

# ABSTRACTS FOR THE TRACK OF POSTER SESSIONS

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## ABSTRACT FOR 21214

### On the Visualization of Three Perpendicular Theorem Using Projection Tool of GeoGebra

AUTHORS: Minji Kim, Minshik Cho

**AFFILIATIONS: Korea National University of Education**

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The three perpendicular theorem is a fundamental content of Korean high school geometry courses and powerful tool for the solving problems on space geometry. But most students have difficulties to understand the theorem and its applications. It seems that students have not sufficiently experienced space geometry. The three perpendicular theorem is mostly presented with 2-dimensional images by standard textbooks and teachers explain it with brief axiomatic proof. However, most students have various misconceptions due to the lack of spatial visualization and don't understand involved geometric meaning in written problems. Because it is not easy to grasp the 3-dimensional figures from the 2-dimensional drawings in the text, it is desirable for students to have experiences the 3-dimensional activities.

GeoGebra is one of the optimal dynamic geometry tool for this study. Students can explore space figures in any directions, which could not be possible in 2-dimensional environment. Particularly, the 3D projection tool of GeoGebra is a nice gadget for students to understand space figures intuitively because the tool construct most likely to 3-dimensional space figures. So we will developed teaching materials using the projection tool of GeoGebra to help students' understanding of three perpendicular theorem and adapt them to problems as well.

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## ABSTRACT FOR 21225

### On the misconceptions and enforcements of visualizing images of tangent line

AUTHORS: Seong Hwan Kim, Minshik Cho

**AFFILIATIONS: Korea National University of Education**

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The tangent line is important to understand the geometric meanings of various curves. Since most curve can be represented as a graph of a differential function, the meaning of a differential coefficient are explained as the slope of the tangent line in textbooks. Many students just memorize it without understanding its concepts. It seems that students feel difficulties in solving problems due to lack of visualizing images of the tangent line. This may not have been provided sufficient opportunities for students to form a visualizing image for the tangent line.

Students have learned the tangent line several times from middle school to high school. Tangent line is accessible from the view of Synthetic Geometry in middle school, the view of Analytic Geometry in high school. And it is noteworthy that the definition of the tangent line is not taught, but the properties of the tangent line in modern sense. It is not easy to connect its meaning to one in association with each other, so it sometimes turn into misconceptions.

Hence it is necessary to enhance the visualizing image of the tangent line, so as to reduce the misconceptions about the tangent line. GeoGebra is one of the optimal dynamic geometry tool for this study. In the text book-based environment, it is difficult to experience dynamic activities, such as moving a point or a straight line, but can be done via GeoGebra. So we will developed teaching materials to help students understand the tangent line.

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## ABSTRACT FOR 21237

### Steady Critical Surface Waves over a Bump with Surface Tension

**AUTHORS:** Jeongwhan Choi, Sangwon Lee, Junkyung Kim, Sungim Whang

**AFFILIATIONS:** Korea University, Ajou University

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We consider steady forced surface waves propagating on a two-dimensional incompressible and inviscid fluid with a small bump placed on a rigid flat bottom. If the surface tension coefficient  $T$  on the free surface is not zero and the wave is moving with a constant speed  $C$ , the wave motion is determined by two non-dimensional constants,  $F = \frac{1}{2}gh$  and  $\gamma = T/(\rho gh^2)$ , where  $g$  is the gravity constant and  $h$  is the height of the fluid at infinity. It has been known that  $F = 1$  and  $\gamma = 1/3$  are the critical values of  $F$  and  $\gamma$ , respectively. In the critical case  $F = 1 + \epsilon$  and  $\gamma = 1/3 + \epsilon$  with  $\epsilon > 0$  a small parameter, a time-dependent forced Kawahara (F-Kawahara) equation is derived to model the wave propagation on the free surface and the steady F-Kawahara equation is studied both theoretically and numerically. It is shown that the steady F-Kawahara equation has many different kinds of one and multi-hump solutions when  $\epsilon$  and  $\gamma$  vary. In particular, for a fixed  $\gamma$ , there is a  $\epsilon_0 < 0$  such that if  $\epsilon < \epsilon_0$ , two one-hump steady solutions can be obtained, one with small amplitude and the other with large amplitude. By using the unsteady

F-Kawahara equation, it appears that the small one-hump solution is stable while the large one is unstable. In addition, two-hump solutions are unstable.

