

Paper Presentation

Concurrent Session 3.1

Assessment and Evaluation

Primary Science

Formative Assessment in Science - Comment Only Marking (COM)

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Abstract

I noticed my primary six students were extremely dependent on me in providing them with the right answers each time they received a marked exercise. I had to find other ways to help my students achieve their success criteria by giving them qualitative written feedback which aimed at getting them to reflect on their work and take necessary steps that would guide them to achieve their success criteria. In order to move students from being dependent learners to involved learners and eventually self-directed learners, I customised a five-step COM approach to suit my students' readiness level (middle progress and high progress learners). I made use of evidence of student learning to assist teachers to adapt their Teaching and Learning as well as to highlight to students what parts of the success criteria had been achieved and guide them towards the next steps necessary to accomplish the established success criteria. 65.5% of students showed significant improvement in reflecting and revising their own work. 95% of them preferred to receive feedback on how they can improve their answering skills. I also noticed that pupils looked forward to receiving the marked assignments and were motivated to share their ideas. This approach has motivated my students to move from dependent learners to self-directed learners. My next step is to explore this Assessment for Learning approach with my foundation science students in the near future.

Keywords: primary education, involved learner, self-directed learner

Paper Presentation

Concurrent Session 3.1

Science Teaching and Learning

Primary Science

Project-based Learning Increases Students' Motivation in Learning Science

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Abstract

We believe that Project-based Learning (PjBL) is a constructivist instructional approach that enhances students' curiosity and interests in learning science. It can engage students in meaningful application of their knowledge, allow them to discover and pursue their passions and become more engaged and productive learners. The primary science syllabus calls for teachers to use more “engaging teaching and learning approaches”, to “make learning more meaningful and enjoyable for their students”. However, it is challenging to make learning “engaging” and “interesting” for the YouTube and Google generation. We believe that PjBL allows students to engage in meaningful learning in an environment with greater autonomy in deciding the direction of their learning. A mixed methods research design was adopted. PjBL was carried out for primary three, four, and five students in 2016 and 2017. A survey was carried out for a random sample size of 10% of these students. Prior coding was done based on common themes from research: ‘Motivation’, ‘Flow Theory’, ‘Learners’ Autonomy’, ‘Learning Styles’, ‘Social Emotional Learning’. The vast majority of the students expressed that learning science was made fun through PjBL as opposed to simply doing structured experiments and completing worksheets. This study has implications in curriculum design, which directly steers the teaching and learning approaches in school. We hope to study if the PjBL approach develops students’ notions of the nature of science better than a transmissive model of instruction.

Keywords: scientific inquiry, motivation, project-based learning

Paper Presentation

Concurrent Session 3.1

Science Teaching and Learning

Primary Science

P5 Students' Experiences in Learning about Water Cycle in Science

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Abstract

This sharing is based on an action research project conducted in a primary school in Singapore on primary five students' experiences in learning about the 'Water Cycle'. A descriptive research was conducted to find out the effects of gender and achievement on attitudes towards science learning, which concepts primary five students found easy to learn and what contributed to their ease in learning the concepts, challenges that the students faced in learning the concepts and what contributed to their difficulties in learning the concepts, and which were students' preferred learning experiences for this topic. The team analysed the questionnaire responses of students from different progress groups on their preferences of learning experiences and the concepts they found easy and challenging. Based on the study, recommendations were made to strengthen the teaching and learning of the topic in the school. Limitations of the study will also be discussed.

