). The IOC of PhBL lesson plans on Plant Life for Grade 7 students were qualified with the IOC in the highest level at 1.00. The implementation of these PhBL lesson plans in real classroom practice will be reported in the subsequent paper.

Keywords: Phenomenon-based learning, Plant Life, Grade 7

B01. The Development of Active Learning Model for Developing Grade 7 Students' Learning Achievement and Critical Thinking Skills in Science Subject

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Abstract

Active Learning is useful in developing several important skills for learners in science. However, the definition of active learning is varied among educators. This research aimed to: 1) develop new active learning model (ALM) to teach science for Grade 7 students; and 2) compare students' learning achievement and critical thinking skill prior and after the ALM science lessons on the Plant Sustenance topic. The sample was 80 Grade 7 students enrolled inthe first semester of 2020 academic year at one secondary school in Phayao province, Thailand.The data collection methods included the panel of experts' Evaluation of ALM lesson plans, the Learning Achievement Test and the Critical Thinking Skill Test. The Evaluation of ALM lesson plans on the Plant Sustenance topic was calculated for their Index of Item-Objective- Congruence (IOC). Also, the students' learning achievement and critical thinking skill prior and after the ALM science lessons in the Plant Sustenance topic were analyzed by using the paired-samples t-test. From the intensive literature review, the researchers synthesized ALM, which was consisted of five teaching steps: a) Preparation and introduction b) Active Participation, c) Discussion d) Application and Reflection, and e) Evaluation. The researchers created six ALM lesson plans on Plant Sustenance. The IOC of ALM lesson plans on Plant Sustenance was ranged from 0.80 to 1.00 that was in an accepted interval. After learned with the ALM lesson plans, the students significantly improved their learning achievement test andthe critical thinking skill at the .01 statistically significant level. The implications of the ALM for teaching science is finally discussed.

Keywords: Active learning model, Learning achievement, Critical thinking skill, Science subject, Grade 7

B02. The Development the System Thinking Ability Assessment on the Chemistry Courses for Secondary School Students

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Abstract

The main purpose of this study was to design and develop the tool to assess the system thinking ability for Secondary school students. The study was performed according to the procedure which was divided into 2 steps. The first step was to design and develop the tool to assess the System thinking ability three factors: (1) ability to identify the components of systems (2) ability to identify relationships among the systems (3) ability to understand the dynamic behavior within the system and holistic view and the second step was to evaluate the results of using tools to measure system thinking ability. The sample, selected by purposive sampling was ten grade 10 students who study in science program. The subjective question tests from the situation in the Chemistry subject were designed and developed to use for the system thinking ability assessment with the sample groups.

The research findings were as follows: The system thinking ability of ten grade students was a fair level and the system thinking ability three factors consisting of 1) identifying the components and processes within the system was 44% 2) identify relationships among the systems was 56% and 3) associative thinking and make the big picture was 42% respectively. However, the results of this research are a preliminary evaluation of the systematic thinking ability of secondary school students to be used to develop an effective tool for evaluating system thinking

Keywords: System Thinking, Chemistry Courses, Secondary School

B03. Perceptions of Grade 11 Students toward Creativity and Critical Thinking Skills through STEM Activity

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Abstract

Creativity and critical thinking skills (2Cs skills) are key elements to drive students on integrated learning as innovators. According to previous studies, redefining of 2Cs skills together lead educators to explore students' perceptions toward each sub-components of 2Cs skills with the relations between two distinct skills. This research visualizes the perceptions about 2Cs skills of 33 grade 11 students through STEM activities. The Survey of Perceptions toward Creativity and Critical Thinking Skills (Survey Pt2Cs skills) consists of 51 questions, including the area of each sub-components of 2Cs skills, the relations between 2Cs skills, andthe practical of 2Cs skills on STEM activity features. The survey was used to collect the data,then analyzed by mean and standard derivation. The 2Cs-Test was used to collect data and analyzed by correlation coefficient to enlarge the relations of students' 2Cs skills before and after engaging STEM activity. The findings indicated students' perceptions toward the relations between 2Cs skills was highlighted, but concerned with pushing the thinking skills tothe practicing in STEM activity. The relation between sub-components of 2Cs skills showed strong positive correlation coefficient between sub-components of critical thinking skills to theimagination which is the sub-component of creativity skills before students engaging in the STEM activity, then shifted to be the originally and the elaboration after STEM activity. The findings suggest benefits of discovering students' perceptions about the effectiveness of usingcreative with logical thinking, and enhancing their perspectives on resilience to overcome the condition and constraints on STEM working.

Keywords: Creativity skills, Critical thinking skills, STEM education

C01. Fourth Grade Students' Ability to Engage in Scientific Argumentation in Health-Related Issues

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Abstract

An ability to engage in evidence- based argumentation is considered as one scientific practice necessary for students to learn at basic education. However, research investigating elementary students' ability to critically examine arguments and, if necessary, to construct counter- arguments is still rare especially in Thailand. This study aims to explore 10 male and 14 female fourth- grade students' argumentative ability in health- related issues using an open- ended questionnaire and individually semi- structured interviews. Data were analyzed using content analysis, focusing on whether the students were able to identify claims and evidence in the given arguments, whether and why the students agreed with the given arguments, and, if not agree, whether the students were able to construct counter arguments. The results indicate that, while many students were able to identify claims and evidence in the given arguments, they had difficulty deciding to agree or disagree such given arguments. Moreover, in cases that they disagreed with the given arguments, they were not able to argue against the given arguments. Furthermore, students' argumentative ability seemed to vary in different issues, depending on the extent which they were familiar with the issues under consideration.

Keywords: Argumentation, Elementary students, Health-related issues, Scientific arguments

C02. Developing the ICT embedded Geo Literacy Learning Model for Developing Grade 9 Students' 21st Century Skills

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Abstract

Geo Literacy (GL) is the term describing one's understanding of how the world worksthat all members of modern society require. Geo literacy is one's ability to reason about Earthsystems and interconnections to make far-reaching decisions. At present, Information Communication Technology (ICT) also play a major part in teaching and learning about geography. This study aimed to present the way how to apply ICT in teaching about Geo Literacy so called "the ICT embedded Geo Literacy Learning Model" (ICT-GLLM). The ICT-GLLM aimed to promote Grade 9 students' GL and 21st century skills including Reading, Writing, Arithmetic, Critical Thinking, Communication, Collaboration, and Creativity. From the documentary research, the authors created the ICT-GLLM consisting of four teaching steps:Step 1 Survey and Search - students use ICT to survey and search for more knowledge about geography; Step 2 Create - students create product from the survey and search process and prepare graphics or infographic for present data; Step 3 Present – Students utilize ICT to presenttheir products to the class or utilize other presentation formats such as short movie, clips, magazines, etc.; and Step 4 Apply – students gain GL and apply geographic knowledge and skills in their everyday lives. After that, the authors created three lesson plans followed the ICT-GLLM and tried out with one Grade 9 classroom. The results revealed that the students increased their learning achievement on geographic at the .05 statistical significant level. The Effectiveness Index (EI) of the ICT-GLLM was .75 and the E1/E2 Effectiveness (E1 and E2 are the effectiveness of process and product, respectively) was very high at 88.75/81.62.

Keywords: Geo literacy, 21st century skills, ICT, Grade 9, Thailand

C03. Effects of TPACK-Problem-Based Learning in Developing Grade 10 Students' Learning Achievement and Problem Solving Skills on Function Matters

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Abstract

This research aimed to: a) develop the Technological, Pedagogical and Content Knowledge-Problem-Based Learning Model (TPACK-PBL) for teaching the Function Matters; topic and b) develop Grade 10 students' learning achievement and problem solving skills on Function Matters. The research design was a quasi-experimental research design. The sample were two Grade 10 classrooms; one was an experimental group and another was a control group. The sample was purposively sampling. The data collection methods included 10 TPACK-PBL lesson plans on Function Matters that took 20 teaching hours. It was consisted of six teaching steps: Step 1 Define Problems, Step 2 Understand Problems, Step 3 DeterminePurpose, Step 4 Collect Information, Step 5 Present Answers and Methods to Find Answers, Step 6 Summarize and Evaluate. Each step is properly integrated technology assisted learning, the Learning Achievement Test, and the problem solving Skills Test. The statistics used for data analysis were percentage, mean, standard deviation, and paired samples t-test. The resultsrevealed that after learned the TPACK-PBL lesson plans on Function Matters, the students improved their learning achievement at the .01 statistical significance level ($t = 17.847$, $p < .01$).In addition, the students improved their problem solving skills at the .01 statistical significancelevel ($t = 18.486$, $p < .01$). These results show the effectiveness of TPACK-PBL in teaching Function Matters for Grade 10 students.

