Mathematical Problem Solving on Numbers and Arithmetic in Upper Primary Mathematics Classroom

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ABSTRACT

Purpose - This paper aimed to present the design of a teaching module on mathematical problem solving for the upper primary mathematics.

Method - The module used Pólya's and Schoenfeld's problem solving models as the theoretical framework. The researchers introduced problem-solving processes through specialized mathematics "practical" lessons together with carefully selected problems from the Arithmetic strand of the Singapore primary school mathematics curriculum. In the selection of appropriate mathematical problems, the following criteria were used: the selected problem (1) could potentially capture students' interest and curiosity; (2) is accessible to students in terms of cognitive resources at the upper primary level (students aged 10 to 12) (3) can be approached in multiple ways; and (4) could potentially promote higher-order thinking and conceptual understanding. The problem-solving lessons comprised four key features, namely teacher modelling, teacher scaffolding, small-group work and independent work. The scaffolding from Toh, Quek, Leong, Dindyal and Tay (2011) was used to guide students through the entire process of problem solving.

Findings – The module provided teachers a unique glimpse into students' mathematical understanding. The writing activities helped students them to think about and articulate what they know on the content topic at hand.

Significance - The teaching module will provide ample support and useful guidance for primary school mathematics teachers who wish to introduce students to the problem solving as a creative process and enhance their problem solving skills.

Keywords: Problem solving, Mathematics teaching, Arithmetic, Teaching module

Effects of Higher Order Thinking Module Approach on Primary School Students' Performance and Problem Solving Skills

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ABSTRACT

Purpose –This study aimed to investigate the use of HOTS-based module approach on the overall performance and problem solving skills of primary school students.

Method – A quasi- experimental, nonrandomized control group, pretest-posttest delayed posttest design was conducted on two intact groups. This study was conducted in two schools in the urban area in one of the states in Malaysia. For school #1, a total of 69 students (37 students in the treatment group and 32 students in the control group) participated. While for school#2, a total of 63 students (31 students in the treatment group and 32 students in the control group) participated.

Findings – The analysis of covariate (ANCOVA) indicated the HOTS-based module approach group out-performed the conventional approach group in the overall performance and problem solving skills in the posttest and delayed posttest. For the posttest, the conventional approach group acquired significant higher scores when compared to the HOTS-based module approach group in the overall performance and problem solving skills. However, in the delayed post-test, the HOTS-based module approach group had significantly higher scores compared to the conventional approach group in both assessments.

Significance – This study showed using the HOTS based Module approach helped students to get better scores and hence it is recommended that this approach should be continued in teaching and learning in the future.

Keywords: HOTS-based module approach, Conventional approach, Problem solving skill, Urban school

Performance of College Students in Calculus: An Institutional Study

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ABSTRACT

Purpose - This study investigated the effect of attitude towards students' performance in Calculus.

Methodology - The researchers used the descriptive method of research. Students who have recently finished their Calculus I and II, in the university and prior to the conduct of the survey, was the common parameter used in identifying the respondents. A 50-item achievement test measured the performance of the BS Civil Engineering, Geodetic Engineering, Sanitary Engineering and Mathematics students in calculus and the Fenemma-Sherman Attitude Scale measured the students' attitude towards Calculus. Sex, course, final grade in College Algebra and final grade in Trigonometry were correlated to students' attitude and performance in Calculus.

Findings - Results indicated that only the BS Civil Engineering students' performance in Calculus is "Satisfactory". Also students' attitude is not significantly related to their level of performance in Calculus. This may imply that there are other predictors of better performance in Calculus.

Significance – Findings will help formulate future actions that may bring improvement in the performance of students in Calculus.

Keywords: Calculus, Attitude, Performance, Learning Outcome

Enhancing Students' Self-Confidence through the Integration of Problem-Based Learning (PBL) and Technology

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ABSTRACT

Purpose –This study aimed to investigate the use of Problem-based learning (PBL) and technology (GeoGebra) in enhancing students' self-confidence in Pythagorean Theorem.

Methodology – This study was an action research conducted at a state junior high school in Indonesia. Twenty-four second year students (12 boys and 12 girls) from the junior high school participated in this study. The sample technique used was purposive random sampling. This study used a pre-experimental design with no control group with both qualitative and quantitative data collected and analysed. There were two cycles in this action research.

Findings – The results showed that the integration of problem-based learning and technology had positive impacts on students' self-confidence in learning Pythagorean Theorem. The students' pretest mean score of 80.54 (average self-confidence) increased to 106.13(high self-confidence) posttest mean score after using technology. In addition, the result obtained from the interviews of the students showed that the learning had positive impact on the students' self-confidence.

