

TSG Agenda

TSG 38: Task design and analysis

Class: B

Four sessions: 90' + 90' + 120' + 90' (390 minutes in total)

- Session 1: 19:30-21:00 Beijing time, July 13th
- Session 2: 21:30-23:00 Beijing time, July 16th
- Session 3: 14:30-16:30 Beijing time, July 17th
- Session 4: 21:30-23:00 Beijing time, July 17th

Session 1 19:30-21:00 Beijing time, July 13th (Invited and Long Orals)

0. Time: 19:30-19:40

Introduction of TSG38

1. Time: 19:40—20:00

Title of the Paper:

Action, process or object? Can they all be perceived in a single task?

Authors:

Maria Trigueros, Asuman Oktaç, Rita Xochitl Vázquez Padilla & Avenilde Romo Vázquez

Institutions:

ITAM, Instituto Tecnológico Autónomo de México

CINVESTAV, Centro de Investigación y de Estudios Avanzados del IPN

UACM, Universidad Autónoma de la Ciudad de México

CICATA, Instituto Politécnico Nacional

Short abstract of the paper:

The main concern of APOS theory is to promote student learning. Task design plays an important role in its methodology, in relation with teaching strategies and assessment tools. Analysis of results obtained by the use of specially designed tasks has shown that these tasks play an important role in providing interesting insights about students' learning. This paper discusses an example of a task designed from the viewpoint of APOS theory to examine students' understanding of linear transformations. Analysis of students' responses

from the lens of APOS theory, coupled with observations made by using the Anthropological Theory of Didactics (ATD) may offer important elements that can be used in the redesign of the task.

2. Time: 20:00—20:10

Title of the Paper:

The design of tasks for automatic formative assessment: Supporting teachers and students

Authors:

Willy Viviani & Kayla White

Institution:

University of Maryland, College Park, USA

Short abstract of the paper:

Designing tasks for automatic formative assessment of student responses, rather than to support student learning through exploration and discussion, changes the challenges involved in task design; formative assessment tasks are more focused on ascertaining what it is that students think, though they can also provide students with opportunities to engage in exploration to change and develop their mathematical perspectives. Designing to support automatic assessment of student responses requires considering what sorts of feedback can be automated and considering what information to provide both to students and teachers. This paper illustrates a distinction between formative assessment and exploratory tasks by comparing and contrasting two sets of tasks designed for use by students in a Calculus class.

3. Time: 20:10—20:20

Title of the Paper:

A joint embodied and simulation design for graphing: Coordinating distances that change together.

Authors:

Heather Lynn Johnson, Anna Shvarts, & Amy Smith

Institutions:

University of Colorado Denver, USA

Utrecht University, The Netherlands

University of Colorado Denver, USA

Short abstract of the paper:

When interpreting or sketching graphs of attributes of objects in motion, students may think that those graphs should represent the literal paths of those objects. We engaged in a joint embodied and simulation design, to develop a new toy car task sequence, in which students could coordinate two distances: the distance traveled by a toy car moving along a path and a toy car's distance from a stationary object. We share the two phases of our joint design, and provide empirical evidence to support its viability. We discuss implications arising from collaborative design methods, which are rooted in different theoretical traditions.

4. Time: 20:20—20:30

Title of the Paper:

Collective work on task design through study and research path for teacher education

Authors:

Berta Barquero & Sonia Esteve

Institutions:

Universitat de Barcelona, Spain

Universitat de Vic-Universitat Central de Catalunya, Spain

Short abstract of the paper:

In this paper, we reflect on the work of transposing research and methodological tools to teacher education for the teachers' practice of designing and analysing tasks. Our research is based on the anthropological theory of the didactic, where task design is integrated into the research methodology proposed by didactic engineering. From this theoretical approach, it emerges the proposal of the study and research paths for teacher education (SRP-TE). We present a particular case of an SRP-TE about teaching statistics in Primary school, to exemplify the aims and tools introduced in the different modules of an SRP-TE with prospective Primary school teachers. We conclude with a reflection about what was achieved through the different modules concerning task design and the progress achieved to bring closer research with practice through the transposition of epistemological and didactic tools for task design.

