Paper Presentation

Concurrent Session 1.1

Science Teaching and Learning

Physics

Developing Student Reasoning Skills and Engagement in PHYSICS using the C.A.R.E Approach and DCLAP Thinking Strategy

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Abstract

It was observed that students have difficulty in communicating their scientific reasoning clearly due to a lack in critical thinking skills. In alignment to 21st century competencies and skills, a lesson study incorporating the C.A.R.E. approach was implemented to develop students' critical thinking skills and improve their quality of experience in the learning of science. We hypothesise that students are more engaged in learning by using the C.A.R.E. approach and are able to communicate better in their scientific reasoning through a scaffolded thinking strategy. Our team designed a lesson package on the topic of 'Turning Effect of Forces' crafted using the 5E instructional model. The lesson package allows students to examine scientific concepts using a hands-on approach. Through learning stations, students analyse real-life complex situations and learn how to apply the concepts learned. We adapted Paul's Wheel of Reasoning and its Universal Intellectual Standards (IS) in teaching students critical thinking skills explicitly and in assessing students' quality of thinking. Students from secondary three Express classes were assessed on their level of critical thinking through pre- and post-tests and questioning. Quantitative data were aggregated using specific assessment rubrics aligned to 'DCLAP'. Qualitative analysis was based on evidence gathered from post-lesson observations and students' discussions, reflections and written responses from their pre- and post-tests. Both data were analysed to determine the extent of improvement in students' reasoning skills. Our preliminary results, which will be shared during the presentation, shows that students' engagement and reasoning skills have improved to some extent.

Keywords: critical thinking skills, quality of thinking

Paper Presentation

Concurrent Session 1.1

Science Teaching and Learning

Physics

The Impact of ICT-Mediated Instructional Activities on Students' Physics Self-Efficacy

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Abstract

Students' self-efficacy has been shown in the literature to be a good predictor of achievement across disciplines. This study aimed to investigate the impact of ICT-mediated instructional activities on students' self-efficacy in physics. The study involved 54 secondary four students (16 year-olds) from two intact classrooms, E3 and E4, in a secondary school in Singapore. Lesson packages for three chapters of 'Thermal Physics' were designed, guided by the Designing for Active Learning framework proposed by Educational Technology Division, Ministry of Education, Singapore. These lessons were implemented in both classes by their respective subject teachers over a period of six weeks. Pre- and post-measures of students' self-efficacy were obtained by administering a validated instrument developed by Fencl and Sheel (2005). Survey results were compared using a paired samples t-test. In both classes, the post-intervention MRI on the overall self-efficacy scale was significantly higher than the pre-intervention MRI. Further analysis of the data showed that the most significant differences appeared in the social persuasion and physiological state subscales. Again, these results were consistent across both classes. This study has shown that the meaningful and appropriate use of ICT tools has the potential to positively impact the way students interact and the way they feel during lessons and can, in turn, significantly affect students' perceptions of their own ability to successfully perform tasks assigned to them.

Keywords: self-efficacy, thermal physics, ICT, active learning

Paper Presentation

Concurrent Session 1.1

Science Teaching and Learning

Physics

Conceptual Understanding of Energy: A Multiple Representations Approach

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Abstract

'Energy' is one of the essential concepts that appears in many parts of the physics curriculum. A good grasp of various aspects of energy is vital for students to build a firm understanding of the fundamentals of physics and its applications in the real world. Unlike other concepts in mechanics such as 'Force' and 'Velocity', energy is intangible to students. Research has shown that students do not come to class as *tabula rasa* (i.e. 'blank slates') but with many alternative conceptions about energy and are often confused by inadequate instruction or unsuitable textbooks (Jewett, 2007). Many teaching approaches and strategies underpinned by constructivism have been proposed to teach this abstract concept such as through the use of analogies (Duit, 1991). The aim of this session is to present and share an evidence-based strategy underpinned by theories for teaching the key ideas on the topic of 'Energy' – 'Transformation', 'Transfer', and 'Conservation'. The instruction will typically begin with a diagnosis of students' preconceptions which is then followed by learning activities and multiple representations of work-energy processes (Heuvelen & Zou, 2000) to scaffold and facilitate students' meaning making. Besides engaging in the Energy Cube and Stop-Motion animation activities, participants can also look forward to learning how formative assessment strategies are embedded in the instructional approach that seek to foster students' conceptual understanding.

