Paper Presentation

Concurrent Session 2.1

Science Teaching and Learning

Primary Science

Primary School Students' Attitudes Towards Plants

YAP Heng Yeow (yap_heng_yeow@moe.edu.sg), Sarah SEAH, Katherine LIM, Nazrah MOHAMAD LATIFF

HUAMIN PRIMARY SCHOOL, SINGAPORE

Abstract

Although the presence of plants is crucial to human survival, plants tend to be under-appreciated. Wandersee and Schussler (1999) highlighted the phenomenon of 'plant blindness' which describes the inability to see or notice the plants in our environment, recognise the importance of plants, appreciate the aesthetic and unique biological features of plants and the tendency to rank plants as inferior to animals. The 'My Garden Project' was developed by a primary school in the northern part of Singapore to give students the opportunity to experience planting and harvesting their own vegetables at the designated plots in school. The programme complements the prescribed science curriculum and aims to help the students develop a deeper understanding of the life cycle of a flowering plant. The aims of this study were, first, to validate the modified Plant Attitude Questionnaire (mPAQ) as an instrument for measuring students' existing attitudes towards plants. Second, to evaluate if the 'My Garden Project' improves students' attitudes towards plants. Third, to investigate if there are gender differences in children's attitudes towards plants. The Cronbach's alpha for the mPAQ for the pre-test and post-test were greater than .8 indicating good levels of reliability. The pair sample t-test shows that the students' attitude scores in the post-test (M = 4.24, SD = .55) is significantly higher than the ATP scores in the pre-test (M = 3.87, SD = .55), t (39) = 3.41, p = .002. The independent t- tests for gender differences were not significant both in the pre-test and post-test.

Keywords: primary education, attitudes, plants

Paper Presentation

Concurrent Session 2.1

Science Teaching and Learning

Primary Science

Use of Variation Theory in the Teaching of Condensation in a Primary Science Classroom

LIM Yen Peng Linda (lim_yen_peng_linda@moe.edu.sg), Ameer Ahamed KHAN, Nor Aishah RAMLI, Kamaliah ABDUL JALIL, TAN Mei San

CHONGZHENG PRIMARY SCHOOL, SINGAPORE

Abstract

One of the aims which the science department in Chongzheng Primary School hopes to achieve is to provide all students with knowledge of science concepts and opportunities to develop skills, habits of mind and attitudes necessary for scientific inquiry. This study describes the learning study journey of a group of science teachers who adopted the use of the variation theory to design and deliver lessons to teach 'Condensation' – a concept which they found many of their students having difficulty understanding through the administering of an assessment probe. Using variation as a guiding principle of pedagogical design, the team designed a lesson to help students discern that condensation is a change in the state of water from the gaseous to the liquid state and that a cooler surface must be present for condensation to happen. The lesson was delivered to two groups (middle and low progress) of primary five students and the outcomes of students' learning were analysed through students' interviews as well as the evaluation of their work. The results from the study revealed that several students were not only able to understand the concept of condensation, they were also able to apply the concept of condensation to the phenomena encountered in daily life. This study also illustrates how the professional learning of teachers is enhanced as a result of going through this learning study process. Success factors, challenges faced, and area for further considerations will also be presented.

Keywords: variation theory, scientific inquiry

Paper Presentation

Concurrent Session 2.1

Science Teaching and Learning

Lower Secondary Science

Use of Design Thinking Approach for Teachers to Develop Lesson Packages to Impart Values in Science Education

Juliza ZULKIFLI (juliza_zulkifli@moe.edu.sg), Muhammad Khairulnizam BIN A R

CHRIST CHURCH SECONDARY SCHOOL, SINGAPORE

Abstract

In this project, we follow the five steps of the design thinking approach to develop a lesson package to impart values in science education for secondary two Normal (Academic) pupils. We noticed that secondary two Normal (Academic) pupils find abstract science concepts too challenging to comprehend. There are also fewer opportunities for the pupils to work and interact with one another. In this teaching package, on the topic of 'Force and Pressure', problem-based learning approaches and Kagan's cooperative learning structures are used to teach students the concept to students from two Normal (Academic) classes. Pupils are required to work together and share their solutions using Padlet. We hope for pupils to learn and exhibit values such as resilience through resolving challenging problems, responsibility through ownership of learning and showing care through working with others. To measure the effectiveness of the lesson, we carried out pre- and post-tests and obtained verbal and online feedback from the pupils. The use of teachers' ratings, recordings of observations of pupils participating in the group activity, peer ratings and pupils' appraisals for evaluating values were emphasised. Through this experience, we hope to get pupils to appreciate the learning of science not just through the content but through their interaction with others and in doing so, develop traits of character values that can better prepare them for the future.