5. Time: 20:30—21:00

Time for questions/discussion

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Session 2 21:30-23:00 Beijing time, July 16th (Short Orals)

1. Time: 21:30—21:40

Title of the Paper:

Exploring mathematical task designed by pre-service teachers

Authors:

Ruchi Mittal & Alprata Ahuj

Institutions:

PhD Scholar, Department of Education, University of Delhi, India

PhD Scholar, School of Education Studies, Ambedkar University, India

Short abstract of the paper:

Task designing is staple to lesson planning. Teachers design task to plan learning experiences for their classrooms. A task is anything that a teacher uses to demonstrate mathematics, to pursue interactively with students, or to ask students to do something. Task can also be anything that students decide to do for themselves in a particular situation. Since, pre-service teachers put a lot of effort in planning as it is an integral component of teacher education program, this paper looks into the mathematical tasks designed by the pre-service teachers. Analysis of task designing is explored from three aspects, namely, their source, its type and appropriateness, to give holistic understanding to the researchers. The researchers has brought forth some of the discussion points which hold implications for various stakeholders related to the area of mathematics education.

2. Time: 21:40—21:50

Title of the Paper:

The fundamental idea of task design in China for algebraic development

Author:

Xuhua Sun

Institution:

University of Macau, China

Short abstract of the paper:

Among international research of task design, algebra knowledge development of task design goal and how the cultural context influent the different task design has been rarely discussed. This paper aims to provide a critical reflection on algebra knowledge

development of task design and their possible correlations with the cultural context as hidden supports or blocks, which have been neglected.

3. Time: 21:50—22:00

Title of the Paper:

Schooling experience as mediating variables in preservice teachers' beliefs and instructional practice when designing mathematical tasks

Author:

Eugenio Chandía Muñoz

Institution:

Universidad de Concepción, Chile

Short abstract of the paper:

This study investigates the relationship between the schooling received by prospective teachers, and their instructional beliefs and practices, and the way they design mathematical tasks. A latent class analysis was used to determine profiles of instructional beliefs and practices conditioned to the experience of 252 preservice teachers, from 18 courses of primary teacher education programs, and the relationship was saturated using conditional probability. We found a predominant pattern-oriented towards constructivist teaching practices, which was influenced by the schooling of the prospective teacher.

4. Time: 22:00—22:10

Title of the Paper:

Transforming mathematics tasks: an important mathematics teacher's role

Authors:

Guillermina Avila-Garcia, Liliana Suárez Téllez, & Víctor Hugo Luna Acevedo

Institutions:

Instituto Politécnico Nacional, Mexico

Short abstract of the paper:

The aim of this paper is to present the work of a teacher in designing a mathematical task in order to include latching stages, exploration, explanation, elaboration and evaluation (model 5e). The mathematical task consists of a teaching sequence for learning the subject of combinatorics with application for a problem of scalar magnitude. The teacher's interventions to promote high school students in Mexico (15-17 years old) highlight the

stages of the 5e model. In this process, the teacher transforms the mathematical task, according to the way he conceives the learning of mathematics. Students perceived the task as uncommon but felt comfortable with the lessons learned.