Keywords: pedagogical content knowledge, teaching approach, formative assessment, CoRe, PaPeR, PCK

Paper Presentation

Concurrent Session 1.2

Science Teaching and Learning

Biology

Joy of Learning in Science

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Abstract

In the 2016 Work Plan Seminar, Mr Ng Chee Meng, Minister for Education (Schools), urged schools to re-think their efforts in fostering the Joy of Learning (JoL). This study aims to find out how JoL can be brought about in the learning of Science. We believe that when our lessons are able to engage students in their *heads*, *hearts* and *hands*, they are intrinsically motivated to explore further and think deeper on their own. To increase student engagement, we have explored two main areas: the design of lesson packages and the role of teachers in effective facilitation of lessons. Our approach to lesson design makes use of the 'ACE' framework in inquiry-based learning. 'ACE' refers to providing students the opportunity to Apply (A) their own knowledge to real world contexts, to Collaborate (C) with peers and to Extend (E) their learning beyond the classroom. To complement the inquiry-based packages, teachers intentionally planned facilitation questions and activities that meaningfully move students' learning forward in achieving the intended learning outcomes. As part of the lesson-study model, teachers developed a set of qualitative indicators including students' verbal and non-verbal behaviours, as indicators of student engagement, and employed these rubrics in lesson observations with the secondary three Express students. Moving forward, we can channel even greater efforts in planning and carrying out engaging lessons that motivate students to develop positive feelings towards learning, which over time, may culminate to true JoL, allowing students to be self-directed learners with a passion for learning.

Keywords: joy of learning, secondary science

Paper Presentation

Concurrent Session 1.2

Science Teaching and Learning

Nutrition and Food Science

Making Thinking Visible – Unpacking the Layers of Meaning in a Food and Consumer Education Lesson

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Abstract

Thinking routines are facilitative structures designed by researchers at Project Zero Harvard Graduate School of Education to guide students' thinking and encourage active mental processing. The Layers thinking routine is one of the visible thinking routines from Project Zero for structuring thought analysis. This routine provides the learners with a structure to look analytically at creative works and acts as a stimulus to encourage critical thinking. In this presentation, participants will discover how the Layers thinking routine, accompanied by various engagement activities, can be used to scaffold and support students' thought processes to have a deeper understanding of food product labels. In doing so, students and participants will become more discerning consumers who are able to assess options and make more informed decisions. Participants will also learn about the importance of clarity in the construction of questions to facilitate deeper learning and reflection; the importance of explicitness in externalizing thoughts to help students better rationalise the significance of the topic, and the creation of Layers of Meaning handouts to monitor students' learning in their lessons and coursework.