Keywords: lower secondary science, design thinking

Paper Presentation

Concurrent Session 2.2

Science Teaching and Learning

Primary Science

Integrating STEM Professionals' Sharing with Biologically Inspired Engineering: Designing and Evaluating STEM Activities for Young Children

LUO Tian (s1119849@s.eduhk.hk), Winnie SO Wing Mui

THE EDUCATION UNIVERSITY OF HONG KONG, HONG KONG

Abstract

STEM education has been recognized as an integrated and effective way for science teaching and learning. A series of informal STEM activities were designed and conducted in a summer camp for students (1st to 4th grade). The design of the activities mainly follows two guidelines. The first is to design STEM activities resembling the process of "biologically inspired engineering". The second is to naturally integrate sharing session of STEM professionals into the STEM activities to provide students with accurate career information. During the camp courses, four STEM professionals were invited to share with the students about their work in person or through videos. In order to understand how students perceive the STEM activities and the career information of STEM professionals, 28 interviews were conducted on 14 students, during which students were also asked to draw a scientist and an engineer. The data from the interviews and drawing tasks will be analysed in light of students' interpretation of their STEM-related experiences and career information they got from the camp. Teachers were also interviewed about their observation of students' learning and difficulty in teaching during the activities. Reflections and possible future implications of integrating STEM professionals' sharing with STEM activities similar to "biologically inspired engineering" will also be discussed.

Keywords: STEM, primary students, STEM professional

Paper Presentation

Concurrent Session 2.2

Science Teaching and Learning

Primary Science

Primary School Science Teachers' Practices with Digitized Textbooks and Factors affecting their Practices

Winnie SO Wing Mui (wiso@eduhk.hk), CHEN Yu

THE EDUCATION UNIVERSITY OF HONG KONG, HONG KONG

Abstract

Quite a number of developed economies are advocating e-learning to prepare the next generation to face the challenges of the 21st century. This study explored primary school science teachers' pedagogical practices with e-textbooks in classrooms and the factors that would affect their effective practices through a multiple case study. Eight science teachers and their students from four Hong Kong primary schools participated in this study. The science topics they taught included 'Seasons', 'Force', 'The Universe' and 'Ecology'. Multiple research methods including classroom observations, pre-and post- lesson interviews, and teachers' reflective journals were adopted to collect the data. The results indicated that the eight teachers made use of e-textbooks to achieve different instructional purposes (enhance students' learning or reinforce students' learning), to provide plentiful visualized resources (pictures, videos, or simulated experiments), to organise various activities (individual task, small group work or whole-class activity), and to create a more interactive science learning environment (increase interactions between textbooks and students or among students). However, factors such as students' over-excitement about and unfamiliarity with iPad use, as well as technical limitations such as the instability of the school WiFi or the limited number of iPads available seemed to decrease the teachers' effective practices with digitised textbooks as they need to pay more attention to classroom management. Implications of this study for science teachers' effective practices with advanced technologies for primary school science education are suggested. More studies on exploring teachers' practices with diverse technologies for science teaching and learning are needed.

Keywords: teachers' teaching, primary science, technology use, factors affecting teaching

Paper Presentation

Concurrent Session 2.2

Science Teaching and Learning

Others

Bi-Pronged Approach to NT Science Education at Singapore Boys' Home and Singapore Girls' Home: A Balance of Authentic Experience and Structured Rote Learning

Senthil SILVARAJOO (Senthil_SILVARAJOO@msf.gov.sg), Ganeshini PRAKASH, Nicole SUPAI

YOUTH RESIDENTIAL SERVICE (SINGAPORE BOYS' HOME AND GIRLS' HOME)
MINISTRY OF SOCIAL AND FAMILY DEVELOPMENT, SINGAPORE

Abstract

The Singapore Boys' and Girls' Homes are legislated as juvenile rehabilitation centres and places of safety for youths. Their core role is to effectively rehabilitate youths and successfully reintegrate them into society as assets. Education in the Homes is fundamentally anchored on the strong belief that education is the key enabler for youths to recreate their future, break out of recurring familial poverty and move towards their aspirations. Education facilitates the youths' re-entry into schools, progression to future learning and employment. The majority of the youths obtain poor results in school, with high absenteeism and disengagement from learning prior to entering the Home. This presented the teachers with two deep-seated issues: lack of motivation in science (a content-heavy subject) and poor content knowledge. Normal (Technical) science education is aligned with the MOE syllabus and teachers are committed to a bi-pronged approach that provides a curriculum geared towards authentic learning with hands-on experiences to address the lack of motivation in the subject and guided rote-learning to boost students' confidence in the subject, level up their knowledge capacity and bridge learning gaps arising from their absence from school. In this presentation, we will provide an insight into the science curriculum for N(T) students in the Homes, which centres on giving students an authentic learning experience and fortifying their content knowledge with structured guidance.