Keywords: TPACK, Problem-based learning, Learning achievement, Problem solving skills, Grade 10

C04. Promoting Attitude toward STEM of High School Student through STEMPartnership for Design-based Learning in PM 2.5 Crisis

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Abstract

Student's attitudes toward STEM are feeling or opinion toward STEM teaching and learning. Attitude could be positive or negative opinions that students have about STEM. In this study, the student's perception of STEM is a school subject. The integrated STEM was exhibited by designing a PM 2.5 detector learning unit. A science teacher, scientist, engineer, mathematics educator, and science educator worked as a STEM partnership. The learning unit consists of air pollution and PM 2.5, impact on life, air pollution indicator and pollution management. The main activity was that the students were asked to design PM 2.5 detector with the appropriate sensor. This paper presents one of three objectives that we studied in the STEM partnership project. The effect of STEM design-based learning on student attitudes was investigated. Seventy-three twelfth-grade students participated in this study. The attitude survey was administrated after the implementation of the learning unit. Moreover, the student attitudes were collected by student's reflective journal, student's interview and student's projects. The data was analysed using thematic analysis approach.The finding revealed evidence of the positive effects of implementing STEM design-based learning on student attitudes. Most students (54.29%) agreed that the STEM subject is fun, most of them happy to talk and work with scientist and engineer and 35.62% believed that they would get Grade A in this subject. However, most students showed uncertainty when they were asked to talk about their confidence and creating innovation. Further research is suggested to explore the relationship between student's attitudes toward STEM on the possibility of choosing a STEM career.

Keywords: Attitude toward STEM, STEM Education, Design based learning

A04. Learning Approaches Enhancing Students' Ability in Constructing Scientific Explanation: A Meta-Analysis Study

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Abstract

Ability in constructing scientific explanation is a process that helps students to understand the scientific phenomena and gains a better understanding of the scientific concepts. Literature review reveals that there are many learning approaches related to enhancing this ability of students. However, there are no research studies report the clear picture of how each learning approach affect better students' scientific explanation. This meta-analysis research aimed to study, gather, and analyze the research about learning approaches enhancing students' scientific explanation and analyze the effect size of each learning approach affecting students' scientific explanation. The samples for meta-analysis were the seven experimental research articles published between 2010-2020 in the Q1 journals in Scopus database and the Thai-journal Citation Index (TCI) 1 and 2 in ThaiJO database. The data analysis included descriptive statistics, content analysis, and the effect sizes using Cohen method (1988).

The results revealed that most research articles were published in 2012. They were experimental research that aimed to study and compare students' ability in constructing scientific explanation. Most samples were secondary school students and were assessed by constructing scientific explanation ability tests. The learning approaches in this research held moderate and large effects sizes. The learning approach that held the largest effect size was the Predict-Observe-Explain sequence in chemistry classroom for lower secondary school students ($d = 2.15$) followed by the Premise-Reasoning-Outcome framework in physics classroom for upper secondary school students ($d = 1.46$) and the model-based inquiry in physics classroom for lower secondary school students ($d = 1.31$), respectively.

Keywords: Meta-analysis research, Scientific explanation, Effect size

A05. Effects of STSE Teaching Model in the Acid-Base Balance Topic for Enhancing Grade 11 Students' Learning Achievement and Problem-Solving Skill

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Abstract

STSE (Science-Technology-Society-Environment) has been extended from STS and provenas effective pedagogy in science. This research aimed to: a) synthesize the STSE teaching model for teaching Acid-Base Balance in Grade 11; b) compare Grade 11 students' learning achievement and problem-solving skill prior and after learned with the STSE teaching model. The research design wasa quasi-experimental research design. The sample was 80 Grade 11 students from two classrooms atone secondary school in Nan province, Thailand; one was an experimental group and another was a control group. The data collection included the Learning Achievement Test and Problem-Solving Skill Test. The data was analyzed by using paired samples t-test. The researchers reviewed five papersrelated to STSE pedagogy and synthesized the STSE teaching model was consisted of eight steps: a)Elicit prior knowledge; b) Engagement with STSE issue; c) Identify problem, d) Explore to solve problem, e) Explain and present; f) Elaborate to STSE; g) Evaluate; and h) Extend knowledge. Afterlearned with the STSE teaching model, the students significantly improved their learning achievement($t = 8.349$, $p < .05$) and problem-solving skill ($t = 18.709$, $p < .05$) at the .05 statistical significance level.

Keywords: STSE, Learning achievement, Problem-solving skill, Acid-base balance, Grade 11

A06. Development of Do It Yourself (DIY) Hands-On Activities on Earth Structure and Dynamics for Enhancing Eighth Grade Students' Design Ability

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Abstract

The purposes of this were 1) to develop Do It Yourself (DIY) Hands-On Activities on earth structure and dynamic topic, 2) to assess students' design ability through DIY Hands - On Activity, and 3) to measure the satisfaction of the eighth - grade students after study with DIYHands-On activity. The sample was 45 eighth grade students selected by purposive sampling. Theresearch instruments consisted of 1) DIY Hands-On Activity on earth structure and dynamic topic, 2) design ability assessment which has an inter-rater reliability at 0.83, and 3) satisfaction questionnaire. During the use of DIY Hands-On Activity, the students were able to find additionalinformation on their own to be used in designing their earth models. After analyzing the information, they must draw a draft of the earth model of which will be assessed for students' design ability. Then, they selected the materials used in the model. Their selection fit quite well with the composition of each layer of the earth, for example: water pipes for the earth core, slimefor the mantle, and plastic ball for the crust. Overall, they were able to construct their earth modelaccording to the information they read. The students' average score on design ability is 10.33 outof 12 points (Excellence Level) Additionally, when teacher pointed out about the moving crust, the student designed models that the crust can move, but it was not accurate enough to be used toexplain about the moving crust. This might be due to the students' design ability, and available materials at hand. Overall students satisfy with the DIY Hands - On Activity at very good level.

Keywords: Do it yourself, Hands-on activities, Design ability

B04. An Evaluation of 8th Grade Students' Infographics about Human Respiratory System

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Abstract

This study aims to evaluate infographics created by thirty-four 8th Grade students (aged 13-14 years old) from a school in Bangkok previously learned about human respiratory system in the first semester, 2020 academic year. Without being directly taught how to make a good infographic, each of the students was assigned to create an infographic about the human respiratory system covering the meaning, organs, air pathway, inhalation and exhalation, diseases and treatments, and some statistical data related to the respiratory system. They were given a short tutorial on infographic creation and allowed to select an online design platform (Canva, Piktochart, etc.) by themselves. A scoring rubric was developed to evaluate the infographics in 2 categories: information (with 2 subcategories; content covering and accuracy) and design (with 3 subcategories; layout, fonts & colors and figures). Each subcategory scores were ranged from 1 to 3 points, 15 points in total. The result from evaluation of the infographics found that the minimum and maximum scores were 5 and9, respectively. None of the infographics was rated in a good level (scored higher than 11 points). The majority (29 infographics, 85.3%) was in a moderate level (scored between 6 - 10 points). The other 5 infographics (14.7%) were marked as poor (scored less than 5 points). It was also found thatmost of the infographics could not provide covered content. Some errors about scientific concepts and data were also found. Details and examples of students' infographics will be shown and discussed.

Keywords: Infographics, Evaluation, Lower secondary education

B05. Scientific Explanation Assessment for Science Student Teachers

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Abstract

This study aimed to develop the test for assessing the scientific explanation of science student teachers. The scientific explanation test allows respondents to identify claim, evidence, and reasoning. The test consisted of six open-ended questions related to the results of biochemistry experiments on nutrients, carbohydrates, enzymes, and lipids. The reliability of the test using Cronbach's alpha equals to 0.793. The test was implemented to 35 third-year science student teachers. Criteria for assessing the scientific explanation ability based on McNeil and Krajcik (2008) assessment framework. The data revealed that science student teachers had scientific explanation score consisted of three components: 1) claim (67.86%) 2) evidence (40.00%) and reasoning (38.57%).

Keywords: Scientific explanation, Assessment, Student teachers

B06. Exploring Scientific Media Literacy Skills and Self-efficacy of Seventh Grade Students in Samutprakarn Province

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Abstract

Media literacy is one of the necessary skills for the 21st Century because there are many exaggerated and negative media. So, Thai children and juveniles should know how to protect themselves and not to be influenced by the media. The purposes of this study were to 1) study Scientific Media Literacy Skills (SMLS) in seventh-grade students 2) study self-efficacy of SMLS in seventh-grade students and 3) study the relation between SMLS and self-efficacy of seventh-grade students. The sample of this study was 488 seventh-grade students in the second semester of the academic year 2019, using a stratified random sampling method from extra-large, large, and small size schools under the secondary educational service area office Samutprakarn. The research instruments consisted of 1) SMLS test, the test reliability was 0.74, the difficulty ranged from 0.22 to 0.71 and a degree of discrimination greater than 0.2. 2) SMLS self-efficacy questionnaire, the questionnaire reliability was 0.89 and a degree of discrimination greater than 0.2. The data were analyzed using frequency, percentage, means, standard deviation and Pearson correlation.

