An Integrated Learning Environment for Developing “Function Sense”
-From Velocity to an Introduction of Calculus with Spreadsheets-

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Abstract: In this poster we present a case study for exploring how to develop a “function sense” on an integrated environment for learning functions (Kakihana et. al, 2000) with spreadsheet and an experiments by using a graphing calculator. In this case study high school students and junior college students were examined how to use their “function sense” to understand the relation between a velocity and the concept of differential. At first they tried to understand the velocity and the shape of a function and then they simulated the situation of walking on the spreadsheet. They input the walking distance for a fixed minutes and the expression of the velocity of this duration. Graphs of the distance and velocity were drawn automatically. On the spreadsheet students change the number of duration. On the worksheet students were asked what kind of relation between a graph, the inputted numeric data, the situation of walking and the concept of velocity/distance. They were able to connect the situation of walking and velocity in the very short duration. These experiences must lead students to the calculus. (Kakihana et. al, 2000) develops “function sense” (Fukuda et. al, 2001). Eight two-year college students were given a problem - solving task to perform in a computer lab based on the 1993 NAEP assessment (Dossey, 1993). Spreadsheets and websites were used. Surprisingly, students did not understand that numeric data in a table are representative data for a function. We also found that students did not relate a graph on a computer screen with an expression. Fortunately, we found that if students were competent in “function sense”, they were able to solve a problem using computer technology even if they had been weak in mathematics at school. It was evident that development of "function sense" depends on how to juggle multiple representations (Goldenberg, 1997).
An Integrated Learning Environment for Developing “Function Sense” - From Velocity to First Steps in Calculus Using Spreadsheets -

Objective: To explore how to develop “function sense” on an integrated environment using spreadsheets and a graphing calculator.

What is function sense?
Function sense
- Ability to use functions as a tool to express changing, corresponding, or mapping in daily life.
- Number sense (NCTM, 1999)
- Symbol sense (J.Fox, 2001)
- Spatial sense (A. Arens, 1984)

Computer Based Environment

Step 1: Explain the velocity and the shape of a function with a graphing calculator by actually walking.

Step 2: Simulate many situations of walking on a spreadsheet integrated environment and understand the relation between distance and velocity.

Step 3: Consider the relation on a graph between distance and velocity without the help of technology.

Result 1: This environment helps students to explore and to understand the relation between distance and velocity on a graph by inputting numeric data.

Result 2: The spreadsheet allows students to experience a situation which they would not in the real world.

Result 3: These activities motivated the students to learn calculus.

Conclusion:
Simulation by using spreadsheets effects on developing students' "Function Sense".

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