Keywords: making thinking visible, thinking routine, Layers

Paper Presentation

Concurrent Session 1.2

Science Teaching and Learning

Physics

Developing Students' Science Inquiry Skills through Visible Thinking Strategies

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Abstract

Learning is a consequence of thinking. Given this important relationship, educators need to support students in becoming skilful and critical thinkers in order to help them become effective learners. This is especially important and relevant in science teaching and learning where we seek to improve students' cognitive understanding of scientific concepts and equip them with science inquiry skills of reasoning and argument. Drawing on the work of Ron Ritchhart (Harvard Project Zero), we adopt strategies for making student thinking more valued and visible in the classroom through the use of thinking routines and other strategies focused on improving students' capacity to think logically and deeply. A whole school approach was undertaken in the implementation of Visible Thinking. It was implemented through Learning Rounds, a professional development platform to support the implementation of school-wide pedagogical approaches. For the science subjects, thinking routines such as 'See-Think-Wonder', 'Connect-Extend-Challenge' and 'Claim-Support-Question' were used during lessons. In teams, teachers conduct and observe these lessons. Subsequently, they discuss strategies to improve and make the lessons more effective based on evidence and feedback collected. During the presentation, participants will discover how to craft inquiry-based science lessons using visible thinking routines. We will also share feedback received from students and teachers. Going forward, we will be looking beyond the routines to establish a broader culture of thinking based on the eight cultural forces defined by Harvard Project Zero. This would lay the foundation for seminar-style science lessons which encourage self-directed learning and collaborative learning.

Keywords: science inquiry skills; visible thinking; Learning Rounds

Paper Presentation

Concurrent Session 1.3

Science Literacy and Practices of Science

Biology

Improving Biotech Education & Scientific Literacy Skills through Labster-based Gamified Laboratory Simulations

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Abstract

As potential practitioners, innovators, and citizens in an increasingly technologically-driven world, Singaporeans should be equipped with necessary scientific literacy skills and a strong background in science to make informed decisions based on principles about current and emerging issues which are important to self, society and the world. The extent of students acquiring these cognitive skills determines their level of scientific literacy and is dependent on how well existing pedagogies link academic science with real world contexts. Despite the enriched curriculum and repertoire of pedagogies implemented in Singapore schools, students in general still lack essential scientific literacy skills such as argumentation. Scientific literacy should be broadly conceptualized for schools to pursue their goals along with the content and methodologies that are most appropriate for their students (DeBoer, 2000). Millennia Institute (MI) conducted a Professional Learning Team project to examine scientific literacy levels amongst students with the aid of Test of Scientific Literacy Skills (TOSLS) developed by Georgia Institute of Technology. Results showed that students were weak at identifying valid scientific arguments, understanding elements of research design, and justifying references and conclusions based on data. In collaboration with Educational Technology Division, Labster's laboratory simulations were acquired and it was hypothesized that incorporating Labster-based gamified laboratory simulations in MI's Teaching & Learning practices can improve students' weak elements of scientific literacy. We hope to share ways to assess students' existing levels of scientific literacy and introduce an innovative method to teach science education through Labster laboratory simulations in order to address students' gaps in scientific literacy.

Keywords: scientific literacy, laboratory simulations, Labster

Paper Presentation

Concurrent Session 1.3

Science Teaching and Learning

Chemistry

The Use of Analytical Rubrics for H2 Chemistry Volumetric Analysis Planning

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Abstract

In the H2 chemistry syllabus, planning is one of the key features in the scheme of assessment. Cognitively, it is very challenging for students as it requires students to engage in higher order thinking to develop a holistic and workable scientific plan to achieve the task requirements. In order to enhance students' planning of Volumetric Analysis (VA) experiments, we posit the use of an analytic rubric as a Formative Assessment (FA) tool to augment students' metacognitive constructs. Based on Dylan William's FA diagram, a generic analytical rubric was developed. Three phases of intervention have been implemented in this Professional Learning Team project. Quantitative analysis of the pre- and post-test revealed that the use of analytical rubrics enhances students' planning of VA experiments. From the teachers' focus group discussion, we gleaned some understanding on the use of analytical rubrics as a FA tool to enhance students' performance in planning.