The results were as follows: SMLS mean score of the students was 40.43% (S.D.=4.9), Most students (55.94%) wereon level 2 (comprehension) of cognitive level.
Self-efficacy of SMLS mean score of the students was 68.64% (S.D.=2.80), Moststudents (47.54%) were on a high level. the relation between SMLS and self-efficacy of the students has positive relation in lowlevel at .01 level of significance and correlation coefficients was also in low level at 1.95.

Keywords: Scientific media literacy skills, Self-efficacy, Media literacy

C05. Pre-service Science Teachers' Experience of and Attitude towards Teaching Science by Drama

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Abstract

This study investigated the pre-service science teacher's attitude towards drama-based activity in science camp for primary school student. The research participants were 16 pre- service science teachers who volunteer to be a staff in the science camp. They were assignedto provide science drama. For that, they attended a 7-days training workshop to enhance 1) assertive skill, 2) pronunciation skills, and 3) dramatic action and also brainstorm to create theirown science drama plot and script. They performed story of "Little red riding hood" by incorporate with simple science activities, for example; bottle eggs, fire gloves, and water bottle rockets. After perform science drama, the pre-service science teachers were interviewed for exploring their attitude towards teaching science by drama. Based on the students' responses in this interview, it can be concluded that pre-service science teachers had thepositive attitude toward teaching science by drama in terms of students' understanding of and their satisfaction with the sciences. There were 15 pre-service science teachers stated that they would apply drama-base science teaching in the future career. Moreover, pre-service science teacher had gain teamwork and assertive skills during preparation of the performances. This study recommends that workshops and courses should be held for science teachers in order to train them in the use of drama in primary education.

Keyword: Drama-base science teaching, Drama science experience, Pre-service science teachers

C06. Teachers' Pedagogical Beliefs on Teaching Science: the Key Frontierin the Quest to Implement Inquiry-based Lessons Effectively

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Abstract

A major trend in science education reform is an emphasis toward inquiry-based instruction over transmission-based teaching. However, implementing a classroom inquiry is ahuge challenge for many teachers, especially pre-service teachers. Teachers' beliefs have beenargued to have strong influence on such a pedagogical practice. This research report discussesa study that investigated Six Thai pre-service teachers' beliefs on teaching science in relation to their practices that involved their attempts to implement inquiry-based lessons. A content analysis of interviews and classroom observations were used to investigate the quality of theirinquiry-based lessons and how pre-service teachers' beliefs on teaching science affected theiractual practices. The study found that even though pre-service teachers agreed on the value ofinquiry-based teaching and attempted to implement inquiry-based lessons in their teaching, many of the lessons they tried it out in their science classrooms had a number of problems thatseemed to stem from their beliefs on teaching science. One of the problematic beliefs that theyseemed to have was that teachers giving explanations of what happened in hands-on activitiesto students was sufficient to help students make sense of what they did in hands-on activities, rather than to eliciting them to construct scientific concepts on their owns. There were many such beliefs found in this study that served as the key reasons belief as the problems in inquiry-based lessons. Based on these, we argue that teacher educators need to evaluate and think carefully about the nature of teachers' beliefs for actualizing effective implementations of inquiry-based lessons.

Keywords: Teachers' Beliefs, Inquiry-based teaching, Science teacher education

C07. Examining Thai Science Teachers' Perceptions of Technological Pedagogical Content Knowledge (TPACK) in Opportunity Expansion Schools

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Abstract

Technological Pedagogical Content Knowledge (TPACK) refers to the knowledge of how teachers integrated technology with specific content for science teaching practices. This study aimed to explore science teacher perceptions of TPACK in seven components includingCK, PK, TK, PCK, TCK, TPK and TPACK. The opportunity expansion schools is teaching atelementary level to lower secondary level and that has a limited of technology for science instruction. The online survey with five- point Likert scale had been distributed to 146 in- service science teachers. Seventy- five science teachers, representing fifty-one percent repliedback to this study. The data from the survey were analyzed using means and standarddeviations. In order to get in depth understanding of teachers' TPACK, three respondent teachers volunteered to be interviewed and the interview data were analyzed by content analysis. The results showed that mean value on CK (3.58), PK (3.53), PCK (3.10), TK (4.13), TPK (2.81), TCK (2.58), TPACK (2.55) and overall 3.18 therefore the teachers' perceptionsof TPACK were at moderate level. They mostly comprehended in CK, PK and TK, but they were uncertain about integrated ideas about PCK, TPK and TCK. The interview data reflectedthat the science teachers were familiar and often used PowerPoint Presentation and video clipwith their lecture, however they couldn't integrate technologies into pedagogy and content knowledge to enhance scientific inquiry competencies for their students. This study recommends that science teachers should get support from teacher organization in order to beable to integrate technology in their science classroom effectively.

Keywords: Technological Pedagogical Content Knowledge, Teachers' perceptionsScience Teachers, Opportunity Expansion Schools

A07. Exploring Grade 10 Thai Students' Scientific Explanation about Ecological Balance

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Abstract

This study aimed to explore students' ability to construct scientific explanations about balance in an ecosystem. The participants were Grade 10 students from a large-sized, private school located in Lopburi, Central Thailand. All of them had learned basic concepts about ecosystems before participating in this study. A scenario of an artificial ecosystem, freshwater aquarium, was used to assess students' scientific explanation. Data including types and numbers of survived organisms and water quality during a period of time were provided. The studentswere asked to identify their claims, evidence, and reasoning to support their ideas whether the ecosystem was in balance or not. To analyze students' responses, a specific rubric was created following Base Explanation Rubric by McNeil and Krajcik (2012). Results and examples of responses will be presented and discussed further.

Keywords: Scientific explanations, Ecosystem, High school level

A08. Development of Game Based Learning Activities in Biodiversity Enhancing Fourth Grade Students' Algorithms Design Skills

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Abstract

This research aims to develop game based learning activities in biodiversity enhancing fourth grade students' algorithms design skills. The samples were 37 students from 2 classrooms, studying in fourth grade in the first semester, 2021. The research instruments consisted of 1) the game based learning activities in biodiversity 2) algorithmdesign skills assessment which has an inter-rater reliability as 86 percent. During the game based learning class, students are able to connect content, knowledge, logical thinking, planning and predict results to lead the problem solving step-by-step. After learning class, students had a very good level of algorithm design skills. They could design and create biodiversity games; for example, bingo games, decipher games, word search games, quiz games, matching games, snake ladder games, running games, collecting images games, random wheel games, and chasing games.

Keywords: Game based learning, Algorithms design skills, Biodiversity

A09. Development of Active Online Learning Activities for Enhancing Grade 4 Students' Learning Achievement of Living Things

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Abstract

This research aims to develop and enhance the active online learning activities of Grade 4 students in relation to the thematic instruction involved in teaching living things. Thesample used in this research study comprises twenty fourth-grade students during School Year 2020, First Semester who were selected through the purposive sampling technique. The research instruments consisted of: 1) active online learning activities of living things using the online teaching platform "Edpuzzle", 2) achievement test on science concept, and 3) satisfaction questionnaire. During the activities, students could interact and pay attention to science stories and questions quite well. After the activities, the student achievement average ($\bar{x}$= 16.25) is measured at a percentage of 81.25 which is significantly higher than the required 80-percent criteria for statistical significance of 10-percent (.01). This high-level achievement average related to this study's objective, i.e., developing and enhancing the active online learning activities in acquiring knowledge of living things, is therefore humbly considered remarkable.

Keywords: Active online learning, Living things, Students' achievement

B07. Using Metacognitive-based STEM Education for Developing Grade 11 Students' Learning Achievement and Metacognition inAcid and Base

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Abstract

At present, STEM education is widely utilized in Thailand. However, there is no study concerning integrating metacognition in STEM education. This study aimed to: a) develop the Metacognitive-based STEM Education (M-STEM) for teaching Acid and Base for Grade 11 students; and b) examine the effect of M-STEM on students' learning achievement and metacognition. The authors created eight M-STEM lesson plans in the Acid and Base topic for Grade 11 students. The total teaching hour was 28 hours. The sample was 29 Grade 11 students from one classroom. The students were asked to take the learning achievement test at prior and after learned with the M-STEM lesson plans. They were also asked to write their metacognitive reflection note at the end of each lesson plans. The metacognitive reflection note stimulated the students to express their metacognition through six issues: a) Summary of key learning, b)Ways of learning, c) Learning problems, d) Solving learning problems, e) Verification of learned things, and f) Further learning. The students' pre-test and post-test were analyzed by using mean, standard deviation, Cohen'd value and paired samples t-test. In addition, the students' metacognitive reflection notes were read and categorized by using the scoring rubricand the scores were analyzed by using the one sample t-test. The results of this study were as follows. First, the M-STEM was consisted of six teaching steps: a) Engagement, b) Exploration, c) Explanation, d) Elaboration, e) Evaluation and f) Metacognitive Reflection. Second, after learned with the M-STEM in Acid and Base, the students significantly improved their learning achievement at the .05 statistically significant level ($t = 12.794$, $p < 0.05$). The Cohen'd value was 0.44. Finally, the M-STEM could significantly promote students' metacognition higher than 3.51 (of 5.00) at the 0.05 statistical significance level ($t = 4.585$, $p < 0.05$).

