Abstract Number: **20202**

Use of Multiple Representations in Teaching Quadratic Graphs

Wenshan Seet, *Yusof Ishak Secondary School*
ChinLing Ng, *Yusof Ishak Secondary School*

The aim of this research is to investigate the effectiveness of a lesson in improving students' ability to interpret graphs of quadratic functions in real-world contexts based on multiple representations model. Based on previous teaching experiences in Mathematics lessons and results obtained from both formative and summative assessments, it was observed that students had difficulty interpreting quadratic functions in relation to a graph, where they were not able to relate the context of the question to the graph, especially in those that are modelled after real-world contexts. Students also faced difficulties when terminologies taught in generic quadratic graph functions are not seen in real-world contexts problems.

The most common method used by teachers in teaching quadratic graphs is to teach it didactically with the use of graph papers, either in hard copy or digital form. Meanwhile, students are taught to answer graph questions using a systematic and procedural approach, which we observed has resulted in students' lack of deep learning. These observations are reinforced by Parent (2015), who mentioned that students 'tend(ed) to think about isolated parts of the problems when solving quadratic problems. They also primarily relied on procedural strategies in solving quadratic problems such as the use of algebraic formulas.' As such, students lack the opportunities to appreciate graphs on a wider and deeper context, such as its uses and relationships as real-world context models. These learning attributes, which lack depth, hinder deep and transferable learning. As a result, students generally experience difficulty when questions are phrased with words that are specific to the real-world context instead of terminologies used in a generic graph question. According to the Lesh translation model (Lesh, 1979), 'understanding is reflected in the ability to represent mathematical ideas in multiple ways, plus the ability to make connections among the different embodiments; and, it emphasizes that translations within and between various modes of representation make ideas meaningful for students' (Cramer, 2003).

Hence, in our lesson study, we aimed to overcome students' difficulty in interpreting quadratic functions through the use of multiple representations in representing quadratic functions. In the research lesson, students experienced the four stages of pictorial, numerical, graphical and algebraic representations successively in order to appreciate and immerse themselves with the different modes in which quadratic functions can be represented. The lesson study involved 43 Secondary Three (Grade 9) students in Singapore who are offered GCE O-Level Mathematics. The students were divided into two groups for the study, namely the high progress learners and low progress learners. After the first research lesson was completed, the same lesson was iterated with improvements made to the lesson plan based on the feedback given by the observers. Improvements were made to the delivery, clarity of and emphasis on the problem, as well as the objectives and expectations of the tasks assigned to the students.

Upon completion of the two rounds of lessons, we conclude through qualitative and quantitative approaches that students have generally shown improvements in the understanding of graphs in real-world context, where they are better able to interpret quadratic functions, and to relate the context of the question to the graph and the generic terminologies used. There are other positive outcomes which are unique to each of the groups. The low progress learners show confidence and competence in plotting quadratic graphs using Google Sheets. The high progress learners are able to make connections between quadratic functions presented in the graphical and algebraic representations and better appreciate quadratic functions that are modelled after real-world contexts.

Abstract Number: **20292**

How Does the Object of Learning Appear in Small Groups Discussion During a Math Lesson?

Jenny SvantesonWester, *Gothenburg University*
Christina Echevarria, *Gothenburg University*
Martin Elofsson, *Gothenburg University*

The aim of this ongoing study is to contribute to knowledge on small group discussions and learning possibilities in mathematics classrooms. The study is a follow-up study from a learning study in mathematics in grade 8 on the topic of enlarging and reducing two dimensional geometric figures (Svanteson Wester, 2014). The variation theory (Marton, 2015) was used as a theoretic frame work for design and analysis. This on-going study explores conditions under which small group discussions may lead to learning the intended object of learning during mathematics lessons. The object of learning in this study is the same as in the previously implemented learning study.

The empirical material includes data from two grade 8 classes. Two lessons from each class were video taped. In each class five to six small groups, got three tasks to solve. In total, the data consists of 33 videotaped small group discussions.

The small group discussions were analysed in detail with a focus on how the pupils handled the specific mathematical content when solving the tasks. How did the object of learning appear in the small group discussions during the three tasks? Significant differences concerning how the content was handled, and thereby differences in the enacted object of learning between the small groups were found. The result shows, among other things that the learning opportunities regarding the object of learning increase when the pupils in their group discussions expressed questions or showed uncertainty about the specific content. In what way the enacted object of learning differed between the small groups and possible explanations why they differed are reported.

Keywords: Learning study, The variation theory, Teaching, Interaction, Small group discussions

E-6-3 **PP-174**

Abstract Number: **20269**

Sharing and Jumping Task to Enhance Learning Quality on the Law of Reaction Rate

Ade Sazaliana, *Universitas Pendidikan Indonesia*
Asep Supriatna, *Universitas Pendidikan Indonesia*

In improving the quality of learning, it is necessary to develop a learning design that can facilitate the characteristics of students. The design of learning should make students think critically and collaborate in solving problems. This is in accordance with the demands of 21st century learning. Based on the results of the Analysis of Teaching Plan of chemical equilibrium in attached Senior High School to Indonesia University of Education, showed that the learning activities focus more on how the teacher teaches instead of how the process of student learning. In addition, teachers also can not predict how students respond when given problems in different contexts, what difficulties of students experience during the learning process. The purpose of this study is to develop the didactical design that can enhance learning quality and facilitate the characteristics of students, to know the characteristics of students' response and self-reflection of teachers. Selected the law of reaction rate as topic in designing a chemistry lesson because this topic is one of the essential topic that always exist in the National Examination in the last five years. In developing the didactical design, teacher activity is designed not only to focus on students and learning materials but also on the relationships between students and learning materials. The didactical design is collaboratively designed between researchers and teachers by predicting students' responses. Sharing and jumping tasks will be applied in didactical design. Sharing task is expected to facilitate slower learners and jumping task to facilitate faster learners.The method applied in the study is Didactical Design Research (DDR), that consists of three stages: 1) didactical situation analysis before learning or prospective analysis, 2) analysis of didactical situations during learning or metapedadidactical analysis, and 3) didactical situation analysis after learning or retrospective analysis. The data was collected by test, observation, interview, documentation and recording (audio and video). The result of the study was validated didactical design of the law of reaction rate. The research finding will be presented in conference.

Keywords: enhance learning quality, didactical design, self-reflection, law of reaction rate, sharing and jumping tasks, didactical design research.