5. Time: 22:10—22:20

Title of the Paper:

Developing silent video tasks' instructional sequence

Authors:

Bjarnheidur Kristinsdottir, Freyja Hreinsdottir & Zsolt Lavicza

Institution:

University of Iceland, School of Education, Iceland

University of Iceland, School of Education, Iceland

Johannes Kepler University Linz, Austria

Short abstract of the paper:

When teachers change their teaching practices, their need for new types of assessment also often arises. Teachers who truly value students' deeper understanding of concepts usually wish to assess conceptual understanding of their students. With the aim to address this challenge, at least partly, the first author of this paper works with teachers at upper secondary school level in Iceland and their 16-17 years old students to develop silent video tasks. Each video is short, animated, without any text or sound, and focuses on one mathematical concept. Students receive the task to add their voice-over to these videos. The resulting student solutions to the task are used as a base for further classroom discussion. After the first cycle of this design research project, it became clear that silent video tasks had a potential to be used as part of formative assessment. Thus, in the currently ongoing second phase of the research project, teachers use silent video tasks as part of their formative assessment practices. Furthermore, emphasis is set on developing further the classroom discussion part of the instructional sequence of silent video tasks.

6. Time: 22:20—22:30

Title of the Paper:

A possible pathway of mathematical inquiry: how to calculate the cube root of a given number by using a simple pocket calculator?

Authors:

Koji Otaki, Hiroaki Hamanaka & Takeshi Miyakawa

Institutions:

Hokkaido University of Education, Japan

Hyogo University of Teacher Education, Japan

Waseda University, Japan

Short abstract of the paper:

Let us describe here some results of our experimentation for realizing authentic inquiry in didactic situations. We designed inquiry for prospective mathematics teachers, which begins with a task about calculation by pocket calculators. This inquiry was conducted from a radical perspective of inquiry-based education: there is no expected piece of knowledge to be taught, and no limitation of the using of the Internet. We analyze the inquiry within the framework of the anthropological theory of the didactic, especially by the Herbartian schema. As consequences of the analysis, we will find out two didactic phenomena which are unusual in ordinary mathematics classroom: the co-production of answers and the elaboration of questions.

7. Time: 22:30—22:40

Title of the Paper:

Integrating covariational reasoning in the learning of science: the case of gravity

Authors:

Erell Germia & Nicole Panorkou

Institution:

Montclair State University, USA

Short abstract of the paper:

This study discusses the forms of integrated reasoning that students exhibited when they engaged in activity integrating covariational reasoning to the learning of gravity. Results from a whole-class design experiment with sixth-grade students showed that students reasoned about the direction of change of the mass, distance, and gravity as those changed simultaneously, the bi-directionality of those relationships as well as the multiplicative change of the quantities as they changed in relation to each other. This paper illustrates the power of covariational reasoning for bridging math and science content and discusses the design activity that was a structuring factor to the formation of students' meanings.

8. Time: 22:40—22:50

Title of the Paper:

Research on designing and teaching of worked examples in reviewing of sequence based on the SOLO taxonomy

Author:

Junyi Li & Chao Zhou

Institutions:

Suzhou Tin Ka Ping Experimental Senior High School, China

Soochow University, China

Short abstract of the paper:

This paper focuses on the design of multiple examples in the teaching of sequence review lessons, and proposes a design framework of worked example based on the SOLO taxonomy. The author conducted an action research on a general grade 11 liberal arts class in an ordinary high school in China. The research show that: (1) The design framework is reasonable, and it can guide teachers to design and organize examples of single lesson or successive multiple lessons. (2) These examples, which are of holistic, hierarchical and self-explanatory, have been acknowledged by teachers and students. Moreover, learning these examples can benefit most students at different levels.

9. Time: 22:50—23:00

Time for discussion/questions

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Session 3 14:30-16:30 Beijing time, July 17th (Invited and Long Orals)

1. Time: 14:30—14:50

Title of the Paper:

Fermi problems as a hub for task design in mathematics and stem education

Authors:

Jonas Bergman Ärlebäck & Lluís Albarracín

Institutions:

Linköping Universitet, Sweden

Universitat Autònoma de Barcelona, Spain

Short abstract of the paper:

In this paper we draw on recent research on so called Fermi problems, and situate the fundamental principles underlying this type of tasks and their use from a task design perspective. We use the models and modeling perspective on teaching and learning to elaborate on aspects related to the design of single-use, as well as sequences of, Fermi problems. In addition, we discuss a framework (called the F_pAT -framework) for supporting the design and use of Fermi problems to facilitate students' learning within particular mathematics content areas and/or aimed at particular concepts or higher order thinking skills. We also illustrate how the F_pAT framework can be used to (i) facilitate interdisciplinary collaborations with other subjects such as the social sciences, but in particular with the other STEM subjects; and (ii) support teachers in adapting and implementing Fermi problems in their classrooms.