Keywords: learning experiences, water cycle

Paper Presentation

Concurrent Session 3.2

Applied Learning in Science

Others

Authentic Learning and Assessment with SAIL

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Abstract

Common concerns in science education include the challenges which students face in applying their understanding of scientific theories to real-world situations and to collaborate effectively. In Yishun Secondary School, the science department embarked on a project named School Area for Integrated Learning (SAIL) to provide an easily accessible infrastructure allowing for authentic, hands-on and experiential learning opportunities. The existing garden was transformed to make better use of the outdoor space by creating a butterfly and culinary garden, a large pond with filtration system, and an aquaponic farm. The authentic curriculum promoted the integration of the learning of science with other relevant subjects (e.g. food science). Students became active learners, engaging in dialogic discourse with their peers and teacher as they learned. Questions asked by students provided the teacher with feedback and insights into students' thinking and conceptual understanding. Information and communication technology (ICT) such as Google tools helped students to record and present their data. Their thought processes were made visible through co-created digital artefacts for formative assessment. Initial findings through the analysis of the students' data indicated positive impact on students' learning outcomes and engagement. Findings will be discussed with recommendations for the development of teacher facilitation skills and the enhancement of students' group processes for collaborative learning. The sharing also aims to increase understanding of the role of the teacher as a designer of learning experiences to enhance teaching practice and their development of pedagogical content knowledge. Participants will be able to translate the insights gleaned from the school's rich experience into meaningful practices.

Keywords: authentic learning, experiential learning, interdisciplinary collaboration, learning designer, formative assessment

Paper Presentation

Concurrent Session 3.2

Assessment and Evaluation

Physics

Developing a Common Feedback Language in Physics using a Problem-Solving Checklist

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Abstract

Changkat Changi Secondary School has embarked on using Formative Assessment in our T&L practice. In Formative Assessment, feedback is instrumental to move the student forward in the learning process. But for feedback to be effective, it must be succinct and written in student-friendly language. However, teachers find this a challenge. Students are introduced to and taught a 5-Step Problem-Solving strategy. Teachers mark and give feedback specific to the student's proficiency in performing each of the steps and applying physics correctly. Notations are used to reduce writing and simplifies the process of giving and reading feedback.

Keywords: feedback, formative assessment, problem-solving strategy, common feedback language

Paper Presentation

Concurrent Session 3.2

Teachers' Professional Learning and Development

Lower Secondary Science

Use of a Professional Development Tool for Planning Lessons on Heat

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Abstract

Pedagogical Content Knowledge (PCK) is generally accepted in educational research as a useful construct for understanding the specialised nature of teachers' knowledge and in developing the teachers' professional practice. A diverse and wide range of instruments and tools to help identify and capture science teachers' PCK exist today (Berry, Nilsson, Van Driel, & Carlson, 2017). CoRe (Content Representation) is one such PCK tool developed by Loughran et al. (2006) to help 'capture and portray' science teachers' PCK. It comprises conceptually significant 'big ideas' for that science topic with accompanying seven prompts to draw out the key pedagogical considerations in the teaching of that topic. The group of teachers engage in discussing and testing each other's pedagogical thinking and reasoning through them. In this way, the collective PCK of the teachers is determined. This paper presents the researchers' exploration in using the CoRe tool with a team of three lower secondary science teachers in 2017 to gain an understanding of how the teachers' collective planning and reflection on the topic of the effect of heat and its transmission can help enhance their classroom practice. The use of CoRe as a tool provides an opportunity for teachers to make explicit their professional knowledge and practice and offers a more comprehensive and relevant approach to professional learning that is situated in the school and is just-in-time.

Keywords: professional development, pedagogical content knowledge, science education

Paper Presentation

Concurrent Session 3.3

Science Teaching and Learning

Biology

Flipping the Classroom to Enhance Active Learning in an Undergraduate Biology Course

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Abstract

Flipping the classroom has been suggested to develop life-long learners and increase engagement with lesson material. It can free up precious in-class time and enhance interactions between students and instructors in classrooms. At the Singapore University of Technology and Design, we studied the effectiveness of flipped classrooms in an undergraduate introductory Biology module. The study was conducted on two batches of first-year students during 2016 and 2017. We prepared five sets of flipped lessons for selected topics in Biology, including cell signalling, cell cycle, genetics in model organisms, human genetics, and cancer. Each set comprised of pre-recorded videos, PowerPoint slides, and a list of keywords. Students were required to complete the flipped lesson and attempt online multiple-choice questions as a pre-requisite for the first lesson of every week. Their understanding of the concepts covered in the flipped classroom was further tested by a short quiz at the beginning of class. Then, students had an opportunity to apply the knowledge they had acquired into various in-class activities, to deepen their understanding of the topic. Student feedback was collected through a survey to assess the impact of the flipped classroom on their learning. Responses from 590 students indicated that most students were confident of their ability to manage this self-paced learning approach. Students agreed that having the lectures flipped not only provided them with sufficient time to schedule and learn the fundamentals more effectively at their own pace, but prepared them for in-class activities.