Keywords: formative assessment, higher order thinking, metacognition, rubrics, professional learning team

Paper Presentation

Concurrent Session 1.3

Science Teaching and Learning

Lower Secondary Science

PBL as an Inquiry Approach to foster the Joy of Learning Science: A Cognitive Neuroscience Perspective

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Abstract

This paper reports the use of Problem-based Learning (PBL) as an inquiry approach to foster the joy of learning science from a cognitive neuroscience perspective. The importance of providing impactful learning experiences to engender the joy of learning in students was one of the highlights at both 2016 and 2017 MOE Work Plan Seminars. As science teachers, we aim to enthuse our students to learn science and nurture them to be responsible, scientifically literate citizens. For engaged learning in science to happen, some critical factors include stirring emotion, experiencing novelty, seeing relevance, firing and sustaining students' interest and motivating them. To foster the joy of learning, what are five key questions for science teachers to consider in their lesson preparation to engender a positive classroom culture during lesson enactment with assessment and feedback? By means of an inquiry-based lower secondary science lesson conducted at the Jurong Lake Park by a secondary school, this paper seeks to explain the neural basis of the joy of learning from a cognitive neuroscience perspective.

Keywords: PBL, inquiry approach, joy of learning, cognitive neuroscience

Paper Presentation

Concurrent Session 1.4

Science Teaching and Learning

Chemistry

Making Thinking Visible in Chemistry

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Abstract

A key issue with teaching and learning chemistry is the abstract nature of the subject. Students can observe the consequence of a chemical reaction, e.g. a change in temperature or the production of a gas, but it is impossible to observe the actual particles as they react. Teachers may struggle with explaining what cannot be directly observed and students can become frustrated as they try to imagine what might be happening at a molecular level. This combination has the potential to create misconceptions in the mind of the student and a difficulty in deep learning and understanding of the subject. In this presentation the facilitator will share a variety of strategies that can be used in the classroom that allow both the teacher and his / her students to make their thinking visible using analogies and models. For example, Duplo Lego bricks can be used by students to model elements, compounds and mixtures. Through visual inspection of students' models, the teacher can quickly assess the level of their students' understanding. Participants will understand that abstract ideas in chemistry can be made visible through the use of analogies and models. When students take things that are familiar (either conceptual or physical) and use them in a way that helps them to understand what is unfamiliar, then learning of abstract ideas can take place more easily.

Keywords: visible thinking, misconceptions, models, analogies

Paper Presentation

Concurrent Session 1.4

Science Teaching and Learning

Chemistry

Modelling Instruction in Electrochemistry and Acid-base Equilibria

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Abstract

The study of chemistry often involves macroscopic and sub-microscopic representations of concepts and processes, which are difficult to visualise through the traditional way of teaching. Thus, the conceptualisation of sub-microscopic phenomena may not be easily achievable. We observed that students face difficulties in conceptualising the acid-base reactions and electrochemical reactions at the sub-microscopic levels. In developing student's subject mastery, Modelling instruction was used as the key approach to promote conceptual change. Our study employed the two main stages of modelling instructions. Firstly, the model development stage where students actively construct appropriate models to study the phenomena observed and secondly, the model deployment stage for students to apply their newly-discovered model to new situations to deepen their understanding of them. Our study demonstrates the value of Modelling instruction in bridging the gap between graphical (titration pH graph)/ diagrammatic (electrochemical cell set up) representations and algebraic problem solving. Our findings show that there is an increase in content mastery and confidence among students for the topic of Electrochemistry and Acid-base Equilibria after adopting modelling instruction. Our findings are consistent with the growing body of literature indicating the effectiveness of the Modelling instruction approach to bring about conceptual change.

Keywords: Modelling Instruction, electrochemistry, acid-base equilibria

Paper Presentation

Concurrent Session 1.4

Science Teaching and Learning

Chemistry

Locational Based Learning in IJC using Memory Palace

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Abstract

A major concern with students transitioning into A-level chemistry is that they are expected to recall, understand and articulate the reagents, conditions and observations (RCOs) of approximately 50 reactions, prevailing across the nine organic functional groups. This acute jump in requirements often proved difficult for students. Leveraging the nature of chemistry that heavily engages the perceptive senses and the exceptionally strong navigational ability innate to the human brain (Weintraub, 2012), this paper presentation espouses the actual use of a constructed memory palace as pedagogical tool. This tool entails the use of architectural features of Innova Junior College to represent all the RCOs and to address students' problems in recalling. A memory palace, or the method of loci (MOL) is a mnemonic device that forms spatial relationships between the "loci" (physical structure and features in a location) and information to recall the learnings (Qureshi, 2014). The presenter will share how to use physical locations to organise reactions of the different functional groups and create a memory palace that empowers students to not only remember the RCOs but also create multi-step reactions as they explore the spatial environment. This pedagogical approach has been proven effective in helping students to process RCOs in ways that are unique to. It also brought about a shift from Assessment for Learning (AfL) to Assessment as Learning (AaL), and can be accepted as a form of independent learning for students.