Keywords: STEM Education, Metacognition, Acid and base, Chemistry, Grade 11

B08. Effects of STEM Activities Integrated with "Phu Thai" Local Context to Develop Grade 11 Students' Learning Achievementand Local Culture Conservation

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Abstract

STEM (Science, Technology, Engineering, Mathematics) education is one of effective teaching strategies in particular to science. This study aimed to: a) develop STEM activities integrated with "Phu Thai" Local Context (LC-STEM), and b) evaluate the LC- STEM lesson plans' Effectiveness and Efficiency Index, and c) examine the effects of LC- STEM on Grade 11 students' learning achievement and local culture conservation. The research design was one group pre-test post-test design. The sample was 33 Grade 11 student at one secondary school in Nakhon Phanom province, Thailand. The local context integrated with STEM was "Phu Thai" context. "Phu Thai" is an ethic group in Renu Nakhon District, Nakhon Phanom Province. Phu Thai people have their interesting unique culture and traditionthat can linked with the chemical reaction concepts and STEM. For example, the local whiskey named "Au", which is usually made from glutinous rice, rice husk, bran and yeast flour, can be used to teach about fermentation and rate of chemical reaction. The statistics used were mean, standard deviation and t-test. There were seven LC-STEM lesson plans on Rate of Chemical Reactions. The panel of experts was asked to validate the Index of Item- Objective-Congruence (IOC) of the LC-STEM lesson plans. The students were asked to take the learning achievement test and local culture conservation questionnaire at prior and after learned with the LC-STEM lesson plans. The results revealed that the IOC of LC-STEM lesson plans on Rate of Chemical Reactions was ranged from 0.80 to1.00 The Effectivenessof LC-STEM lesson plans on Rate of Chemical Reactions was 66.19 /65.75 that was higher than the expected level. The Efficiency Index of LC-STEM lesson plans was 54.34% that means the students' learning progress was 54.34%. After learned with the LC-STEM lesson plans on Rate of Chemical Reactions, the students significantly improved their learning achievement at the .05 statistically significant level. The students increased their culture conservation of PhuThai at a very good level (63.89 mean score of 75).

Keywords: STEM, Local context, Learning achievement, Local culture conservation, Grade 11

B09. The Development of STEM for Developing Grade 8 Students' Learning Achievement and Creative Thinking in Prism and Cylindrical Topic

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Abstract

This research aimed to: a) develop the STEM model to teach mathematics in the Prismand Cylindrical topic for Grade 8 students; and b) compare students' learning achievement andcreative thinking (CT) prior and after learned with the STEM model. The population of this study was 12 classrooms with the total number of 454 students. The sample was one classroomwith 36 students by using the purposive sampling. The data collection included the evaluationof STEM lesson plans, the Learning Achievement Test and the CT Test. The experts'Evaluation of STEM lesson plans was calculated for their Index of Item-Objective-Congruence(IOC). Also, the students' learning achievement and CT prior and after learned with the STEMmodel were analyzed by paired-samples t-test. The results showed that the STEM model is consisted of eight teaching steps: 1) Present situation and identify problem, 2) Understand problem, 3) Analyze problem and find solutions, 4) Plan investigation, 5) Investigate, 6) Test,evaluate and improve, 7) Conclude and 8) Present and evaluate. The researchers created 12 STEM lesson plans took 24 hours on Prism and Cylindrical. The IOC of STEM lesson plans was ranged from 0.6 to 1.0 that was accepted. After learned with the STEM lesson plans on Prism and Cylindrical, the students significantly improved their learning achievement ($t = 16.30$, $p < 0.01$) at the .01 statistically significant level. Also, they improved their CT ($t = 40.94$, $p < 0.01$) in particular to Fluency ($t = 35.58$, $p<0.01$) Flexibility ($t = 32.15$, $p<0.01$) Originality ($t = 38.22$, $p<0.01$) components at the .01 statistically significant level.

Keywords: STEM, Prism and cylindrical, Learning achievement, Creative thinking, Grade 8

B10. Development of Camping Knowledge, Leadership and Teamwork Skills of Pre-Service Science Teachers through the Science Camp Project

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Abstract

A science camp is increasingly being recognized as an effective approach for informal science learning therefore pre- service science teachers should be preparation and practice. The research objective was to study the effects of the science camp project; a professional development program using project- based learning with GROW model for coaching, on development of camping knowledge, leadership and teamwork skills of pre- service science teachers. The participants were comprised of 25 third- year pre- service science teachers who attended a 15-week science camp project. The project consisted of four steps applied from the4P process Planning, Practicing, Presenting, and Pondering. The research instruments utilized included: the camp- based learning management plan, a camping knowledge test, a self-assessment of leadership and teamwork skills. The data analyzed were by using mean, standard deviation, percentage, and t- test dependent. The results from the research indicate that the participants' camping knowledge had showed improvements as the post-test scores were higher than the pre-test scores with a significance level of .05. After participating in the science camp project, the participants' leadership and teamwork skills were highest level.

Keywords: Camping Knowledge, Leadership and Teamwork Skills, Science Camp Project, Pre-Service Science Teacher

C08. The Spatial Ability of Young Children Aged 3 to 4 Years

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Abstract

Spatial ability is the capacity to understand and remember the spatial relations among objects. It helps people to understand and have perception about spaces, directions, and positions. Research about spatial ability pointed out that young children who have limited spatial ability would face difficulty in languages, reading, and writing, and also in studying mathematicsand science. Thus, the purpose of this research was to explore the spatial ability of young children aged 3-4 years in 1) the position and direction 2) the perception of objects in different points of view 3) the connection and disconnection 4) the relation of position and 5) the similarity and dissimilarity. The samples were 430 kindergarten 1 students (age 3-4 years old) studying in the first semester of 2020 academic years from private schools in Samutprakarn Province selected by stratified random sampling. The data was collected by spatial ability test consisting of 15 three drawing multiple choices. The content validity, the discrimination, and degree of difference of each item were between 0.67-1.0, 0.4-0.7, and 0.4-0.7, respectively. The reliability coefficient of the test was 0.9. The research finding suggested that in overall spatial ability of samples was at a low level. In the dimensions of the position and direction, the perception of objects in different points of view and the relation of position were at a low level. In the dimensions of the connection and disconnection, and the similarities and dissimilarity were at a medium level. The results of this research willbe useful for early childhood teachers to use as basic information for designing learning activitiesto improve spatial ability in early childhood education.

Keywords: Spatial ability, Early childhood, Kindergarten

C09. Infusion Active Learning in Undergraduate Biology Laboratories

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Abstract

Active learning is an approach in which students are engaged in learning processes by actively participating in doing things and thinking about what they are doing. Active learning has a powerful impact on students' learning. Unfortunately, most undergraduate laboratories follow acookbook style to confirm the theory. Thus, laboratory learning seems not to be active enough. This study aimed to investigate how to promote active learning in undergraduate biology laboratory classes using action research. Participants were two volunteer biology lecturers in the faculty of science of a university located in Bangkok. Various sources of data including observations, interviews, and students' documentaries were collected and analyzed by content analysis. Six guidelines for promoting active learning in the undergraduate biology laboratory learning emerged from this study including: integrating technology in learning; engaging in both answering and posing higher-order thinking questions; utilizing an open inquiry-based learning; changing slowly step by step; learning collaboratively; and constructing a supportive atmosphere. It was found that the undergraduate students improved their understanding of concepts, inquiry skills, communication skills, higher-order thinking and attitude towards biology laboratory learning. Students also more actively engaged in learning activities. In addition the results indicated that there were differences in time used for encouraging undergraduate students to participate in active learning between students in the Bachelor of Science and Bachelor of Education program. These guidelines suggested in this study would be useful for science laboratory instructors in higher education.

Keywords: Action research, Active learning, Biology lecturers, Undergraduate biology laboratory

C10. Enhancing of Pre-Service Science Teachers' Sustainability Awareness through Socio-Scientific Issues using Argument-Driven Inquiry Activities

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Abstract

The research purpose was to investigate the effect of the socio-scientific issues using argument-driven inquiry (SSI-ADI) activities toward pre-service science teachers' sustainability awareness. The socio-scientific issues used for the SSI-ADI activities focused on the topic of environmental issues located in Thailand. Topics of SSI investigated include; road building at the Panoenthung scenic point, initiating of nuclear power plant, and the use of paraquat. The participants were comprised of 28 fourth-year pre-service science teachers who are studying at the faculty of education, in a university in Thailand. The data was collected by distributing a pre- and post-sustainability awareness questionnaire which consisted of four sub-dimensions including; economics, society, the environment, and views regarding education. The quantitative data was analyzed using average and percentage. The qualitative data was analyzed using content analysis. The result of this study found that the pre- service science teachers showed an overall improvement in regards to sustainability awareness.