Keywords: flipped classroom, active learning, blended learning, biology, teaching tips

Paper Presentation

Concurrent Session 3.3

Science Teaching and Learning

Biology

Deepening Students' Learning and Understanding in Biology Using Variation Theory through Learning Study

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Abstract

This study explores the application of Variation Theory through the framework of Learning Study in the teaching of biology to secondary three students in a government school in Singapore. Three different classes were taught techniques to handle information and solve problems in contextualized questions, with specific reference to the Critical Answering Rubrics in Biology (CARB) descriptors crafted by the team. Lesson activities were planned using the patterns of variation of contrast and separation. Data was collected through pre- and post- tests, pre- and post-lesson interviews, booklet responses, classroom observations, video recordings of students' conversations during discussions in the classroom and teachers' reflections captured during post-lesson colloquium. Data analysis was conducted in the form of a one-tailed T-test for the pre- and post-lesson tests. Qualitative analysis was done in the form of highlighting critical thinking in the student interviews and booklet responses, as well as highlighting segments within classroom discussion that showed the process of students co-constructing knowledge. This paper highlights the noticeable increase in quality responses as a result of teaching techniques with the use of Variation Theory. Using Learning Study as a research tool also helped facilitate professional dialogue among teachers to improve pedagogical design and instruction.

Keywords: variation theory, learning study, biology

Paper Presentation

Concurrent Session 3.3

Science Teaching and Learning

Others

Hands-on, Experiential Strategies for Everyday Science Teaching

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Abstract

Hands-on and experiential pedagogical methods have been shown to be effective to communicate and engage the student in learning science. However, science teachers themselves may lack expertise or the know-how to use these strategies to engage their students. Currently, science teachers have to juggle between the delivery of content, various administrative duties, as well as developing appropriate pedagogical strategies to enhance the teaching and learning of science concepts. This last task is often a challenging one for the busy science teacher. For that reason, the course "Innovation in Science Teaching" was developed, as part of the Joint ANU-NUS M.Sc. in Science Communication programme, with the goal to share innovative, hands-on teaching strategies that may help science teachers improve student learning in the classroom. We introduce various non-conventional methods to teach science, such as engaging audience with demonstrations and hands-on activities, employing apps and basic programming, reaching out to the masses with blogs, social media and videos, (science) busking and (science) event organising. Overall, these strategies provide students with a more active and experiential learning experience, increase their awareness of the relevant concepts of science phenomena and generate greater interest in science learning.

Keywords: experiential learning, demonstrations, blogs, video, science event organising

Paper Presentation

Concurrent Session 3.4

Science Teaching and Learning

Chemistry

Active Learning in Electrolysis

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Abstract

This lesson study aims to show the effectiveness of students learning through practice to understand how electrolysis processes work. Students are engaged in inquiry processes of critical thinking and hands-on activities to deepen their understanding of scientific explanation and support their development of practical skills. A “research-share-perform” cycle is used as a primary support to allow students to engage in scientific reasoning, reflect on the thinking behind the doing, and share and reflect on their experience. The activities designed adopt a hands-on approach where students experience phenomena, analyse results, read a relevant text, investigate deeper ideas and questions, construct new ideas and finally develop the expertise to share the experience.

Keywords: active learning, critical thinking, thinking behind the doing, reflection

Paper Presentation

Concurrent Session 3.4

Science Teaching and Learning

Chemistry

Leverage on Learning Study to Improve Lesson Delivery on Teaching Le Chatelier's Principle

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Abstract

Chemical equilibrium is considered one of the most difficult and important topics in physical chemistry and students often have a lot of misconceptions about Le Chatelier's Principle. This learning study explores the incorporation of the Variation Theory of learning with lesson study to design and further refine lesson delivery in teaching Le Chatelier's Principle to students. The teachers collaborated in the planning, implementation and peer review of lessons. This was followed by lesson analysis, evaluation, then identifying ways to improve teaching and student learning in subsequent lessons in other classes. The Practice of Science was emphasized through an inquiry-based learning process. To appreciate the Le Chatelier's Principle, students were given hands-on experience with models to investigate how the position of equilibrium is affected by changes imposed on the system. This presentation will also showcase the models used in the lessons and how the students were guided to the understanding of Le Chatelier's Principle. A comparison of the students' performance in the pre- and post-tests showed that this study had helped students to gain a deeper understanding about the topic, in particular, the effect of shift in position of equilibrium on the value of the equilibrium constant. It also helped teachers in their own professional development because they took responsibility in the design and implementation of lessons.