Keywords: Normal Technical (NT) science

Paper Presentation

Concurrent Session 2.3

Science Teaching and Learning

Chemistry

Use of Learning Study Approach to Teach Strengths of Acids

WONG Yoke Ung (wong_yoke_ung@moe.edu.sg), KOH Bing Qin, YEO Chee Keong, Mohammed Riffaii MAIDIN

PASIR RIS SECONDARY SCHOOL, SINGAPORE

Abstract

Chemistry is perceived to be a difficult subject to learn at the secondary school level as it requires the understanding of abstract and intangible theories at the sub-microscopic level. In particular, the concept of the strength of an acid in relation to its degree of ionisation is difficult to grasp. Leveraging the learning study cycle approach, the team developed a lesson to address the gap in the learning of the aforementioned concept. The learning study cycle approach started with the identification of the object of learning and the critical aspects of the concept that students must be able to discern. Applying the Theory of Variation in our pedagogical design, a practical-based lesson incorporating the patterns of variation was developed and implemented. This approach provided an avenue for the team to engage in professional discourse that resulted in lessons that are more focused, structured and student-centred. This has also enhanced students' understanding as shown in the results of the pre- and post-tests, where students were better able to differentiate between strong and weak acids.

Keywords: learning study, theory of variation

Paper Presentation

Concurrent Session 2.3

Teachers' Professional Learning and Development

Biology

The Impact of Learning Study on Teachers' Professional Development

Eunice CHAN (tan_baofen_eunice@moe.edu.sg), TAN Jieying, WONG Fui Yen, Jessica KNAPP

ANG MO KIO SECONDARY SCHOOL, SINGAPORE

Abstract

Learning study, which is based on variation theory, can be used collaboratively by teachers to design, evaluate and improve instruction to enhance students' learning. This paper aims to find out how the learning study process has impacted teachers' professional development as learning study is not only designed for students' learning, but also for teacher's learning and change (Cheng & Lo, 2012). With variation theory as the theoretical underpinning, teachers can look at a topic through the lens of a student to sieve out the object of learning and its critical aspects before designing lessons for instruction in the process of learning study. Our team of biology teachers, with varying years of teaching experience, worked together to develop a lesson for secondary three students, focusing on the antigen-antibody relationship in ABO blood types. As a means to track teachers' professional growth, this team of teachers reflected and documented their experiences before, during and after the learning study process. Comparisons were then made with another teacher who does not go through the learning study process to design her lesson.

Keywords: learning study, collaborative learning, variation theory, pedagogical design

Paper Presentation

Concurrent Session 2.3

Science Teaching and Learning

Biology

Designing Virtual Laboratories for a Freshmore Biology Course

Bina RAI (Bina_rai@sutd.edu.sg), ZHU Yajuan Julia

SINGAPORE UNIVERSITY OF TECHNOLOGY AND DESIGN, SINGAPORE

Abstract

One effective way of incorporating new technologies into the classroom is by using virtual laboratories (VL). VL environments provide repetitive practice in technique manipulation and data interpretation that students cannot easily experience in the usual three-hour period of the traditional teaching laboratory. We designed and implemented VL activities for reinforcing concepts in cell signalling, cell cycle regulation and fly genetics for about 500 undergraduate students who are predominantly non-Biology majors enrolled in the compulsory freshmore biology course at SUTD. Each virtual activity consisted of seven steps: design, set-up, run experiment, select technique (flow cytometry/western blotting/microscopy), run technique, analyse data and conclude. The customised lab simulation exercises were generated using existing software builders (StarCellBio and StarGenetics). An anonymous student survey consisting of six multiple-choice questions and one short question was conducted at the end of the course to access the students' perceptions of VL and the impact of VL on their learning. Data received from 229 students who responded revealed that approximately 80% agreed that they learned about experimental design and how to carry out experiments, discovered how to analyse data generated by biology techniques, and deepened their knowledge and understanding of biology concepts through participating in VL. Students commented that they found VL useful, helpful, safe, engaging and good for visualisation of concepts. For future work, we will improve VL assignments by including more concise exercises, clearer instructions and providing more time to complete the activity as per feedback received from instructors and students.