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## ABSTRACT FOR 21265

### Intention analysis in explainer indications for elementary geometry documents using laser pointer images

**AUTHOR:** Yuki Toyosaka, Naoki Tamura, Ryoji Fukuda

**AFFILIATIONS:** Faculty of Engineering Oita University, Faculty of Information Science, Kyushu Sangyo University, Japan , Graduate School of Engineering, Oita University, Japan

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We analyzed human intentions during explanations of elementary geometry using graphical contents. The lecturer indicates graphical contents by laser pointer during the explanation, and we create BMP images by using digital video camera. We prepared position data of the graphical elements in the graphical contents, and the feature values for the analysis are defined by using relative position of indicated pointers with respect to the graphical elements and their moves. We divided an explanation into several parts considering connections of meaning, and we succeeded rough discrimination for the parts using these feature values.

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## ABSTRACT FOR 21266

### Visualization of accuracy and reliability of approximation of density function in a discriminant analysis

**AUTHOR:** Yuki Ogino, Yuki Toyosaka, Ryoji Fukuda

**AFFILIATIONS: Faculty of Engineering Oita University, Graduate School of Engineering, Oita University , Faculty of Information Science, Kyushu Sangyo University Japan**

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For a discriminant analysis using one feature value, conditional probability with respect to a given value must be a good evaluation value, in the case where we correctly know the density functions for two groups. In an actual data analysis, approximations of density function values sometimes are not correct enough, especially in cases where data size is small or the appearance ratio is small.

We developed a software to visualize these situations, for example, estimation of density functions or reliability of discrimination. We evaluate the performance by a simulation using random variables which laws are contaminated normal distributions.

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## ABSTRACT FOR 21278

### A study of first graders' performance in number line estimation

AUTHORS: Yuan Yuan, Min-yuan Wei

**AFFILIATIONS: Chung Yuan Christian University, Taiwan**

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Educators have suggested that number sense is an important ability in developing students' mathematical concepts. Therefore, many countries make efforts in considering the nurture of number sense as one of the core mathematics abilities to develop. Examining research related to the number sense topic, many of them focused on investigating children's ability of number sense or on developing curriculum for teaching. Little research has focused on designing a tool to assess young children's development of number sense. Although there are lots of research related to study children's number sense, most of them are conducted at a single time for a single grader, or collected data with different graders at one time. Therefore, this study will apply a 3-year longitudinal study to explore lower graders' performance of numeric estimation on the number line. Four different assessment approaches will be designed to collect children's performance of numeric estimation. Three factors will be examined to see if they will affect the children's performance of numeric estimation. The major purpose of this study is to study if there is an appropriate assessment tool that can be used as the effective tool to measure early children's number sense and how can it predict the development of number sense in the future. This study is the result of this first graders' performance in number line estimation, and discusses the relationships between number line estimation and other mathematics abilities (number comparison, length estimation, and place value concept).

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## ABSTRACT FOR 21324

### Geometric Constructions with Cinderella and ketcindy -- Application of mathematics to mathematics in senior high school

AUTHOR: Hideyo Makishita

**AFFILIATIONS: Shibaura Institute of Technology**

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Geometric constructions normally mean generation of a figure suited for given conditions using rulers and a pair of compasses only for a finite number of times. Hereinafter, this is referred to simply as figure drawing. This poster presents a discussion of, in addition to geometric constructions, the practice of geometric constructions by adding mathematical contents. When mathematical material is added to geometric constructions using rulers and compasses, the use of dynamic geometry (DG) software is one option, whereas ketcindy is used for this study because ketcindy is equipped with DG's Cinderella as GUI and can be used for drawing figures by Script as CUI. Therefore, mathematically precise figures can be drawn with ease, producing beautiful results. The author explains geometric constructions while the quadratic curve concept is added to figure drawing. The author considers that geometric constructions by Script is extremely useful for mathematics education from the viewpoints of application of mathematics to mathematics. The author would like to discuss with you on this point.

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## ABSTRACT FOR 21352

Experimental attempt to practice flip teaching with ShowMe

AUTHORS: Mahiko Takamura

**AFFILIATIONS: The second high school at Takashima, Thailand**

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The poster session will clarify the advantages and disadvantages of using materials created by a learning application software ShowMe.