Keywords: Le Chaterlier's principle, learning study, collaboration

Paper Presentation

Concurrent Session 3.4

Science Teaching and Learning

Chemistry

The Use of Concept Attainment and Object Lessons in the Chemistry Classroom

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Abstract

Despite the call to reduce direct telling and to allow students to instead explore and learn science through discovery and inquiry, the drive to cover content still runs deep within the psyche of teachers in Singapore. In their race to prepare students for exams, teachers feel an urgent need to expose them to as many examples as possible, for fear that their students will lose out if any of these are not covered. With the shift towards higher-order thinking and data-based type of questions in our high-stakes examinations, this becomes an increasingly uphill task for teachers. Are there ways to deliver content and yet develop in students the necessary skills to handle new information and knowledge? How can we design lessons and guide students to access new information and analyse data while teaching new concepts? In this session, the presenters will share how traditional lessons can be tweaked to become more student-centred and inductive, in order to engage students in analysing information, identifying trends, and arriving at their own generalisations, in ways that resemble what scientists do. They will also demonstrate how simple objects have been used to help students to visualise concepts like 'Isotopic Abundance' and differentiate between elements, compounds and mixtures. These activities have been tried out in our Integrated Programme classes, but are equally relevant for students in the O-Level Programme.

Keywords: concept attainment, concept development, inductive teaching, object lessons, chemistry

Paper Presentation

Concurrent Session 3.5

Science Teaching and Learning

Others

Complex Systems-based Instructional Unit on Kinetic Theory of Matter: Integrated Curriculum and Implementation

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Abstract

This paper focuses on the instructional strategy used to help students construct a more accurate interpretation of Kinetic Theory of Matter (KTM). Participants will discover how the unit was customised to be aligned with existing learning outcomes from the GCE 'O' level science syllabi (SEAB, 2017) by integrating the requisite learning outcomes from biology, chemistry and physics into a coherent flow. The complex systems-based instructional framework that underpins this unit will also be described. In this framework, the instruction began with the learning of the movement of a single particle before proceeding to interaction of a few and many particles. A computer simulation tool NetLogo (Wilensky, 1999) was used in visualising the movement and interaction. Students were gradually guided in constructing an understanding that systemic properties such as random motion, Brownian motion, diffusion and osmosis simply emerged from the constant motion and multiple interactions among particles. To guide students in interpreting this complex phenomenon, constructivist-based questioning techniques were used so as to enhance the quality of teacher-student discourse. Such discourse typically is more open-ended, requiring longer responses and elaboration, and the teacher engages the students in self-reflection and elaboration of their own responses (Mortimer & Scott, 2003; van Zee & Minstrell, 1997). This framework will be used to provide an analysis of the conversational patterns in the classroom to demonstrate how teacher-student discourse has helped students to acquire a good understanding of the complex particulate phenomenon.

Keywords: kinetic theory of matter, integrated curriculum, implementation

Paper Presentation

Concurrent Session 3.5

Science Teaching and Learning

Physics

Visible Teaching using Concept Based Approach in the Topics of Waves

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Abstract

Teachers teaching physics at the secondary school level commonly find it a challenge to distil the main concept to be taught for a particular topic. They also find it difficult to make students' learning visible so as to understand their difficulties in developing deep conceptual understanding. Through Concept-based Curriculum and Instruction, we seek to highlight the similarities between concepts, identify their differences and deliver the curriculum revolving around these key concepts to achieve the desired conceptual understanding. With these, the students can be more successful in applying the concept in new, unfamiliar and more complex scenarios. Using this approach, students' learning can therefore be made visible, and teachers can better track their stages of learning so as to guide them towards attaining the success criteria. Using Concept-based Curriculum and Instructional Approach (Erickson, 2007), teachers can distil main key concepts and build connections between these concepts, thereby making teaching visible (Hattie, 2012) for the students. Through identifying the success criteria at the various stages of understanding and monitoring their progress, the teacher can make students' learning visible (Hattie, 2012). With this knowledge, the teacher can provide targeted feedback to students, thereby moving them towards their success criteria. In our lessons we aim to engage the learners through concept identification, concept connection and the identification of similarities and differences in concepts, and allow learners to confidently extend and apply concepts to new, unfamiliar and unique scenarios. The outcome of an action research project will also be shared.