Significance – Based on the findings, teachers should maximize the integration of technology such as GeoGebra in teaching and learning of mathematics to enhance students' self-confidence. As part of 21st century society, students need to develop self-confidence in order to survive in the workplace.

Keywords: Problem-based Learning, Technology, GeoGebra, Self-confidence, Pythagorean Theorem

Learning Computational Thinking through A Collaborative Mobile Serious Game

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ABSTRACT

Purpose – This study aimed to create a mobile serious game that incorporates a learning framework, particularly collaborative learning theory, to develop students' computational thinking skills.

Methodology – Based on the framework of Brennan and Resnick, an adaptation was made within the context of a mobile serious game mapping the different dimensions of Computational Thinking: computational concepts, practices, and perspectives within different game tasks. Different game tasks were developed to foster more collaboration among the two players. In order to obtain initial feedback on its effectivity on translating different Computational Thinking skills into game tasks, 12 pairs of Grade 12 students with prior programming knowledge were asked to play a sample level of the game and evaluate the game task's skills.

Findings – The results showed that the students generally felt that the game would help other students acquire skills corresponding to Brennan and Resnick's framework ($\overline{x}$ = 4.36), and believed that the collaborative aspect was generally effective in highlighting the different skills in solving the game ($\overline{x}$ = 4.2). Furthermore, different qualitative feedback was gathered that supported evidence of the three dimensions of Computational Thinking proposed by Brennan and Resnick as the students played the sample level.

Significance – Computer programming presents an essential skill to learn not only because of the demand in the industry, but moreover it imparts important skills such as abstraction, generalization, modularization, and automation. The creation of a game that imparts Computational Thinking skills can be a way for students to get comfortable and accustomed to programming skills and logic, which in turn can be a stepping stone to using computation as a tool for problem solving within their respective disciplines.

Keywords: Computational thinking, Collaborative learning, Game design, Serious games

Development of Scaffolded Mastery Learning (Ml) in Cell Division Module and its Impact in Teaching and Learning Process

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ABSTRACT

Purpose – The purpose of the study is to develop a Scaffolded Mastery Learning (ML) module in cell division topic for both teachers and students and study its impacts in teaching and learning process.

Method – The study employed Sidek Module Development model in developing the modules. Three expert teachers and ten Form 4 students were involved in pilot study to obtain validity and reliability using the validity index and Cronbach alpha value, respectively. The module was implemented among Form 4 Biology class students. Observation and interview sessions were conducted for teachers and students to obtain the impact of the modules in teaching and learning process.

Findings - The module obtained high validity score (0.96) and high reliability value (α: 0.90). The module can be used as teaching aids to assist the teachers in teaching and learning process of cell division topic in Biology. The module also showed positive impact among Form 4 students as they utilized it in learning the topic.

Significance - The module is suitable for use by the Biology teachers in teaching and learning process of cell division topic while the students can utilize the module in improving their understanding regarding to the topic.

Keywords: Scaffolded Mastery Learning, Cell division, Module development, Biology, Teaching aid

Exploring Philippine Traditional Games as Motivational Activities for Learning Science in the K-12 Curriculum

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ABSTRACT

Purpose –This study aimed to explore the possibility of tapping traditional games as motivational activities that can aid in the teaching of the sciences in the K-12 curriculum and eventually will help learners increase their interest as well as performance in science.

Method - This study is a qualitative research that aims to gather an in-depth understanding of science ideas, concepts and practices in Philippine traditional games. The purposively selected respondents of this study were comprised of the top 1 pupils and students from Grades 3 to Grade 10 from various schools. The respondents were invited every weekend to play one traditional game, and to observe their classmates and friends play during free time. These students were interviewed using the conversation analysis method wherein the Hiligaynon dialect was translated into English. This was tape recorded and responses related to science were extracted and triangulated and then were themed into four major science topics such as Earth Science, Biology, Chemistry and Physics.

Findings – The study found that scientific ideas and concepts were embedded in the Philippine traditional games and can be used as instructional materials in teaching and learning science in K - 12 Basic Education Program of the Department of Education. With the inclusion of these traditional games, learners will become more interested in learning science.

Significance – An instructional material using traditional games was formulated to be used in teaching science curriculum in basic education program. This is to help below average learners understand and appreciate science learning.