Keywords: biology, virtual laboratories

Paper Presentation

Concurrent Session 2.4

Science Teaching and Learning

Biology

Using ICT Platforms to Implement SDL(Student Directed Learning) and to Infuse Social and Moral Values for Teaching and Learning of AIDS

TAN Jin Poh (tan_jin_poh@moe.edu.sg)

DEYI SECONDARY SCHOOL, SINGAPORE

Abstract

Media savviness and social media have increased students' awareness of AIDS. However, they lack the deeper understanding of the social and moral implications that could afford them a more informed understanding of the facts and issues at hand. How do we then engage students and teach values at the same time? This presentation aims to address this question and explore how we can deepen students' knowledge through self-directed learning and collaborative learning. Students will work collaboratively to research the topic, verify the accuracy of their prior knowledge and participate in a moral dilemma discussion. The students will be working on the internet using a closed social media environment hosted on the school Learning Management System, Padlet and Google Docs. The learning activities will end with a simulation on the spread of HIV. Through a range of activities, the students would have ample opportunity to deepen their knowledge, learn about the social impact and at the same time learn about the values that could minimise the spread of the disease.

Keywords: ICT, SDL, AIDS, social and moral values

Paper Presentation

Concurrent Session 2.4

Science Teaching and Learning

Chemistry

Making Connections and Infusing Values: Learning and Teaching Chemistry in Context

Irene TAN (irene_tan@moe.gov.sg)

ACADEMY OF SINGAPORE TEACHERS, MINISTRY OF EDUCATION (SINGAPORE)

Abstract

In educating our students to be future-ready, learning of content or subject related skills is not sufficient. They need to be strongly grounded in values and have a great passion for what they do. This session will focus on how chemistry teachers can facilitate learning of chemistry by helping students discover the joy of learning by connecting what they learn with everyday life, and finding out for themselves why being values-driven is important. Teaching chemistry in context can help students learn the relevance and impact of chemistry in everyday life, the society and the larger environment. Fink (2003), found that when a learning experience has a profound effect on the students, it can result in a greater sense of care for the subject, for themselves, others, or learning in general. This in turn, can lead to new interests, energy for learning, or a change in values (Fink, 2003). The presenter will share how ethics and values can be infused in the teaching and learning of chemistry. Samples of student work, as well as the rich reflections from them will be shared. Participants will take away ideas on how they could adapt these strategies in their classrooms.

Keywords: chemistry, values-based education, context-based learning, PBL

Paper Presentation

Concurrent Session 2.4

Science Teaching and Learning

Chemistry

Chemistry Value Based Questions as an Alternative to Strengthening Character in High School Students

Sulastri (sulastri@fkip.unsyiah.ac.id), Rusman, Asri Arifa

CHEMISTRY EDUCATION DEPARTMENT, FACULTY OF TEACHER TRAINING AND EDUCATION, SYIAH KUALA UNIVERSITY, INDONESIA

Abstract

This paper concerns the preparation of values-based questions in chemistry on the topic of hydrocarbon and petroleum materials. These values-based questions aimed to strengthen the character of high school students. Religious, aesthetic, ethical, economic, and intellectual values are integrated into the chemical issues. These questions were validated by three expert lecturers and 11 chemistry teachers in Banda Aceh. The results show that there are 18 hydrocarbon and petroleum problems developed worthy to be tested on the students. Based on the results of the research, it can be concluded that the questions developed are able to strengthen students' character. The development of values-based questions still needs to be done for other chemistry learning.

Keywords: learning chemistry, values in science, values based question, character, high school

Paper Presentation

Concurrent Session 2.5

Applied Learning in Science

Nutrition and Food Science

Making Food Science Relevant

Nur Haryani BINTE MOHAMED HATTA
(nur_haryani_mohamed_hatta@moe.edu.sg)

JURONGVILLE SECONDARY SCHOOL, SINGAPORE

Gnanamany PHILIP

ACADEMY OF SINGAPORE TEACHERS, MINISTRY OF EDUCATION (SINGAPORE)