Keywords: Pre-Service Science Teachers, Socio-Scientific Issues-Argument-Driven Inquiry, Sustainability Awareness

C11. The Development of Primary Teachers' Computational Thinking (CT) by using Unplugged Coding

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Abstract

Computational thinking (CT) is an approach to problem solving. It involves the breaking down of a problem into smaller chunks, working on them individually and finally bringing them together to provide a solution to the problem at hand. The objectives of this study were 1) to investigate primary teachers' current understanding of Computational Thinking (CT) in classroom and 2) to improve the understanding of primary teachers' Computational Thinking and ability in creating activities in their classroom by using Unplugged activities which teachers are not working on a computer. They will often work with pencil and paper or physical manipulatives. There were 3 research phases. Survey research was employed in research phase 1: Investigation the current understanding and practice of Computational Thinking. Research phase 2: development the understanding of primary teachers' Computational Thinking and ability in creating the lesson plan using the CT training workshop. The classroom observation was in used in Research Phase 3. Qualitative method was mainly used in this study. The participants were 6 primary teachers. The research instruments were semi-structured interview, lesson plan and reflection of instructional learning. The data were analyzed by content analysis. In this research the participants demonstrated their Computational Thinking through the process of design Unplugged activities, teaching in the classroom and discussion with researchers during interviews. The result show that the primary teachers' ability in creating activities in fusing CT into their teaching and aforementioned four components of Computational Thinking (Decomposition, Pattern Recognition, Abstraction and Algorithm).

Keywords: Computational thinking, Unplugged coding, Primary teacher

A10. Science Teachers' Perceptions on Elementary School Students' Non-Cognitive Skills

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Abstract

'Is education system do well in preparing learners to be qualified workforce?', a classic question asked by labor market; due to the fact that a number of studies highlights success in academic achievement does not guarantee success in career. Real life happiness and success in career require non-cognitive skills (grit, social skills, and self-control). Previous studies reports people with well proficient in social skills are likely to develop their potential in the workplace when comparing with whose have solely cognitive ability. As such, this study explored teachers' perceptions of elementary school students' non-cognitive skills within science classroom context. In this study, three components of non-cognitive skills (grit, social skills, and self-control) were chosen because they can be investigated and improved in education setting. Data were collected from 30 teachers from 38 different schools (78.95% of population). The teachers were invited to complete a questionnaire that included 17 items in a checklist format and followed by 4 items in an open-ended format. The questionnaire was validated by three experts from science education, and educational research and evaluation. The reliability of the questionnaire was .80. Data were analyzed via content analysis. Findings reveal that the majority of the teachers believed the major goal of learning science was for helping students to apply scientific knowledge into their daily life (76.67%). Only a few teachers mentioned on holistic development of a child, particularly in term of non-cognitive skills. Nevertheless, the science teachers pointed out a number of students presented misbehaviors while learning science. Most of the problems is related to grit (46.67%) and social skills (40.00%). For instance, students did not pay attention in learning science; they lacked of communication skills; they did not want to work in group; and they did not responsible for their own learning. When asked about source of these problems, the teachers mentioned on intrapersonal factor (e.g., self-esteem, self-control) (66.67%) and interpersonal factor (e.g., family and peer) (53.33 %). For instance, students had low self-confidence and parents did not pay attention to their children. This finding can be a catalyst for a discussion on how we, as science educators and teachers, should promote holistic development of a child and how science classroom should be functioned to serve children's success not only in academic but also in life.

Keywords: Teacher perception, Science classroom, Non-cognitive skill, Elementary school student

A11. The Effects of Game-Development Based Learning Activities on 7th Grade Thai Students' Conceptual Understanding about Cells and Algorithm Design Ability

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Abstract

Game - development based activities about the Basic Unit of Living Organisms(Cells) were created to enhance students' conceptual understanding and algorithm design ability. Thirty-one Grade 7 (aged 12-13 years old) students from a mixed ability classroom ofa medium-sized public school in Bangkok were participated in this study. Data were collectedduring the second semester of the 2020 academic year (February-March 2021). All participants previously learned how to write algorithm flowcharts from a Computer Science Course. In this study, each group of the students were required to apply their conceptual understanding about cells to design a game then create a flowchart to graphically representthe algorithm of their own games. This unit was divided into 2 sessions and different game types were required to design; Cell Structure & Functions (computer games: using Word wallor PowerPoint) and The Microscope (board games). With teacher guidance, some groups still had some errors in writing algorithm flowcharts. Multiple-choice tests on learning achievement and algorithm design ability were used before and after the implementation of the game - development based activities. Pre-test and post-test scores were analyzed and compared by dependent sample t-test. Results revealed that the students gained conceptual understanding about cells and algorithm design ability at .01 statistically significance level.

Keywords: Game-development based instruction, Conceptual understanding, Algorithmdesign ability

A12. Lahu Sixth Graders' Socioscientific Reasoning about Environmental Issues in Northern Thailand

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Abstract

aLahu is an ethnic group of people in northern Thailand. While having Thai nationality, theyare considered as a minority needing special education services. Science education for them shouldthus be provided in a way consistent with their sociocultural background. Given that scientific literacy is important for all students and socioscientific reasoning can be considered as a key characteristic of scientific literate persons, this study aims to explore 10 Lahu sixth graders' socioscientific reasoning about environmental issues including global warming, haze pollution, and alien species. Their socioscientific reasoning was measured using an open-ended questionnaire in combination with individually semi-structured interviews. Their socioscientific reasoning was analyzed by considering as to whether it includes claims, evidences, and justifications. The results indicate that, while most of the students included claims and evidences in their reasoning, the lack of appropriate justifications was identified. Moreover, the quality of their socioscientific reasoning seemed to vary according to the contextual scope of environmental issues where global warming appeared to be most challenging for the students to reason.

Keyword: Environmental issues, Ethnic students, Socioscientific reasoning

B11. Using STEM Activities in Developing Grade 11 Students' Learning Achievement and Creative Thinking Skill in Light as Electromagnetic Radiation

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Abstract

This research aimed to: a) develop the STEM activities in teaching the Light as Electromagnetic Radiation topic for Grade 11 students; b) examine Grade 11 students' learning achievement and creative thinking skill after learning with the STEM activities in Light as Electromagnetic Radiation. The sample was 38 students enrolled in the first semester of 2020 academic year at Moeiwadeepittayakhom School, Roi-et province, Thailand. The sample was purposively sampling. The data collection included the Evaluation of STEM lesson plans on Light as Electromagnetic Radiation, the Learning Achievement Test and the Creative Thinking Skill Test. Five experts' evaluation of STEM lesson plans on the Light as Electromagnetic Radiation topic was calculated for the Index of Item-Objective-Congruence (IOC). Also, the students' learning achievement and creative thinking skill prior and after the STEM lessons in the Light as Electromagnetic Radiation topic were analyzed by using the paired-samples t-test. The results showed that the STEM pedagogy was consisted of six teaching steps. The researchers created four STEM lesson plans on Light as Electromagnetic Radiation. After learned with the STEM activities, the students significantly improved their learning achievement and the creative thinking skill at the .05 statistical significance level. The overall development of creative thinking skill was at a high level ($\bar{x}$ = 4.24, S.D. = 0.23). Regarding the component of creative thinking skill, the participants developed Originality in a very high level ($\bar{x}$ = 4.86, S.D. = 0.31) and the others in a high level as Fluency ($\bar{x}$ = 4.22, S.D. = 0.23), Flexibility ($\bar{x}$ = 3.98, S.D. = 0.13) and Elaboration ($\bar{x}$ = 3.91, S.D. = 0.13).

Keywords: STEM, learning achievement, creative thinking skill, physics, Grade 11

B12. The Development of STEAM in the Equilibrium Topic for Developing Grade 10 Students' Learning Achievement and Problem-Solving Skill in Physics

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Abstract

STEAM (Science-Technology-Engineering-Art-Mathematics) is proposed as one teaching method extended from STEM in helping learners develop the21st century skill. This research aimed to: a) develop the STEAM teaching model to teach Equilibrium for Grade 10 students; and 2) compare students' learning achievement and problem-solving skill prior and after learned with the STEAM lesson plans on Equilibrium. The authors created five STEAMlesson plans in the Equilibrium topic took 25 teaching hours, i.e., Equilibrium (6 hr.), Center of Mass and Gravity (4 hr.), Translational Equilibrium (5 hr.), Rotational Equilibrium (5 hr.) and Stability of Balance (5 hr.). The sample was 35 Grade 10 students enrolled in the first semester of 2021 academic year at one secondary school located at Ubonratchathani province,Thailand. The data collection methods included the panel of experts' Evaluation of STEAM lesson plans, the Learning Achievement Test and the Problem-solving Skill Test. The Evaluation of STEAM lesson plans on the Equilibrium topic was calculated for their Index of Item-Objective-Congruence (IOC). Also, the students' learning achievement and Problem- solving skill prior and after the STEAM science lessons in the Equilibrium topic were analyzedby using the paired-samples t-test. The results showed that the STEAM teaching model was consisted of six teaching steps: Inspiration making, Problems Selection and Boundary Identification, Data Collection, Work Creation and Integration of Art, Presentation and Evaluation. The researchers created five STEAM lesson plans on Equilibrium and their IOC were ranged from 0.80 to 1.00 that was accepted. After learned with the STEAM lesson plans,the students significantly improved their learning achievement ($t = 19.44$, $p < .01$) and the problem-solving skill ($t = 25.85$, $p < .01$) at the .01 statistical significance level. The implications of the STEAM for teaching science are finally discussed.