Keywords: Memory Palace, organic chemistry, A Levels, assessment for learning

Paper Presentation

Concurrent Session 1.5

Applied Learning in Science

Biology

Developing 21CC in Secondary 2 Students through the Use of Scientific Method and VIA in Project Work

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Abstract

Due to the current VUCA environment, there is a need to plan and implement science programmes that nurture the problem solving ability of students using the scientific method in an authentic scenario. Hence, secondary two project work was used as a platform to provide opportunities for students to experience the scientific method as well as communication, collaboration and independent learning strategies. As a student-initiated project, students had the choice of one of six environmental domains; “Global Citizenship”, “Biodiversity and Nature”, “Climatic Change”, “Health and Well-Being”, “Conservation” and “Gardening”. Students proceeded to apply the scientific method to find solutions and present their findings in the form of a Values in Action activity to the local as well as to members of the international community. Data was collected from rubric scores, reflections, competency checklists and focus group discussions. The results showed that the students were engaged and acquired many skills to face future challenges more confidently. The findings could have implications on how the scientific method can be further developed to promote the development of competencies and values in our students to be future-ready learners.

Keywords: scientific method, project work, competencies, environmental domains, student-initiated project

Paper Presentation

Concurrent Session 1.5

Assessment and Evaluation

Biology

Criteria for Success: A Tool for Assessment, Learning, and Improving Quality of Self-Directed Responses to Written Assessments

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Abstract

This study used a pre-post design to compare four secondary two Express classes for the learning and teaching of Ecology. At the end of the topic, students were given identical assignments except that the group receiving intervention (two classes) had printed Criteria for Success accompanying the test item whereas the control group (two other classes) received verbal instructions in lieu of the printed Criteria for Success. The mean score of the intervention group was significantly higher than the control group ($p<0.05$) in one comparison pair of classes, but not significantly different in the other comparison pair. This could be due to the differences in the pre-test readiness levels between the two comparison paired classes. There is great potential in the use of Criteria for Success as a tool for learning, assessment, and student-directed feedback.

Keywords: self-directed; criteria-referenced; standards-referenced; assessment

Paper Presentation

Concurrent Session 1.5

Assessment and Evaluation

Lower Secondary Science

Secondary 1 Science Curriculum with Skills-based assessment (SBA) and Creative Science Innovations (CSI)

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Abstract

We develop our own secondary one science curriculum for students to deepen their knowledge of science and inculcate valuable skills that will develop them into creative and critical thinkers, which are necessary in the 21st century workforce. With the 5 levels of science inquiry in mind, the department introduces four main ideas into the curriculum. (1) *"Engage" and "Explore" Science Read Programme*: Students are given a special science article to read weekly. They will learn about innovations in the world and more about science-related careers. There are also questions for the students, promoting critical and analytical skills. (2) *"Explore" and "Explain" Creative Science Innovations (CSI)*: Students are given a three-month project as part of their assessment. They work in groups and use the scientific method to plan, design and explain the innovations or solutions behind the problem that they would like to address. Through this CSI, students learn to be more creative and develop their communication skills as they work with others. (3) *"Explore" and "Explain" - Performance Task Assessment (PTA)*: Through many planned mini tasks, students learn about a topic, "Digestion" by themselves. The tasks are assessed mainly by rubrics. Some of the mini tasks included "calorie-counting", "food essay" and "stop-motion video". (4) *"Elaborate" and "Evaluate" - The testing of 21st century skills through Skills-based Assessment (SBA)*: Instead of pen-and-paper tests, several SBA tests are conducted to develop students on 21st century skills. Their focus is on data analytics, graph-plotting and problem-solving skills through our designed SBA tests.