Abstract

To ensure the relevance of what is being learnt in real world situations, the Nutrition and Food Science unit (NFS) in Jurongville Secondary School collaborated with the science and PE department between 2015 and 2017. This collaboration seeks to connect Science and skills to Health and Wellness. Experiential learning strategies were used to make learning authentic. Having gone through the Food Science module in secondary one and Sports Science module at the beginning of secondary two, JVS' first batch of Applied Learning Programme (ALP) students embarked on a project work in 2016 to apply the relevant knowledge and skills learnt from both modules. Students were tasked to solve an authentic problem that required them to identify possible causes underlying certain issues in a case study, and to create artefacts that address the issues identified. The learning experience strengthened students' competencies in critical and inventive thinking as they needed to explore possible options, and evaluate the functional qualities of proposed solutions before deciding on the final product. At the end of the project work journey, students presented their findings and their artefacts and shared relevant points of application to the rest of the class and the school community. In this presentation, we will be sharing some of the food science lessons that were designed to scaffold the students' learning of the issues and how they may be addressed. These lessons will not only stretch students beyond what is learnt in textbooks but will also develop potential Food Science enthusiasts.

Keywords: food science, application

Paper Presentation

Concurrent Session 2.5

Science Teaching and Learning

Nutrition and Food Science

The REEE Approach in the Teaching and Learning of Nutrition and Food Science

QUEK-CHANG Way Lie (chang_way_lie@moe.edu.sg), CHENG Soon Kuee Crystal, CHIAM Wende Daniel

HONG KAH SECONDARY SCHOOL, SINGAPORE

Abstract

The inquiry-based learning approach has been successful as an effective pedagogy in developing student's enduring understandings. The Nutrition and Food Science (NFS) unit in Hong Kah Secondary School used the Reflect-Explain-Explore-Excel (REEE) approach to promote inquiry as a habit of mind among students. Teachers used this approach to involve students in conducting investigations using appropriate scientific techniques and tools, evaluating evidences, and constructing their understanding. This constructivist approach provides students with opportunities to be engaged in critical and inventive thinking, and develop information seeking skills in the process. In this session, the NFS teachers will share their experiences in guiding secondary two students to conduct preliminary investigations on the use of different types of sugar and flour when making muffins. In the process students learn of the impact of different ingredients (e.g., protein content in flour) on the taste, texture and appearance of muffins. This sharing also provides evidence on how students learn through experimentation and presenting data using appropriate tools such as charts. Teachers also scaffolded students' meta-cognitive skills (e.g., helping them explain how they learnt, and why they learnt what did). At the end of the lesson, students assessed what they learnt and how they could bridge their learning gaps.

Keywords: food experiment

Paper Presentation

Concurrent Session 2.5

Science Teaching and Learning

Nutrition and Food Science

Let's Create using the Experiential Learning Cycle

Gloria GURUNG (gloria_maria_seet@moe.edu.sg), Mohana D/O S SINNIAH, Kavitha Amara Joyce S RAJOO

CHIJ ST. NICHOLAS GIRLS' SCHOOL, SINGAPORE

Abstract

As proposed by David Kolb, the Experiential Learning Cycle (ELC) aims to enable a learner to comprehend concepts at a level that they can generalize and apply to new situations, or combine with other key concepts they have learned. Our lower secondary food and consumer education students go through a four-stage process in ELC to be engaged in and to reflect on what they learnt during food science lessons. The learning process with this ELC model serves to contribute to the students' comprehension, application, explanation, and innovation through the steps of concrete experience (doing), reflective observation (reviewing), abstract conceptualization (concluding), and active experimentation (planning). This is aligned with our objectives of giving students space to be creative and also show how much they have understood in terms of concepts that can be applied in real world situations. In this presentation, we will be sharing the use of the ELC model and the impact it has on students' learning. Prior to the lesson, students were taught basic cake making skills of rubbing-in, creaming and whisking, together with the basic recipes and functions of main ingredients in baked products. Equipped with these essential knowledge and skills, students set out to plan and create an original cake recipe. They evaluated their final products using a worksheet with guiding questions and sensory vocabulary. This learning process enabled students to make connections between the outcomes of their experimentation to key theoretical concepts, paving the way for self-directed and self-regulated learning.