Keywords: STEAM, Learning achievement, Problem-solving skill, Equilibrium, Grade 10

B13. The Effect of Developing Lesson Plans Integrated STEM Pedagogy on The Creativity skill of Pre-Service Science Teachers

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Abstract

STEM approach is one of the newest teaching and learning approach in the world. Here, STEM isan elective course that designed by Science Education Study Program as a science teacher preparation program that must update with the recently teaching and learning in 21st century era. This course aims to increase the skill of pre-service science teachers (PST) to prepare STEM basedteaching sets. The purpose of this research is to examine the effect of developing lesson plans integrated STEM pedagogy on the creativity skill of pre-service science teachers (PST) before andafter the STEM course. This study employed a quasi-experimental one-group pre-test post-test design. The population wasthe third year of PSTs who took STEM as one of elective course. The purposive sampling methodwas chosen to carry out the pilot study on 24 PSTs at Science Education Program, Universitas Negeri Semarang. The creativity skill rubric was designed to assess the creativity in making lessonplan. Data analyzed by using paired sample t-test. From the findings, significant differences in scores were found. It can be concluded that developing lesson plans integrated STEM pedagogy affected the creativity skill of PSTs.

Keywords: Lesson plan integrated STEM pedagogy, Creativity skill, Pre-service science teacher

A13. Naïve Physics Teachers' Self-Efficacy to Pedagogical Development in Teaching

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Abstract

According to recent Thai educational policy, a physics teaching career requires a degree in education and the reformation of the Five-Year curriculum program for Physics teacher education into the Four-Year curriculum program. At a large university in lower northern Thailand, a variety of undergraduate students were enrolled in method courses for their future careers. As a case study, this research aimed to examine self-efficacy in science teaching of the undergraduate students. There were 75 physics students who volunteered to participate in the study, from the faculties of education (n = 62) and science (n=13). The survey, which consisted of twenty-eight questions adapted from Hudson and Ginns (2007), was implemented to investigate their five pedagogical dimensions: curriculum theory, development of students, lesson planning, teaching practice, and attitudes. The data was analyzed using mean, frequency, and mean percentage score. As a result, the undergraduate physics students from both education and science faculties previously perceived that they had pedagogical development at the "agree" level. After the first teaching course was finished, the 5-year program students' (n = 25) and the 4-year program students' (n=17) mean scores were at the "agree" level. Aside from that, the science faculty students' average scores were at the "strongly agree" level but also gained over 10% of self- efficacy mean percentage score (total=3) for each dimension, particularly in children development and attitude. The findings prompt future research into teacher education in science/physics teaching courses, how novice teachers reflect on their pedagogical development, and what evidence supports their perceptions.

Keywords: Naïve physics teachers, Self-efficacy, Pedagogical development, Teacher education, Teaching

A14. Assessing Science Student Teachers' Science Communication through Writing Information Sheets about the Middle School Chemistry Content

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Abstract

This study aimed to develop a rubric for writing science communication and utilize the rubric to assess science student teachers' writing intended to apply as information sheets (ISs)for the middle level (Grade 7-9, aged 13-15). A rubric for writing science communication wasadapted from previous research done and reviewed by 3 experts in science education. Withoutany guidance, 59 science student teachers were asked to write an IS related to chemistry taughtin the middle school level. The created ISs were about chemistry concepts and principles (44 sheets), calculation (14 sheets) and experimental techniques (1 sheet). All of the ISs were evaluated by one of the researchers. The initial scores were then negotiated with the other tworesearchers to reach a consensus. The results showed that 16 of the ISs were at an improved level, while the other 43 were at an acceptable level. Considering the average score (x) of eachcomponent (an acceptable level is 2.5 out of 4.0), it was showed that the ISs needed improvement in 5 out of the 6 components: sources and evidence (x = 0.14), context and purpose (x = 1.05), visual aids (x = 1.80), content development (x = 2.00), and organization and presentation (x = 2.07). Control of syntax and mechanics was the only component which obtained scores over 2.5 (x = 3.00). The implications to enhance writing communication skillshighlight an emphasis on coherence of contexts and representatives used for clarifying the chemistry content and procedures.

Keywords: Rubric, Science communication, Chemistry, Science student teachers

A15. Designing a Method Course for Developing Pre-service Science Teachers' Metacognition and Pedagogical Content Knowledge for Teaching with Metacognition

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Abstract

Metacognition is very important for enhancing learners' cognitive development and characteristics of life-long learner. Teachers are demanded to integrate metacognition in their teaching. Pedagogical content knowledge (PCK) for teaching with metacognition is, therefore, needed in in-service teachers including pre-service teachers. However, in general, the method course in university programs rarely includes metacognition and associated PCK. This study aims to design a method course for developing pre-service science teachers (PST)' metacognition and PCK for teaching science with metacognition. The interview was conductedwith a group of PSTs as well as lectures. In addition, the documentary research was conductedwith a bunch of literature. Then, the researchers developed a 16-week method course. The activities in the course were revised from the older version to include understanding about metacognition and PCK for teaching with metacognition. This method course was implemented with 22 PSTs in the Bachelor of Education program (majoring in General Science) in one Rajabhat University. The designed method course was validated by a panel ofexperts, who experienced in metacognition, teacher education and science education research.The data from experts was analyzed by calculating for the Item-Objective-Congruence (IOC) ranged from 0.80 to 1.00. The experts also provided several valuable suggestions for further improving the method course. The implication is the detail of method course should concern the context of education in each university and a pre-service teachers' metacognitive background. The researchers revised the method course and implemented in the real classroompractice. However, the result was reported in another paper.

Keyword: Pre-service science teacher, Metacognition, Pedagogical content knowledge (PCK), Method course, Thailand

B14. Enhancing of STEM education concept on the science subject of seventh grade students through Problem Based Learning

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Abstract

The purposes of this research were 1) to design and create lesson plan on the Science subject through Problem Based Learning (PBL), 2) to compare learning achievement on the Science subject of seventh grade students after learning through Problem Based Learning (PBL) and 3) to compare STEM education concept on the Science subject of seventh grade students after learning through Problem Based Learning (PBL). The population of this research was grade seventh students in academic year B.E. 2563 of Kasetsart university laboratory school, Kamphaeng Saen Campus, Educational research and development center. The sample were 36 students, they were selected by simple random sampling. The research instruments consisted of 1) lesson plan on the Science subject, 2) learning achievement test 30 items with difficulty 0.34-0.72 and discrimination 0.26-0.89, and 3) STEM education concept test 20 items with IOC 0.67-1.00.
The results were as follow : 1) the pre-test average of learning achievement score of 11.05, standard deviation 2.08 and the post-test average of learning achievement score of 24.62, standard deviation 2.15. The data revealed that the learning achievement after the treatment was significantly higher than that before the treatment at the .05 level. 2) the pre-test average of STEM education concept score of 4.91, standard deviation 1.56 and the post-test average of STEM education concept score of 13.51, standard deviation 1.12, from the data revealed that the STEM education concept after the treatment was significantly higher than that before the treatment at the .05 level. And the results of participant observation and informal interview showed that knowledge and understanding of content and motivation for learning affects STEM education concept.

Keywords: STEM education concept, Problem Based Learning, Learning achievement, Seven grade students

B15. The Blended Learning for Promoting Collaborative Problem-Solving Competencies in STEM Classroom Under the Covid-19 Pandemic

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Abstract

This classroom action research aimed to investigate students' collaborative problem solving (CPS) competencies using the Blended Learning of STEM Classroom Under the Covid-19 Pandemic. CPS is essential for students to develop the skills needed via various ideas and perspectives of team. Blended Learning in this study is a mix of online using Google Classroom with face-to-face in STEM projects. The participants were 38 twelve-grade studentsfrom a reginal science school in the second semester of 2020 academic year. Data were gathered by CPS observation forms, student's worksheet and students' artifact, consisted of 3 primary CPS competencies which establishing and maintaining shared understanding, taking appropriate action to solve the problem and establishing and maintaining team organization. The CPS competencies were analyzed using the CPS rubric score adapted from the PISA 2015framework and the content analysis approach. The result indicated that students' CPS competencies increased from the first to the thirdcycle of classroom action. The most advanced competency of students was establishing and maintaining group organization, followed by selecting an appropriate action to solve the problem and establishing and maintaining shared understanding, respectively. Research finding suggests that the Blended Learning of STEM Classroom makes students dare to express their opinions and use technology to work together systematically. The group learning activityfocuses on students joining voluntary groups. Learning activities should encourage all studentsto learn, participate in discussions, and exchange knowledge with fellow members about finding a solution and supporting students more opportunities to argue between groups for thereasons.