Keywords: skills-based assessment, scientific method, alternative modes of assessment, creative science innovations, creative thinkers

Paper Presentation

Concurrent Session 1.6

Science Literacy and Practices of Science

Primary Science

Inquiry-Based Science Comic as a Medium to Promote Science Literacy on Primary Students

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Abstract

As a social enterprise, Kuark had developed educational products to support the development of science literacy in primary students in Indonesia. Inquiry-Based Science Comic is one of the products which had been developed. This product was used in a classroom as a methodology to promote science literacy among the students. The intention was to increase the opportunity for students to access science readings, think critically about science phenomena, and discuss scientific concepts and issues. To evaluate the use of this product in the classroom, a study was conducted. This comic was developed based on the inquiry approach consisting of: (1) Amati (observing); (2) Bertanya (questioning); (3) Cari (finding); (4) Diskusi (discussing); and (5) Evaluasi (Evaluating). This approach was used to provide students the opportunity to read, discuss, and respond to the content of the comic. In the process of promoting science literacy in the classroom, there were three stages in learning approach which consisted of: (1) Pre-reading; (2) While reading; and (3) Post-reading. In the first stage, the teacher engaged students with a picture to pique their curiosity about the scientific concept. Then, the teacher asked the students to pose a question about the picture. In the second stage, students read the comic and explored the scientific concept through role-play and discussion. Lastly, the students gave a presentation in which they summarised their learning. The students' artefacts indicated that they were engaged in meaningful activities which promoted scientific literacy.

Keywords: inquiry, science comic, science literacy, literacy

Paper Presentation

Concurrent Session 1.6

Science Teaching and Learning

Primary Science

Incorporating Play into the Flipped Classroom Approach

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Abstract

Every June, each primary five learner brings home their own electrical kit to play with. They use their electrical kits and, with the help of other online resources, work on a challenge and then document and share their work on the school's online learning platform. They learn the concepts in electricity through play before the lessons are taught in the upcoming term. Using the flipped classroom approach encourages ownership in learning while freeing time in class for more scientific discourse and higher level cognitive activities. However, learning resources in the form of online reading materials and videos were not as appealing to younger learners who prefer hands-on activities and play. Experiences through play also made it easier for learners to apply abstract concepts in electricity and trigger deeper learning. Incorporating the element of play in the flipped classroom approach marries the benefits of these two approaches. Findings indicate students' greater engagement in learning. Learners also have a stronger and more enduring understanding of concepts in electricity. Teachers were able to customise lessons to immediately address learning gaps identified through various formative assessment tools instead of delivering lessons in a prescriptive manner. The lessons have since become part of the primary five curriculum in the school. It has also encouraged teachers from other levels to employ similar approaches in their lessons. Long term benefits include a shift in teachers' mindset to provide for more learner ownership and more nimble lesson deliveries that takes into consideration learners' prior understanding.

Keywords: flipped classroom, electricity, play

Paper Presentation

Concurrent Session 1.6

Science Teaching and Learning

Biology

Open Source 3D-Printed Biological Models

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Abstract

Models are quintessential to represent systems, scales, forms and functions in science. The use of 3D-printed models in the particular context of (re)movable parts enables greater tactility, which therefore offers a more authentic and meaningful learning experience. In this project, we present the design, development and production of 3D-printed biological models that are pivotal to a student-centred classroom that motivates innovation in the sciences.