Keywords: food science, experiential learning cycle

Paper Presentation

Concurrent Session 2.6

Assessment and Evaluation

Biology

Using 4-tier Diagnostic Instrument to Identify Common Misconceptions in Genetics

TAN Jian Zhong Adrian (tan_jian_zhong@moe.edu.sg)

MILLENNIA INSTITUTE, SINGAPORE

Abstract

The literature reveals that high school teachers rate genetics as one of the most difficult topics in Biology. The numerous alternative conceptions (AC) documented in the literature together with the lack of local studies on this topic warrant a need to develop a diagnostic instrument to identify misconceptions in genetics. This study aims to address the following questions: (1) To what extent is the diagnostic instrument a valid and reliable instrument to evaluate A-level students' understanding of the concepts in genetics? (2) What are some common alternative conceptions on genetics held by A-level students in Singapore? The final version contained 20 four-tier multiple choice (4TMC) items, each comprising an answer tier, confidence rating of answer, reason tier and confidence rating of reason. The overall difficulty level and discriminating power of the instrument were considered fair. Our findings suggest that our instrument is reliable and valid in diagnosing students' ACs. Furthermore, the use of confidence ratings allowed us to delve deeper into the nature of students' learning difficulties, which would not be possible with the use of test scores alone. A total of 34 ACs were reported to be significant. 20 of the significant ACs could be considered genuine with a mean confidence rating of more than 3.50. We attributed these ACs to confusion over genetic terminology, poor understanding of hydrogen bonding, difficulties with concepts on homologous chromosomes, poor understanding of meiosis and mitosis, limited understanding of differential gene expression, and difficulties in understanding mechanisms underlying heredity.

Keywords: misconceptions, diagnostic instrument, 4-tier multiple choice questions, genetics

Paper Presentation

Concurrent Session 2.6

Science Teaching and Learning

Physics

Developing Critical Thinking Skills in Science using Intellectual Standards

NG Boon Hwee (ng_boon_hwee@moe.edu.sg), Alan Varella JOSEPH, NEO Kian Siah, Joanne NG Li Min

TEMASEK JUNIOR COLLEGE, SINGAPORE

Abstract

We hope to develop critical thinkers who are self-guided, self-disciplined by infusing in our students the belief and habit of working diligently to develop the traits of intellectual integrity, intellectual humility, intellectual courage, intellectual empathy, intellectual perseverance and confidence in reason. This research study examines whether students' understanding and use of Intellectual Standards (IS) (Paul & Elder, 2002) in guiding their thinking and refining their answers improves their performance in physics. Based on the concepts in "Mechanics", we focused on seven IS: clarity, precision, accuracy, relevance, significance, depth and logic. A lesson package was designed and implemented in four secondary three classes over seven weeks to support students in developing explicit and implicit knowledge of the standards, means for critical thinking and metacognition. The use of higher-level questioning is positively related to improved student achievement (Redfield & Rousseau, 1981). This work is centred on the belief that the teacher is a designer of curricular and instructional activities that facilitate the interactions required for learning to the level of understanding. This view of teacher and student roles acknowledges questioning to be a core function of both learning and teaching (Perkins, 1992; Hunkins, 1995; Wells, 2001). Data sources included students' written work and assessment performance. Teachers' perspectives elicited through reflections highlighted the gains and the challenges encountered against contextual realities. Students' perspectives elicited after implementation provided useful insights into the impact of the intervention on students' learning. Pedagogical implications and recommendations for future work will also be presented.

Keywords: critical thinking skills, intellectual standards, science, physics

Paper Presentation

Concurrent Session 2.6

New Media and Technologies

Chemistry

A Beginner's Guide to Using Augmented Reality in the Classroom

TAY Su Kian Jamie (tay_su_kian_jamie@moe.edu.sg), SOH Sze Chuan Sabrina, KOH Yilin Sheryl, Martin LEE Tze Chuen

HOLY INNOCENTS' HIGH SCHOOL, SINGAPORE

Abstract

'Augmented Reality'(AR) appears to be the latest buzzword in education. It may be daunting to infuse AR into lessons. Feasibility and effectiveness are among the many questions that will arise. This sharing explores how AR was integrated into our Science curriculum. An example would be the teaching of Elements and Compounds for secondary one to three levels using the Elements 4D app. The impetus for using AR is two-fold – the attention of students is captured and lessons are more interactive. For instance, students can scrutinise elements that are usually considered too dangerous. With AR, improved student engagement and retention of concepts were apparent. Students were involved in greater self-directed learning, with many using their devices to explore concepts beyond those listed in the worksheets. AR also lends itself well to collaborative learning as it stimulates discussion in the classroom. Clearly, AR apps not only develop students' digital competencies, but also nurture students' interest in Science. However, with rapid technological advancement, educators are confronted with the challenge of apps quickly becoming obsolete. As such, besides being introduced to other AR apps, participants can listen to how our school has adapted these apps' resources and infused thinking routines to create lesson packages for different levels and streams. We will also share the templates we have created, and the challenges of implementing an AR-based lesson. With more AR options coming up, the use of AR in education is more a question of when, not if.