2. Time: 14:50—15:00

Title of the Paper:

Opportunities for inquiry-based learning provided by Chinese and Dutch lower-secondary school mathematics textbook tasks

Authors:

Luhuan Huang, Michiel Doorman and Wouter van Joolingen

Institution:

Freudenthal Institute for Science and Mathematics Education, Utrecht University, The Netherlands

Short abstract of the paper

Textbooks are considered to highly influence instruction in lessons, while mathematics textbooks were found not supporting constructivist pedagogy. We explored through a textbook perspective about opportunities for inquiry-based learning (IBL) provided by tasks in lower-secondary mathematics textbooks of Beijing and the Netherlands. Based on an analysis framework related to IBL levels in phases of the IBL cycle, preliminary results show that tasks in both textbooks provide some opportunities for IBL in phases related to solution procedures and representations, but not in the other phases, which have potential for designing tasks in support of IBL practice in mathematics education.

3. Time: 15:00—15:10

Title of the Paper:

Developing digital mathematical tasks to promote students' higher order thinking skills

Authors:

Meryansumayeka, Zulkardi, Ratu Ilma Indra Putri, & Cecil Hiltrimartin

Institution

Universitas Sriwijaya, Indonesia

Short abstract of the paper:

Higher Order Thinking Skills (HOTS) and the use of technology become emphasizes of Indonesia curriculum in doing instructional activities for students. One effort to support students to develop their mathematical knowledge is through developing mathematical tasks and asking students to solve those tasks. This study purposed to develop mathematical tasks in the form of digital video and to analyze how students work on those tasks. Design research type development study was chosen as the research methodology. Data were gathered through observation, interview, documents such as students' worksheet and digital video. The digital mathematical tasks, which were developed, adapted PISA problems categorized into HOTS problems. They were validated through expert reviews and were evaluated through one to one stage until field test to see their practicality and their role in supporting students to develop their higher-order thinking skills.

4. Time: 15:10—15:20

Title of the Paper:

Potential, actual and practical variations for teaching functions: cases study in China and France

Authors:

Luxizi Zhang, Luc Trouche & Jiansheng Bao

Institutions:

East China Normal University, China

ENS de Lyon, France

East China Normal University, China

Short abstract of the paper:

This contribution is based on two major hypotheses: task design is the core of teachers work, and variation is the core of task design. Taking into account the variation in task design has a profound theoretical foundation in China and France, and developing my PhD

with two co-supervisors, in China and France, I wish to seize this opportunity for constructing an analytic model of “teaching mathematics through variation” making profit of this theoretical diversity. This model distinguishes potential variation and practical variation and is based on the process of transforming potential variation into actual variation, and of using practical variation for rethinking potential variation. The design of this model is based both on theoretical networking, and on cases analysis, in France and China. In this contribution, we will focus on a critical aspect in the two cases, from potential to practical variation.

5. Time: 15:20—15:30

Title of the Paper:

Students’ opportunities to engage in mathematical problem solving

Author:

Jonas Jäder

Institution:

Dalarna University, Sweden

Short abstract of the paper:

Problem solving has proven valuable for students’ learning. This presentation includes results from three studies where students’ opportunities to engage in mathematical problem solving have been studied. The results show that textbook tasks to a great extent are of routine character rather than mathematical problems. Furthermore, students mainly work on the easier sets of tasks, including even fewer mathematical problems. Thus, students’ opportunities to engage in mathematical problem solving are limited. In an ongoing project an analytic framework is developed to better understand some of the important components of mathematical problem solving and possibly also be of support in the design of mathematical problems.