Keywords: visible teaching, concept based approach

Paper Presentation

Concurrent Session 3.5

Science Teaching and Learning

Physics

Addressing Student Misconceptions when using Kirchhoff's Law – An Action Research to Address Misconcepts, their Instructional Implications and Remediate Problem Solving

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Abstract

Higher secondary students have difficulty in applying Kirchhoff's law in physics. An action research project was undertaken in Padma Seshadri Senior Secondary School, in Chennai, India (2016-17) with one class of 27 Students, to identify commonly made mistakes in applying Kirchhoff's law. The research consisted of a two-part exercise. The first part was to find the effective resistance of various combinations of resistors using Kirchhoff's laws and verify it using a multimeter. In the second part, experiments with variations of potentiometer circuits were performed in the laboratory and conclusions were drawn by the students. The first exercise revealed that students do not understand 'shorting' and also gave the teachers an insight into some common misconceptions in their minds while identifying equipotential points and axis of symmetry. As a remedial measure, students were given a few soldered circuits and equipotential points and shorting was explained to them using a multimeter. In the second exercise, some students managed to theoretically corroborate their experimental findings, which implied a good understanding of the theory taught. However, some students gave incorrect explanations of what they observed experimentally. This was an indicator for the teacher to strengthen the connection between what is taught and what is observed. As a counteractive measure, it was decided that instead of teaching potentiometer problems qualitatively, numerical values will be used at the start, so that students can quantify their conclusions and eventually graduate to tackle these problems qualitatively with greater confidence.

Keywords: Kirchhoff's law; action research, science teaching techniques, potentiometer problems, effective resistance

Paper Presentation

Concurrent Session 3.6

New Media and Technologies

Primary Science

The Patterns of Students' Science Learning with an E-Learning Platform and Multimedia Resources in Primary Schools

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Abstract

With increasing technology integration in learning environments, how students learn with technologies has attracted more researchers' attention. This study explored the patterns of pupils' learning about science with an e-learning platform "Interactive General Studies" via iPad. Eight classes of students from four Hong Kong elementary schools were invited to experience the e-learning platform and multimedia resources. In addition to lesson observations, interviews using a cognitive walkthrough technique with a total of 24 students (six students of each school) were conducted for the data collection to understand pupils' learning patterns with the e-learning platform. The findings indicated that the majority of the students were able to be engaged in the lessons as they were provided opportunities to explore the platform individually or in groups. They were encouraged to use the evidence-based, experiential, and Predict-Observe-Explain inquiry approaches afforded on the platform to explore natural phenomena and to learn about scientific processes and methods. Moreover, it was found that the students interacted more with others particularly when discussions were raised based on the answers they uploaded to the platform. They would become excited when they got all answers correct using the checking answer icon by themselves. Sometimes they would seek teachers' help to solve problems in operating the iPad. Implications for effective technology integration to promote pupils' learning about science are suggested.

Keywords: e-learning platform, iPad use, primary science

Paper Presentation

Concurrent Session 3.6

New Media and Technologies

Primary Science

ICT infusion to MAke Science Thinking Visible (iMASTV)

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Abstract

In the teaching of primary science, it is observed that pupils are not naturally inclined to make scientific observations of the environment around them, and as a result, they do not think deeply and critically. To address this challenge, science teachers redesigned lessons leveraging the affordances of technology and physical environment to create learning experiences that would pique pupils' interest in learning science. Mobile devices were used with commonly available technology tools to make pupils' learning processes and thinking visible to their peers and teachers. The intentional use of affordances of technology consists of a two-pronged approach. The first focus is on providing experiential learning (Kolb, 2014) and making scientific phenomena visible by harnessing video technology like time-lapse videos. The second focus is the mindful development of a culture of thinking (Tishman, Perkins & Jay, 1995) to make pupils' thinking visible using questioning techniques and maximising pupils' participation leveraging ICT platforms like Nearpod and Google Apps. The redesigned lessons were enacted over two semesters with pre- and post-measures of pupils' attitudes in inquiry science and conceptual understanding. This study aims to understand how affordances of technology and environment are used to enhance inquiry-based (IB) learning. The design process and lesson enactment were observed and documented along with teachers' reflection. Pupils' artefacts in lesson enactment were recorded. The presentation will share teachers' experiences in redesigning IB lessons by leveraging affordances of technology, design principles that were adopted, and results of the post-measures collected after lesson enactment.