Keywords: augmented reality, mobile app, thinking routines, self-directed learning, collaborative learning, chemistry, lower secondary science, secondary

Paper Presentation

Concurrent Session 2.7

Science Literacy and Practices of Science

Physics

Deepen Students' Conceptual Understanding and Nature of Scientific Knowledge (NOS)

QUEK Siew Ling (quek_siew_ling@moe.edu.sg)

PIONEER JUNIOR COLLEGE, SINGAPORE

LEE Siew Lin, LIN Li

ACADEMY OF SINGAPORE TEACHERS, MINISTRY OF EDUCATION (SINGAPORE)

Abstract

The history and philosophy of science plays an important role in teaching the Nature of Scientific Knowledge (NOS), as reasoned by many scholars (e.g. Khalick, 2012; Lederman, 2002; Mathew, 2015). The revised H2 syllabus requires that teachers infuse Practices of Science (POS) in their instruction. This includes understanding that scientific knowledge is reliable and durable, yet subject to revision in the light of new evidence (POS-A4) and that evidence used to construct explanations must be based on evidence justified through reasoning and logical argument (POS-B5). The presentation outlines strategies to advance students' conceptual knowledge in A-level Physics through historical perspectives, argumentation, thinking routines and inquiry activities. The work of Niels Bohr and his contributions to the quantum view of the atom were incorporated as a lesson activity in this study. When students experience and articulate the reasoning that Niels Bohr developed with his contemporaries, they better appreciate why "wrong ideas are wrong" (Osborne, 2010). A survey instrument adapted from Views on Science Questionnaire was fine-tuned after trialling in a few Junior Colleges, and administered to the students before and after the NOS lesson. A few students were also selected for a short interview to probe deeper their understanding of NOS after the lesson. The findings of the study suggest that there was an uneven understanding of NOS in a significant proportion of students. The presentation seeks to inspire the audience with ideas on weaving NOS into the A-level curriculum to challenge students' pre-conceived notions of Science and help them develop stronger scientific inquiry skills.

Keywords: practices of science, nature of scientific knowledge, argumentation, thinking routines

Paper Presentation

Concurrent Session 2.7

Applied Learning in Science

Lower Secondary Science

Development of STEM Performance Tasks for Applied Learning in SST

TAN Hoe Teck (tan_hoe_teck@sst.edu.sg)

SCHOOL OF SCIENCE AND TECHNOLOGY, SINGAPORE

Abstract

SST's mission statement is to nurture passionate innovators who improve society through real-world applications of science and technology. Central to SST's curriculum planning process are five curriculum organisers: Applied Learning approach, 21st century competencies & dispositions, Information and Communication Technologies, Inter-disciplinary Research Studies, and Innovation & Entrepreneurship. Performance tasks provide a good platform to deliver these approaches and learning competencies. Through a carefully crafted real-world problem, students are required to develop a solution as a team, using the Engineering Design Process. In this way, we challenged our students to develop authentic solutions to meet the requirements. I will be presenting a few performance tasks that have been implemented before to illustrate a good range of STEM performance tasks in Physics. Examples include the Mouse Trap Vehicle, the Bridge Building Competition and the Household wiring circuits. The performance tasks are not limited to Physics but can be inter-disciplinary in nature. I will also be presenting a few new possibilities that lends itself to interdisciplinary STEM applications. Examples include Fox Hunting, Earthquake design and Water Rocket activities. I welcome teachers who have a passion for Authentic Learning to form a community of practice with me, so as to share our projects and learn from each other to enhance the learning of Physics or other subjects.

Keywords: applied learning, performance tasks, STEM

Paper Presentation

Concurrent Session 2.7

Assessment and Evaluation

Others

Learning Analytics of Student Data

Norman LEE (norman_lee@sutd.edu.sg), Oka KURNIAWAN, NG Geok See

SINGAPORE UNIVERSITY OF TECHNOLOGY AND DESIGN, SINGAPORE

Abstract

We describe the insights into student behaviour gained by applying data mining techniques to data collected during our first-year introductory computer programming course at SUTD in 2017. During the course, students submit various programming assignments to our learning management system throughout the term. Each action by the student is recorded in the server log. Examples of such actions are the time the submission page is accessed and the time the assignment is submitted. Subsequently, processing the log data enables features for each student to be extracted. These features include how long the student spent on each assignment, how close to the deadline the assignment was submitted and so on. The feature data for each student is then put together with their results from the various assessment components in our course to form the dataset for our analysis. Any information that identifies any individual student is removed before analysis is done. Data mining techniques applied to the data include classification trees, clustering and association analysis. We found that students with better overall performance in our course showed different behaviours from those who performed poorly. The results from the analysis could be used to help instructors identify which students are most likely to perform poorly in the course, enabling timely pedagogical intervention to be carried out. For future runs of the course, similar analysis can be done so that trends in student behaviour can be seen.