6. Time: 15:30—15:40

Title of the Paper:

Tasks and scenarios for promoting inquiry based mathematics teaching

Authors:

Michiel Doorman, Matija Bašić, Zeljka Milin Sipus & Rogier Bos

Institutions:

Utrecht University, The Netherlands

University of Zagreb, Croatia

University of Zagreb, Croatia

Utrecht University, The Netherlands

Short abstract of the paper:

This study focuses on the role of task design in promoting inquiry and the learning of mathematics in daily practice. We combined the theory of Realistic Mathematics Education and the Theory of Didactic Situations to develop open and context-rich tasks and to support teachers in balancing phases of student-led inquiry with phases for creating a whole class shared understanding of mathematical structures. The tasks were enriched with scenarios for the lessons including examples of expected students' reactions and other teachers' experiences. These resources were tried out in Croatia and the Netherlands. Student work and interviews with eight teachers revealed that the tasks enabled students to learn from each other. The scenarios supported teachers in orchestrating the lessons and convinced them that the tasks and their implementation are worth the time and effort.

7. Time: 15:40—15:50

Title of the Paper:

Towards differentiated instruction: Insights from constructivist learning design

Authors:

Ng Kit Ee Dawn, Lee Ngan Hoe, Cynthia Seto, Liu Mei, June Lee, & Wong Zi Yang

Institutions:

National Institute of Education, Singapore

National Institute of Education, Singapore

Academy of Singapore Teachers, Singapore

National Institute of Education, Singapore

National Institute of Education, Singapore

National Institute of Education, Singapore

Short abstract of the paper:

This paper proposes four interacting elements for consideration when developing a mathematical activity supporting the construction of mathematical concepts in the Singapore secondary classrooms as part of a task design research: (i) the activity has an open-ended structure, (ii) activation of prior knowledge related to targeted concept is required, (iii) critical attributes of the concept are weaved in, and (iv) an iterative mathematisation process is prompted. An activity intended to foster students'

construction of the concept of “gradient of a straight line” will be used to exemplify how the four elements are applied. Analysis of students’ work from the activity revealed different trajectories of how teachers can plan for differentiated instruction towards a robust construction of the concept. The four elements and the resulting trajectories of instruction inform the development of a Constructivist Learning Design to guide teachers in using similar activities for a differentiated approach in the teaching and learning of mathematical concepts.

8. Time: 15:50—16:30
Time for questions/discussions

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Session 4 21:30-23:00 Beijing time, July 17th (Short Orals and Closure)

1. Time: 21:30—21:40

Title of the Paper:

Task for introducing the vector concept using technology

Authors:

Sofia Paz Rodriguez, Carlos Armando Cuevas Vallejo, & osé Orozco-Santiago

Cinvestav

Institutions

IPN, Mexico

Short abstract of the paper:

In this article we present a sequence of tasks framed in a practical action projects principles that can be applied to task design whose objective is to help the student to go from an elementary conception of vector in physics to conceiving it as an element of a vector space. The activities begin with a context problem simulated in a digital environment that allows the movement of a robotic arm showing the vector, first as an arm, then as an arrow with magnitude, direction and sense and finally as an ordered pair of real numbers in a geometric environment. The tasks were implemented for seven university students; this report presents the results of the pilot study.

2. Time: 21:40—21:50

Title of the Paper:

Design tasks in MLR environment: Constructing examples for proving logical statements

Author:

Galit Nagari-Haddif

Institution:

University of Haifa, Israel

Short abstract of the paper:

In this paper, we aim to demonstrate and characterize the challenge related to tasks in which students construct and submit examples for refuting or supporting a statement in an MLR environment. This design pattern (DP) also includes the construction of a fixed false universal statement and the formulation of a general case in a true universal statement. we describe the activity "Asymptotes and parametric functions", that instantiates this DP and report a few excerpts from the submissions and the solution process of four students.