Keywords: Blended learning, Collaborative problem-solving, STEM education

B16. Indigenous Knowledge of Bulan Kite in the Deep South of Thailand for Teaching Meaningful Physics Concepts

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Abstract

The teaching and learning of physics that can be linked to the cultural context of students is a challenging task. Indigenous knowledge is the unique knowledge confined to a particular culture or society. It is also known as local knowledge, folk knowledge, people's knowledge, traditional wisdom or traditional science. This kind of conceptual representations would enable students to learn physics in an understandable and meaningful way. Especially in the unique context where the private Islamic schools in the deep south Thailand are locatedin which all students are Muslims. The standard core curriculum in science of Thailand has been decontextualized and westernized. This research aims to discover cultural fund of knowledge in southernmost province of Thailand that has a potential to be brought in a physicsclassroom. For three months, document analysis, immerging in the local, interviewing provincial cultural experts, learning with a local expert on making Bulan Kite were conductedto understand the potential cultural artifact to adapt for teaching physics concepts. The findingsindicated that the bank of local knowledge of Bulan Kite can be used to teach many physics concept such as the equilibrium of three forces, center of mass and center of gravity. The findings will lead to the design and development of innovative physics lessons that integrates local knowledge with Western science. Then physics teachers will be invited to participate in a workshop on how to integrate Islamic cultural knowledge to teaching physics to make learning physics relevant and meaningful for students who live in a culturally rich context. Hopefully, they would understand physics concepts and appreciate their Islamic culture.

Keywords; Indigenous Knowledge, Bulan Kite, Deep south of Thailand, Physics concept.

Poster Presentation Abstracts

P01. Assessment of Computational Thinking Skills in 5th Grade Students

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Abstract

This purpose of the research was to analyze the defects of computational thinking skillsin elementary school. The population of the research was 5th grade students at AnubanKanchanaburi school, Thailand. The sample group consisted of 138 students and selected by Cluster Random Sampling. The research instrument consisted of Roman-Gonzalez,Perez-Gonzalez, & Jimenez-Fernandez (2017) computational thinking tests which modified bythe researcher consist of 7 concepts: basic directions and sequences, for loop - repeat times, while loop - repeats until, if - simple conditional, if/else - complex conditional, while conditional and simple functions. The reliability coefficient (Cronbach's alpha) of computational thinking tests was 0.80. The results showed that the students had the computational thinking scores with a fairly average (X = 10.03, SD = 3.04). When evaluated by concepts showed thatstudent's deficiencies in basic directions and sequences, for loop - repeat times were reported at moderate level. While loop - repeats until, if - simple conditional, if/else - complex conditional, while conditional and simple functions were reported at fair level. The research results are a guideline for developing teaching and learning model to develop computational thinking skill in elementary school.

Keywords: Computational thinking, Assessment, Elementary school

P02. Development of Interactive Learning Material to Enhance Numerical Solving Problem Skill toward Concept about Force and Motions for High School Students

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Abstract

Ability in numerical solving physics problems is a crucial issue influencing physics learningachievement, especially processing problems and application problems. This research aimed to develop interactive learning materials to enhance the Grade 10 students' ability in solving physicsproblems in context of force and motion by emphasizing problem design in different conditions such as frictionless surfaces, friction surfaces, mass and angles of floor's slope, and designed the interactive learning materials which consists of equipment and measuring tools. By using the materials, the students set up the equipment following the given condition of each problem to learnand to observe the force on the objects, the motion of objects and the result of force that caused the object stopped, moved with constant speed and moved with acceleration, for examples. This interactive activity helped students to be able to write the diagrams based on their understanding from learning the context by setting up these actual interactive learning materials and able to calculate various answers of the given problems, able to compare with the answers that were frommeasuring tools. It is the process of using the interactive learning materials which the learners have to perform by themselves to be able to connect the given problem with physical learning materialsto verify the calculation on their own. As a pilot study, the interactive learning materials were introduced to 20 students of Grade 10, this research found that they were more concentrated to solving the problem by themselves and their learning satisfaction by using the interactive learningmaterials was in a high level.

Keyword: Physics Education, Interactive Learning Materials, Numerical Problem Solving

P03. Students Fabricate Paper Towel-based Experimental Device to Investigate HowFactors Affect Chemical Equilibrium and K_C

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Abstract

Our recent development of the fabrication of paper towel-based experimental devices (PTEDs) to be used for the demonstration of the factors affecting chemical equilibrium and chemical equilibrium (Kc) for educational purposes have been successfully proposed. PTEDs have successfully demonstrated to students the factors (concentration of reagents and temperature) affecting chemical equilibrium using the fabricated PTEDs. With the naked eye, a color change of two differently colored Co(II) complex ions, from $Co(H_2O)^{2+}_6$ (pink) to $CoCl_4^{2-}$ (blue) can be observed when a tiny drop of a set of hydrochloric acid solutions and the treatment of heat by using hot air dryer were applied to the PTEDs. To reverse the color change from blue to the original pink color, a tiny drop of water was placed onto the reaction zone and cooling treatment was applied by using an ice bath for 10 min. Because the technique to produce this low-cost device does not require expensive and sophisticated instrumentation, a quick demonstration of the chemical equilibrium can be achieved. In addition, the concept of the K_C aswell as how to determine the K_C value of the same reaction is easily quantified using the digital image of the detection zones of PTED captured with a smartphone camera under control light box coupled to ImageJ software. These fabricated PTEDs are well suited to introductory chemistry laboratory courses in school and at university, especially in countries where resourcesare limited. Students fabricate the PTEDs and use smartphones to investigate how factors affect chemical equilibrium and K_C.

Keywords: Hands-on microscale laboratory, Factors affecting chemical equilibrium, Le Chatelier's principle, Paper towels-based experimental devices (PTEDs), Smartphone assisted learning

P04. An Investigation of Grade 10 Students' Conceptual Understanding and Analytical Thinking about Genetic Inheritance

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Abstract

The purpose of this research study is to investigate students' conceptual understanding and analytical thinking in the topic of genetic inheritance. Twenty-five items in a five- optioned multiple choice test format were used, 13 items for conceptual understanding and 12items for analytical thinking. Item analysis showed that difficulty (p) was ranged from 0.24 -0.83 and discrimination (r) were ranged from 0.21 - 0.76. Reliability coefficient (Kr-20) of the whole test was 0.87. The respondents were 29 Grade 10 students from a University Demonstration School situated in the central region of Thailand. These students were selectedpurposefully because they were in a Math and Science Program and their school entrance examination marks showed low scores on scientific understanding and analytical thinking. Data was collected in April 2021 by an online test via Google Form. The students had learned about genetic inheritance before taking the test. They were needed to complete the test within 30 minutes. The results revealed the average score of the whole test was 12.45, approximately equaled to 5 0 percent of the full score. When considering separately, the students earned average scores of 7.45 (57.31%) for the conceptual understanding part, and 5.00 (41.67%) for the analytic thinking part. It was also found that a larger number of scores derived from the items asked about monohybrid cross and multiple alleles in blood types. Lower scores on dihybrid cross and pedigrees indicated students' learning difficulties in both parts.

Keywords: Conceptual understanding, Analytical thinking, Genetic inheritance, Secondary school

P05. STEM Activities to Enhance Grade 9 Students' LearningAchievement of Light Refraction and Visibility

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Abstract

The purpose of this study were 1) to develop light refraction and visibility STEM activities for 9th grade students, 2) to compare between pre-learning and post-learning achievement of light refraction and visibility test average score and 3) to compare the post- learning achievement test average score with the criteria of 70 percent. The sample group wasone classroom of 9th grade students (n=40) from a high school in Ratchaburi province. Teaching was done with a 5E (enter, explore, explain, elaborate, evaluate) plus with the STEMactivities. The research instruments consisted of 1) the STEM activity packages on refraction light and visibility, and 2) the learning achievement test (Cronbach's alpha equals to 0.722). The research is an experimental research with one group pretest-posttest design. The statisticsused for analyzing the collected data were mean, standard deviation, percentages, t-test for dependent samples, and t-test for one sample. Results indicated that: 1) post-learning achievement of light refraction and visibility average score was higher than pre- at significantlevel .05 and 2) post-learning achievement of light refraction and visibility average score was
75.31 percent higher than criteria at significant level .05

Keywords: An inquiry-based learning by design model, Light refraction and visibility, Learning achievement

P06. The Effect of Using an Animation on Grade 7 Students' Learning about Diffusion and Osmosis

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Abstract

The purposes of this study were 1) to compare students learning achievement before and after using an animation about diffusion and osmosis, and 2) to examine satisfaction afterusing the animation about diffusion and osmosis. The participants were 44 Grade 7 students from a large urban school in Central Thailand. Data was collected during the first semester of 2020 academic year. A short animation created by one of the researchers, utilizing cartoon characters to engage students to the science topic, illustrate the processes and examples of diffusion and osmosis with wrapping up at the end. A multiple-choice achievement test about Diffusion and Osmosis (total score of 12) and a five-scale survey of learning satisfaction were created to assess students' learning outcomes. Due to the government policy for disease control during the first wave of Covid-19 epidemic in Thailand, every classroom needed to split up. A half of students could come to school and learn with teachers, while the other half needed to stay at home and learn online. The participant students were assigned to watch the animation via Youtube during online learning at home. When coming on-site, they completedhands-on activities about diffusion and osmosis. The test and the survey were employed after the whole lesson was accomplished. Analysis of average scores and comparing difference between two means for dependent sample revealed that average scores before and after learning were 5.66 and 7.89, statistically difference significant at .05. Their satisfaction of learning was in a good level.