Keywords: data mining, learning analytics

Workshop

Concurrent Session 2.8

Science Teaching and Learning

Physics

Design of Practical Work for Physics Instruction

WONG Jon Sien Darren (darren_wong@moe.gov.sg), LEONG Tze Kwang, YANG Yarong, TAN Zhiming Darren

CURRICULUM PLANNING AND DEVELOPMENT DIVISION, MINISTRY OF EDUCATION (SINGAPORE)

Abstract

Practical work in science forms a valuable part of students' learning experience in engaging in the practices of science (such as modelling and argumentation) while learning science concepts. In this workshop, we will share the pedagogical considerations in the design of practical work to facilitate effective learning, where practical work is both about manipulating ideas and manipulating equipment. Through a mix of inductive and deductive approaches, practical work can help to promote scientific thinking and reasoning, develop creative thinking and problem solving, as well as help students link theory and experiment. Participants will have the opportunity to experience some hands-on activities that illustrate how practical work could be designed to make learning of science meaningful and stimulating.

Keywords: practical work, practices of science, modeling, design challenge

Workshop

Concurrent Session 2.9

Science Teaching and Learning

Others

Fostering Intrinsic Motivation and Sustained Engagement amongst Lower Progress Learners through Fun and Simple Design-Based Science Activities

Muhammad Nazir BIN AMIR (muhammad_nazir_amir@moe.gov.sg)

ACADEMY OF SINGAPORE TEACHERS, MINISTRY OF EDUCATION (SINGAPORE)

Abstract

Design-based Science (DBS) is a pedagogy in which new scientific knowledge and problem-solving skills are constructed in the context of designing and making artefacts (Fortus et al., 2004). Such a pedagogy can be useful to motivate and engage low progress learners in gaining science concepts and skills that are prescribed in the science syllabus. This hands-on workshop aims to share ideas on how science teachers can present academic content in their science syllabus, and at the same time foster inventive thinking amongst their students through fun design-based science activities. Participants in this workshop will be brought through a hands-on design-based toy activity called the 'Creative Cartesian Diver' project. In this project, participants will be exposed to the process of guiding their students to acquire concepts and skills related to the topic of 'Density' by using only simple materials, and gather ideas on ways to guide their students in coming up with variations of the toy using contexts that are embedded in the application of science principles. The workshop facilitator will also share ideas on how other topics in the science syllabus can be aligned to a number of fun design-based science activities. This will be highlighted through several case studies. This workshop is suitable for teachers and AEDs supporting low progress students in primary and secondary schools, and for educators who are on the lookout for ideas to motivate and engage students who may be easily distracted in class.

Keywords: intrinsic motivation, engagement, arousing interest, creativity, toys

Workshop

Concurrent Session 2.10

Science Teaching and Learning

Others

Learning Science through Experiential Learning Cycle (ELC)

CHAN Kin Chuah (chan_kin_chuah@moe.edu.sg), ZHONG Wanying, TOH Siew Kim

CHIJ ST. NICHOLAS GIRLS' SCHOOL, SINGAPORE

Abstract

In a 21st century classroom, it is essential for students to learn both content and develop 21st century competencies. The Experiential Learning Cycle (ELC) provides a framework for teachers to plan and implement lessons to achieve this. The school would like to share how ELC has changed the learning experience of students for science. The ELC consists of four stages, i.e. Concrete Experience (CE), Reflective Observation (RO), Abstract Conceptualization (AC) and Active Experimentation (AE). CE typically consists of an activity that provides a memorial point for students to anchor their learning. During RO, students reflect on their experience, attempt to make sense of their observations and raise queries. Student-student interactions and teacher-student interactions during AC allow students to develop an understanding of the concepts behind their experience. AE aims to let students transfer their learning to new situations or experience which may lead to a new cycle of learning. Our experience with ELC shows that students are able to change their thinking on their prior misconceptions. They are also able to retain what they learned as reflected in their answers in both formative and summative assessments. Feedback from students indicates that they are engaged in their learning; are more aware of their areas of weaknesses; and have become confident in articulating the concepts in their explanation. ELC provides opportunities for interplay between activity and reflection. This allows students to learn subject content while developing 21st century competencies.

Keywords: ELC, pedagogy, engaged learning, active learning