3. Time: 21:50—22:00

Title of the Paper:

Didactic sequence planning for the study of the teaching and learning of isometries in future primary school teachers

Authors:

Marta Martin Nieto & Natalia Ruiz-Lopez

Institution:

Universidad Autónoma de Madrid, Spain

Short abstract of the paper:

In the Math education research community, there is an interest in the development of mathematical knowledge of primary teachers, as this is an area where serious shortcomings have been detected. Geometry is one of the parts where students have more problems. The future primary teachers who are studying at University need to master their problem-solving skills for their profession. Specifically, related to rigid movements in two dimensions. The goal of our research is to create a didactic sequence of problems and a tool to guide the resolution for teaching and learning isometries. The method used is Design Research. It has been a qualitative study undertaken with nine pairs of students from last year using the GeoGebra software and including discussion with the whole group. This analysis addresses the obstacles of learning encountered. A questionnaire was used to collect data about students' attitudes, expectations, assumptions and motivation. The

methodology used in the analysis of the activities in this problem solving process may be useful for those teachers and researchers who want to integrate Dynamic Geometry Software in their classroom.

4. Time: 22:00—22:10

Title of the Paper:

Analyzing primary two pupils' errors answering fractions' task using the Newman procedure

Authors:

Rosmawati Mohamed & Munirah Ghazali

Institutions:

PhD Candidate, School of Educational Studies, Universiti Sains Malaysia, Malaysia

School of Educational Studies, Universiti Sains Malaysia, Malaysia

Short abstract of the paper:

Previous research reveals that pupils struggle to understand fractions and committed various misconceptions due to the mistakes in communicating using different representations. This study provides some evidence for such claims and describe the types of errors 30 pupils constructed using Newman procedure. First, pupils' test answers were analyzed, followed by semi-structured interviews after selecting pupils who presented some mistakes. Findings suggest that pupils made comprehension, transformation, process skill and encoding errors because of ambiguous factual, conceptual and procedural knowledge, and connections the knowledge using different representations. Making the link between conceptual knowledge and the strategies used are the way of expert thinking. For the improvement of understanding fractions, implications are discussed.

5. Time: 22:10—22:20

Title of the Paper:

Effects of low floor high ceiling mathematical tasks on students' mathematical proficiency in seventh-grade geometry

Authors:

Franklin Falculan & Maria Alva Aberin

Institution:

Ateneo de Manila University, Philippine

Short abstract of the paper:

This study investigated the effects of using Low Floor High Ceiling (LFHC) mathematical tasks on students' mathematical proficiency in seventh-grade Geometry by closely examining their conceptual understanding and procedural fluency. Two intact classes composed of thirty-two grade 7 students in each class, participated in the study. The control group was taught and had practice using conventional, algorithmic tasks while the experimental group was taught and had practice using LFHC mathematical tasks. The post-intervention task based interview participated by selected six students from each group revealed that the students in the experimental group have developed better abilities in integrating different geometric concepts, correcting errors, and accurately executing procedures to solve mathematical tasks.

6. Time: 22:20—22:30

Title of the Paper:

Collaborative design of unit that fosters reification of a mathematical object

Author:

Minoru Ohtani

Institutions:

Kanazawa University

Short abstract of the paper:

This research aims at designing learning environment that fosters reification of a mathematical object by knot working actors who participated in a design research with different roles. Based on the Activity Theory, researchers of different expertise, and secondary teacher collaboratively designed teaching units on linear function in Japanese 8th grade. The team consists of researcher of task design heuristics, commognitive analysis, ICT specialist, Lesson Study specialists. The teaching unit includes a series of tasks, a milieu of coherent discourse and a dynamic ICT environment. In this paper, we illuminate how various actors across communities play different roles.

7. Time: 22:30—23:40

Time for discussion/questions

8. Time: 22:40—23:00

Summary and conclusions of TSG