Keywords: primary science, technology, experiential learning, inquiry-based learning, IBL

Paper Presentation

Concurrent Session 3.7

Teachers' Professional Learning and Development

Physics

Teaching Newton's Third Law of Motion by Inquiry

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Abstract

The physics Professional Learning Team (PLT) embarked on a lesson study which was focussed on the teaching of physics by inquiry. The topic chosen for this project was 'Newton's Third Law of Motion'. It is a relatively new topic in the new physics syllabus that is difficult to comprehend because of students' inability to 'accept' certain concepts about forces when taught to them, such as the magnitude of the action-reaction forces being equal. Physics teachers from Bedok North Secondary School formed a PLT focussed on creating a lesson to help the students learn Newton's third law better by inquiry. The members of the PLT were particularly interested to investigate the following two research questions: "How effective is the teaching of Newton's third law of motion through inquiry?" and "Is this pedagogy able to help increase students' level of engagement?" A mixture of quantitative and qualitative data will be used to respond to the two research questions. Even though the inquiry-based lesson was quite effective in ensuring that students achieve at least three of four learning outcomes, follow-up actions in the form of revision of test questions pertaining to the last learning outcome, and clarification of the concept and its implications by practising similar questions were necessary.

Keywords: inquiry, Newton's law, third law

Paper Presentation

Concurrent Session 3.7

Teachers' Professional Learning and Development

Physics

Collaborated Professional Learning Approach to Enhancing Physics Teachers' Pedagogical Content Knowledge on Electromagnetism

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Abstract

When teaching the topic of DC motors, teachers have to contend with students' lack of prior knowledge and difficulties in visualising the interactions of magnetic fields and the interconnectedness of the various components of a DC motor. Our paper proposes Content Representation, or CoRe, as an approach to develop teachers' Pedagogical Content Knowledge (PCK) in electromagnetism. In particular, under the leadership of master teachers from the Academy of Singapore Teachers, the methodology of CoRe has helped the physics fraternity organise the big teaching ideas for the topic and develop unique classroom practices that support students' learning. Complementary to CoRe is the Pedagogical and Professional-experience Repertoire, PaP-eR, as a form of teacher reflective practice. The developmental learning and insights gained by teachers can be facilitated using the methodology of PaP-eR. Our paper also advocates the use of visualisation-based learning pedagogy via a 3D DC motor demonstration kit and a DC motor applet which was developed by the Educational Technology Division of Ministry of Education. The demonstration kit was prototyped and trialled at the Centre for Teaching and Learning Excellence (CTLE) and eventually mass produced for schools with the Singapore Science Centre. Masterclasses on developing teachers' PCK in electromagnetism have also been conducted at CTLE. These educational partnerships allow greater dissemination of knowledge and scalability of resources across schools in Singapore. Our paper concludes with some positive impacts on students' learning as well as the usefulness of CoRe and PaP-eR in developing the professional knowledge and practices of the physics fraternity.

Keywords: content representation, pedagogical-and-professional-experience repertoire, pedagogical content knowledge, teacher reflective practice

Paper Presentation

Concurrent Session 3.7

Science Teaching and Learning

Physics

The Joy of Learning Sound and its Real-world Applications: A Cognitive Neuroscience Perspective

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Abstract

At both the 2016 and 2017 MOE Work Plan Seminars, the importance of helping students experience the joy of learning was highlighted. As science teachers, we desire our students to experience the joy of learning during our lessons with the goal of developing students' scientific literacy. 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 hands-on and minds-on Master Class lesson on *Sound and its Real-world Applications* conducted at the Centre for Teaching and Learning Excellence at Yusof Ishak Secondary School, this paper seeks to explain the neural basis of the joy of learning from a cognitive neuroscience perspective.