Keywords: Traditional games, Science concepts, Motivational activity, Science standards, K-12 Curriculum

Development of the Malaysian Biotechnology-STEM (MBS) Module for Interdisciplinary STEM Teaching & Learning

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ABSTRACT

Purpose - This study developed an interdisciplinary STEM module called the 'Malaysian-Biotechnology-STEM' (MBS) based on the proposed conceptual framework. In addition, this study demonstrated an interdisciplinary approach to teach biotechnology.

Method - A two-week pilot test was conducted in Perak, Malaysia. The student questionnaire and biotechnology achievement test were administered to 12 secondary school students (16-18 years old) from a selected school that offered Additional Science. The data were analysed with descriptive statistics.

Findings - The study found that the MBS module could improve students understanding in biotechnology and help to foster their 21st century skills such as digital era literacy skill and inventive skill. The study also found that the average mean score of the student achievement improved after the intervention with MBS module.

Significance - It can be concluded that the implementation of interdisciplinary MBS module could improve student understanding in biotechnology. Thus, it could further enhance students' interest to pursue the field in higher learning institutions and produce sufficient future workforce for the biotechnology industry.

Keywords: Malaysian-Biotechnology-STEM module, Interdisciplinary STEM, Biotechnology, Additional Science, 21st Century skills

Educational Robotics: A Review of the Impact on Students' Cognitive Development

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ABSTRACT

Purpose - This study explored the relationship of robotics activity with the development of conceptual understanding skills among secondary school students.

Method - Forty-four sixteen-year-old Form 4 (Year 10) students in a fully government-aided school who have access to functioning LEGO-Mindstorms sets during physics lessons participated in the research. This study analyses how students use thinking skills and science process skills to solve robotics challenges. The Force and Motion Conceptual Evaluation (FMCE) test was utilized to assess students' understanding of the concept of force and motion.

Findings - The descriptive statistics revealed significant gains in mean scores from the pretest to the posttest in the various cluster breakdowns. Cohen's *d* also shows a strong effect size, indicating that the activities are capable of promoting conceptual understanding.

Significance - The flexibility of the teaching instructions was able to provide opportunities for students to explore and learn through investigations, leading to an increase in cognitive skills, thus supporting the expansion of science, technology, engineering and mathematics (STEM) programs and enlarging the pipeline for the future of STEM, particularly in a high-tech world that has become increasingly complicated in the 21st century.

Keywords: Educational robotics, Force and motion, Thinking skills, Process skills, Science, Technology, Engineering and Mathematics (STEM)

Enhancing an Entrepreneurial Mindset in Secondary School Students by Introducing the Green-Stem Project via the Integration of the 6E Instructional Model

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ABSTRACT

Purpose – This exploratory study aimed to examine the development of entrepreneurial mind-set among lower secondary school students while undergoing Green STEM project, which integrates the Thinking Based Learning in the 6E Instructional Model as a teaching strategy.

Methodology – This study employed fully qualitative approach with one intact class comprising 27 students in one sub urban National Secondary School in Kelantan. The extended period after school time was used for purpose of this study. The students were divided into 5 small groups that work cooperatively to produce a model of Raft using material available in their community. They were guided using Green STEM for eight weeks. The data were obtained through focus group interview after eight weeks.

Findings – Analysis of the data showed that the integration of Thinking Based Learning in the 6E Instructional Model as teaching strategy while doing STEM project supported the cultivation of entrepreneurial mind-set among lower secondary students. The entrepreneurial mind-set led students to apply reflective thinking and reasoned decision to solve problems using their creativity and resourcefulness even in a risky and uncertainty environment.

Significance – With the success of cultivating entrepreneurial mind-set, integration of Thinking Based Learning in the 6E Instructional Model could inspire the teachers to consider implementing Green STEM project as a part of enriching programme in class room or outside classroom activity.

Keywords: STEM project, Thinking based learning, 6E Instructional model, Entrepreneurial mind-set, Thinking skills

The Enhancement of Undergraduate Students' Scientific Explanations Using Online Platform as a Context for Discussion and Feedbacks

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ABSTRACT

Purpose – This study aimed to investigate the use of ePortfolio as context for discussion and reflection in improving students' scientific explanation after laboratory activities.

Method - This action research study aimed to solve the limitation of the undergraduate laboratory course in fundamental biology course by using available free source of mobile application to improve students' scientific explanation. The target group were 33 first-year undergraduate students enrolled in Fundamental Biology Laboratory Course which was one of the requirement courses to graduate a Bachelor of Science program, Faculty of Science and Technology. Duration of action research study was eight weeks. Quantitative data were analysed using descriptive statistics (percentage) while qualitative data were analysed by content analysis.