Keywords: 3D-printing, biological models, science

Workshop

Concurrent Session 1.7

Applied Learning in Science

Lower Secondary Science

Applied Learning with Design Thinking and Arduino

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GAN ENG SENG SCHOOL, SINGAPORE

Abstract

GESS Applied Learning Programme for Science focused on design thinking and applications of the Arduino programme to bring about collaborative learning. The programme takes students through various stages, i.e. Empathise, Define, Ideate, Prototype and Test, in alignment to the theme "Water, Our Precious Resource". The integration of ICT using the Arduino programme to develop probes to measure water quality allows students to experience the actual applications of science knowledge and ICT to solve real-world problems. The workshop allows participants to understand why the school embarked on design thinking, its advantages compared to scientific method, as well as our customised and differentiated approach to integrate design thinking and basic programming for the different streams. It will also enable participants to have hands-on experience to build sensors to measure and compare different water parameters.

Keywords: applied learning, design thinking, Arduino programming

Workshop

Concurrent Session 1.8

Science Teaching and Learning

Primary Science

Inquiry in Science: Fun With Toys

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Abstract

Understanding of science concepts is best developed by enabling a learning environment which provides students with opportunities to explore playing with toys, engage in group discussions, and challenge one another's ideas. Using toys as learning tools encourages dialogic interactions in which the students can justify their claims with appropriate evidence and reasoning. This purposeful play with toys stimulates students' curiosity and interest and helps them relate to science in their daily lives. Teachers take on new roles in this inquiry science classroom by guiding and supporting students to play an active role in discussions to co-construct knowledge. Teachers' questioning encourages greater student participation, elicits students' thinking and facilitates the understanding of concepts. In this workshop, we will share lesson ideas based on the five themes of the primary science syllabus, i.e. diversity, interaction, system, cycles and energy. Participants will use hands-on activities with readily available toys to design learning experiences for students to co-construct new knowledge. The "explore", "explain" and "elaborate" phases of the 5E instructional model, and productive questioning will be used. We will also share how the students take responsibility for their own learning when doing inquiry investigations.

Keywords: questioning, 5 E inquiry instructional approach

Workshop

Concurrent Session 1.9

New Media and Technologies

Chemistry

Secondary School Chemistry: ICT in Formative Assessment, Group Work and Pedagogy

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Abstract

This workshop focuses on how ICT resources are incorporated into formative assessment, group work and pedagogy in chemistry. For formative assessment, processing student responses using automated analytical tools saves lesson time because the teacher can easily trace which questions are worthy of discussion. The pros and cons of using the Flubaroo add-on and the Response Summary feature in Google Forms are compared. For group work, the use of Showbie as a platform for students to give peer feedback is explored. Students collaborate in small groups on the synthesis of an organic compound using restricted starting materials. During peer review, students can give long comments as audio notes, or draw or type short comments. For pedagogy, the use of games and simulations for fun and meaningful learning will be shared. The app Write Formula was designed as a way to gamify the practice of writing chemical formulas and names by turning this practice into a competition to earn points. The game Bond Breaker teaches students about sub-atomic or molecular interactions and reinforces learning by having students use those interactions to solve puzzles. Simulations from the site pHET are also useful in helping students bridge the macroscopic to microscopic representations for a wide variety of concepts. Augmented reality, with the app Elements 4D, is impressive as students are able to observe the state of the 36 elements available through their digital devices. The topics that these apps can be used for, as well as their limitations, are discussed.

Keywords: chemistry, ICT, group work, game, formative assessment, pedagogy

Workshop

Concurrent Session 1.10

Science Teaching and Learning

Chemistry

Inquiry-Based Learning with Titration Curve Simulator (TCS)

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Abstract

Students often find it a challenge to learn and understand titration curves. For deep understanding, it is key that students can visualise and interpret the macroscopic, sub-microscopic and symbolic changes occurring during titration. We aim to enhance students' learning experiences via our self-developed Titration Curve Simulator (TCS) and accompanying classroom resources. In this workshop, participants will tinker with the TCS, and design a lesson incorporating TCS with inquiry-based learning.

Keywords: titration, simulation, inquiry-based learning, eduLab