Keywords: joy of learning, inquiry-based, cognitive neuroscience

Workshop

Concurrent Session 3.8

Science Teaching and Learning

Chemistry

Making Qualitative Analysis Fun

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Abstract

Qualitative analysis (QA) plays a central role in experimental chemistry, and unlike in other countries where QA is introduced to students at college or university levels, the topic is a required component of end-of-course practical assessments for 16 year-old students in Singapore. In addition to developing the necessary conceptual understanding, students also exhibit difficulties in acquiring and utilising appropriate technical language to communicate their scientific understanding, which demands a level of precision and consistency not required in day-to-day communication (“Introducing Scientific Language”, 2017). In this study, the chemistry Professional Learning Community team from Orchid Park Secondary School will implement two interventions to support students’ learning in QA. Three different interactive card games (based on tests for gases, cations and anions) were developed to engage the students, and make the acquiring and retention of scientific technical language more fun and interesting. Secondly, peer-marking and strategies for effective feedback were adopted to clarify students’ understanding of the learning targets and to close the gap between their performance and the required learning targets. Additionally, the element of feedback was embedded in the design of the games. Through these interventions, the team hopes to better support students’ conceptual understanding and development of appropriate scientific language to achieve the learning targets for QA. Results from this study will be presented during the workshop.

Keywords: scientific language, interactive card games, peer-marking, effective feedback, learning targets

Workshop

Concurrent Session 3.9

Science Teaching and Learning

Physics

An Inquiry-Based Approach Promoting Student Discovery and Learning of Gas Laws (Boyle's Law, Pressure Law and Charles' Law)

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Abstract

Dataloggers were first introduced in Singapore schools under the first IT Masterplan (1997-2002) and studies have shown that the use of dataloggers in an inquiry-based approach is an effective way to acquire science content and develop understanding of the nature of science (Gipps, 2002). The use of dataloggers not only increased students' understanding of the use of ICT in general, it helped them critically evaluate the use of data and scientific methods, and develop their ability to use scientific methods. It also made it easier for them to link science to their everyday life (Boniec et al., 2011). To enhance and deepen students' understanding of the gas laws and engage them with technologies in science, an instructional package was developed where students engaged with dataloggers and customised apparatus to collect experimental data and investigate the relationships between pressure, volume and temperature for gases. The students then processed and analysed the data to eventually derive the gas laws (Boyle's Law, Pressure Law and Charles' Law). Through this inquiry-based approach to learning, the students not only developed a deeper conceptual understanding of the scientific concepts (as seen from pre- and post-test results) and a better appreciation of the nature of science and the joy of learning, but also gained greater confidence in the use of technology for scientific learning and experimentation. In this workshop, participants will experience this inquiry-based approach to the learning of gas laws augmented by the use of dataloggers.

Keywords: IBL, dataloggers, gas laws

Workshop

Concurrent Session 3.10

Teachers' Professional Learning and Development

Biology

Cultivating a Love for Learning– An NLC's Journey of Self-Realisation

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Abstract

This workshop will chronicle the two-year journey of our Networked Learning Community as we explored and reflected as a group of passionate professionals. This journey engendered many eureka moments of deep learning and self-realisation. The workshop will consist of two parts. In part one, we will share our methodology of reflective conversations and affirm how it has helped us grow and become more effective practitioners. Drawing primarily on the work of Jackson and Temperley (2007) – “From Professional Learning Community to Networked Learning Community”, and Stoll and Seashore (2007) – “Professional Learning Communities, Divergence, Depth and Dilemmas”, such conversations are opportunities for educators to make meaning and jointly come up with new insights and knowledge. Workshop participants will be given an opportunity to participate in such a reflective conversation. Part two of the workshop will consist of a curated snapshot of the learning the team has picked up along the journey. Thematically, this will revolve around how the team has managed to enhance the love for learning amongst their students in their classrooms. Team members will share lesson ideas and pedagogical insights. There will also be an opportunity to practise one of the lesson ideas shared. It is hoped that through this workshop, participants will be inspired to experience the joy of learning as part of an NLC and that they will also take away with them some lesson ideas that will help deepen their students' love for learning.

Keywords: networked learning, joy of learning, reflective conversations