Keywords: Animation, Diffusion and osmosis, Blended learning, Covid-19

P07. Investigating Effectiveness of Intelligent Tutoring System with Integration of Problem-Based Approach for Learning Python Programming

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Abstract

With development of Thai basic education core curriculum, computing science and design of technology were included in the learning area of Science and Technology in which Python programming were used as the example mean for developing learners' programming skills. In addition, in this pandemic situation from COVID-19, the learning management process has been unavoidable shifted to be online. This research aimed to design and develop the Intelligent Tutoring System with integration of Problem-Based Approach (ITSPBA) for Learning Python Programming, and to investigate students' learning achievement and learning gain from learning by using ITSPBA. The research instruments consisted of the ITSPBA, adaptive tests, and questionnaires. The ITSPBA system was developed in form of a web application using PHP, MySQL database, Javascript, and Boostrap framework. The ITSPBA system was tested by a sample of 22 university students majoring in computers selected by purposive sampling. They were studying at a university in Ubon Ratchathani Province. The data were analyzed by mean, standard deviation, dependent sample t-test, and normalized gain. The results showed that the average of post-learning achievement score was statistically higher than that of the pre-learning achievement score at the significant level of .01. The average of the normalized gain of the class was 0.30 which was at the medium level. The average of students' satisfaction toward ITSPBL for learning Python programming was 3.47 (SD = 0.59) which was at the high level. According to the results, it suggested that the proposed system could be beneficial and be an alternative way for managing learning process online as well as it could improve students' programming skills.

Keywords: Intelligent tutoring system, Learning management process, Python programming, Problem-based learning

P08. Development of Game-Based Astronomy Virtual Classrooms for Understanding Structures of Earth and Stars

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Abstract

The objectives of this research were to design and develop games for learning earth and stars in astronomy virtual classroom via oculus devices to which virtual reality technology was applied, and to study users' attitudes towards the developed games. The games were designed and developed as an interactive media in form of 3D animation model displayed in 360 degrees perspective with sound effect so that learners are able to get experience like being in a real environment. Inside the virtual classroom, not only the learners are able to learn about solar system, but also there are 3 games for learning about the solar system including virtual star game, rearranging planet game, and solar system quiz game. Each game consisted of 3D animation model including Sun and 8 asteroids which are Mercury, Venus, Earth, Mars, Jupiter, Saturn, Uranus, and Neptune. The development tools consisted of Maya and Unity 3D. The games are run on Windows displayed via oculus rift and interacting with models using oculus touch. The results of development and test using satisfaction questionnaires collected from 94 elementary and junior high school students showed that 98.94% of students found the games were easy to use, 89.36% of them commented on sound was clear, and 93.62% of students gained more understanding and memorizing of the solar system. The average of overall users' satisfaction was 4.67 (S.D.=0.57) which was at highest level. The game is built suitable for both elementary and junior high school students which help engage learners' interest, promote the active learning process, encourage learners' creativity, and also use as a learning media for teachers.

Keywords: Virtual classroom, Astronomy, Solar system, Virtual reality, Games for learning

P09. Exploring High School Students' Scientific Claims Believable in the Context of Advertisements for Health Products

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Abstract

The study aimed to explore whether high school students found scientific or scientific-sounding claims believable in the context of advertisements for health products. The two pseudo-science health products were introduced: 1) Calcium Plus supplement; used the scientific-sounding produce name and employed to emphasize the concentration of the product's active ingredient and 2) Anti-diabetic patch;referred to specific herb ingredients used in their product which inferring to have positive effect. forty-five grade 12 students, who had studied science to a certain level, were asked to considering the potential effectiveness of a scientific support and wording in the advertisements. The students' responses revealed that most of them did not believe in advertising with regard to the exaggerated problem- solution discourse such as 96 percent of diabetic were forever cured. While some of them referred the FDA (Food and Drug Administration) labeling to support the products without scientific or scientific- sounding claims and reasoning. Although the students empirically explained and tended to display disbelief over pseudo-scientific claims in the advertising; for example, other factors influences a person's height or causes of diabetics and its treatments. They were not be able to provide precisely scientific seasoning and supportive evidences to solidly reject the different pseudo-science health claims.

Keywords: Pseudoscience, Scientific, Advertisements

P10. The innovative lesson plan for enhancing students' ideas in Physics about application of Newton's laws through STEM Education

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Abstract

The paper aimed to clarify the innovative lesson plan learning activities about making facilities or assistance methods for disabled or elderly. The activities provided concept of application of Newton's laws which were developed through STEM education. The STEM education learning activity will be developed based on Sutaphan and Yuenyong (2019) the context-based STEM education learning approach. The activity will start from identification of the social issue of desirable urban life for elderly and disabled who are not as comfortable as they deserve. The issue will engage students to develop projects for solutions. The problems have arisen inadequate facilities or services for the disabled or the elderly. Starting from that thought, it would be very suitable if STEM was applied in the development of ideas related to making simple tools to design facilities or assistance methods for disabled or elderly. Through the context-based STEM education learning approach, students may motivate students to apply knowledge about physics (e.g.application of Newton's laws, friction) to design prototypes or products through the engineer design process. This paper may have implications for designing STEM education learning activities.

Keywords: STEM education, STS approach, pedagogy

P11. Developing STEM Education Learning Activity of Making the Lighting Shop Signs

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Abstract

The paper will clarify SEM education learning activity of making the lighting shop signs. TheSTEM education learning activity will be developed based on Sutaphan and Yuenyong (2019) the context-based STEM education learning approach. The activity will start from Identification of social issue of design a lighting shop sign to promote marketing. The issue enables students to design a lighting shop sign that increase customer motivation. the lessonplan will provide activities regarding on the 7 stages of Sutaphan and Yuenyong (2019) thecontext-based STEM education in order to scaffold students to practice knowledge fordesigning some technology prototypes or products through engineer design process. Formaking something related to light sigh, the lesson plan will provide students chance topractice integration of knowledge. These knowledges include Physics (e.g., circuit design), mathematics (e.g., calculation skills, measurement skills), arts (e.g., creative label image),Business (e.g., build something that can attract customers) and so on. This paper may haveimplications for designing STEM education learning activities.

Keywords: STEM education

P12. Fostering Grade 4 Students' Creative Thinking Through STEM Education Activities Entitled "A Young Engineer"

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Abstract

This research aimed to compare students' creativity before and after learning in a STEM learning management. 24 of grade four students in the second semester of the academic year 2020 were involved. They were challenged to work as an engineer by designing and construction of a flood proof house-like. Then, they had learned about hardness, elasticity, thermal conduction, andconductivity. They used this knowledge to work in small groups to design, build, and test the houses made out of different materials. They then shared their findings with other groups of students and redesign their house. The research plan involved a one group pretest-posttest design. Research instruments included the STEM learning management plan, a 4-questions subjective testof creativity assessment, and rubric scoring. The results revealed that students who studied with STEM Education had a higher score for creativity than the score they had before learning with thenew method, with a significant difference of .05. The average normalized gain score on creativitywas 0.60, which was at a medium level. The highest score was obtained from that involved elaboration (<g> = 0.71) which was at a high level because students can completely explain the properties, advantages and disadvantages, limitations, cost effectiveness of the materials used.

Keywords: STEM Education, Materials and properties of material, Creative thinking

P13. A Light Source from Gravity

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Abstract

The purpose of this research is to design and make a light source from gravity. It will beused in daily life and in places that don't have electricity such as rural regions, camping areas, nature trails, and in case of any emergencies. A light source created from gravity will reduce unnecessary energy consumption by increasing the efficiency of work that produces the same results but uses less energy. The average of light emitting duration was tested by using the weight of the counterweight and measuring the potential difference. A 111.7 centimeter long chain was used in the experiment, and the results showed that if a light counterweight was used, the counterweight at the end of the chain will fall slowly. This will cause the axel of the bicycle to rotate slower and the light bulb to light up longer. The largestpotential difference measured was 2.02 volts, with a 0.3 kilograms counterweight, and a light emitting duration of 5.18 seconds.

Keywords: Stem Education, Generator, Alternative energy