Findings - The results indicated that after experiencing the ePortfolio most students had developed scientific explanations at a high level which means that the students provided a causal story to explain why something happened or used unobservable/theoretical components of a model to explain an observable phenomenon.

Significance - In this online environment, the students had the opportunity to examine and present their own scientific explanations to be critiqued with value and norm developed together in class and being effectively scientific citizens in the changing society.

Keywords - Scientific explanation, Biology laboratory course, ePortfolio, Higher education, Argumentation

Impact of the Twincle Student-Exchange Program on Students from ASEAN Countries

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ABSTRACT

Purpose – This study aimed to determine the impact of the implementation of the Twin College Envoys (TWINCLE), a student-exchange program of Chiba University in collaboration with MEXT on ASEAN students.

Method - This study analysed the effect of the program, especially for ASEAN students, using students' comments on activity reports via text-mining methods. This program consisted of three major activities, namely; a teaching internship in a high school; a science educational experiences such as laboratory visits and science experiment classes, and study of Japanese culture.

Findings - According to the analysis, terms such as "laboratory coursework", "culture", "school visit", "workshop", "Twincle program", "culture", and "Japanese" are extracted with "good" and "learning" as categories to explain the program contents. Cluster analysis reveals three groups of students based on their ward usage. However, the groups have many similarities in ward usage.

Significance - The results suggested that TWINCLE ASEAN exchange students have positive impressions of Japan and the Japanese culture by participating in the program.

Keywords: Science education, Exchange program, Teacher internship, ASEAN students

Revalidation of Instruments Using Parial Least Squares Structural Equation Modeling (PLS-SEM)

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ABSTRACT

Purpose – This research aimed to examine the reliability and validity of instruments used to determine self-efficacy beliefs, teaching motivation, attitudes towards teaching science and behavioural intention by using Partial Least Squares Structural Equation Modelling (PLS-SEM).

Methodology – This research has adopted quantitative research design with cross-sectional survey method. The respondents were 135 pre-service science teachers from the government-funded universities in Malaysia. 'Science Teaching Efficacy Belief Instrument-Form B' (STEBI-B) was used to measure pre-service science teachers' self-efficacy beliefs. 'Work Tasks Motivation Scale for Teachers' (WTMST) was used to measure teaching motivation. The 'Dimensions of Attitude towards Science' (DAS) was used to measure attitudes towards teaching science, whereas the 'Behavioural Intention Scale' was used to measure behavioural intention in teaching science. PLS-SEM approach was used to evaluate the reliability and validity of the instruments.

Findings – This research has concluded that all instruments tested were valid and reliable to be used in future study.

Significance – The research instruments were revalidated by using PLS-SEM which is highly stringent in measuring multidimensional aspects of reliability and validity.

Keywords: Self-efficacy beliefs, Teaching motivation, Attitudes towards teaching science, Behavioural intention in teaching science, Pre-service science teachers

The Development of Learning Chemistry Module Integrated With Green Chemistry and Ethnoscience to Development of Students' Generic Science Skills and Soft Skills of Conservation in Central Java

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ABSTRACT

Purpose - This study developed and applied the chemistry learning module integrated with green chemistry and ethnoscience to develop generic skills of science and soft skills of conservation of high school students in Central Java, Indonesia.

Methods – The participants consisted of Chemistry education students (22 students), students from MAN I Semarang (68 students), students from SMA Negeri 1 Bae Kudus (69 students), and students from SMA Negeri I Semarang (69 students). Development of chemistry learning modules was conducted through stages of defining, designing, and development to produce appropriate and effective chemical learning modules. Data collection techniques passed the test instrument to measure the mastery of generic science skills, observations and questionnaires to find out the soft skills of conservation, and the students' responses to the chemistry learning module and the developed scientific approach. Data analyses included feasibility analysis, module effectiveness and chemistry learning approach. Analysis of generic science skills and conservation soft skills was carried out through N-gain and t-test.

Findings - The results of this study revealed that the chemistry learning module integrated with green chemistry and ethnoscience was feasible and effective. Generic science skills and students' conservation soft skills achieved moderate and high performance levels based on N-gain test results; as well as students' cognitive learning outcomes were significant.

Significance – The chemistry learning module integrated with green chemistry and ethnoscience was feasible, valid, reliable and effective to develop generic skills of science and soft skills of conservation of among high school students.

Keywords: Learning modules, Green chemistry, Ethnoscience, Generic science skills, Soft skills, Conservation