Motion Sensors in Mathematics Teaching: Learning Tools for Understanding General Math Concepts?

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The extended abstract:

On the one hand, physical experiments have a remarkable potential in maths lessons. For instance, findings from case studies suggest that it is possible for nine-year olds to interpret graphs they generate through interactions with sensors.

Furthermore, eleven-year old learners can gain an intuitive understanding of basic calculus concepts by using a position sensor with a computer that generates a real-time graph of the learner's motion and velocity. On the other hand, mathematics has often been called the language of physics. Therefore, incorporating technology tools into the mathematics classroom adds a new dimension to the teaching of math concepts. Especially, gathering data in a hands-on and real time method helps classrooms coming alive and promotes the development of understanding the connections between maths and physics. Researchers exploring educational technologies have many examples of approaches that allow students to learn far more, better, and earlier in contexts that take advantage of the educational impact of information technologies. For example, important concepts of rate and change can be learned even at surprisingly early grades with the motion detector.

By enhancing learning experiences with computer-based motion detectors, six tasks, which were used in study, aimed to support students in making conjunctions between abstract math concepts and fundamental physics phenomena by involving them in mathematical representations of real-world phenomena. Within a physics lab especially focusing on the development of maths concepts, students used motion sensors to collect physical data that were graphed in real time and then could be manipulated and analyzed. Thus, due to the fact that data were presented in an immediately understandable graphical form, students were allowed to take an active role in their learning by encouraging them to construct mathematical knowledge from observation of the physical world. Research was conducted with 44 students from grade 9 within three successional years. Data sources included video and audio recordings of students and teacher during three 90-minute sessions, students' written notes, semistructured student interviews and the teacher's journal. For testing students' knowledge gains the TUG-K test was used within a pre, post and follow-up design.

Findings suggest that, utilizing a predict-observe-explain format, students learned about slope, determining slope, and distance vs. time graphs through motion filled activities. Furthermore, exploring the meaning of slope, viewed as the rate of change motion, students acquired competencies reading, understanding and interpreting kinematics graphs involving a multitude of mathematical representations. As students worked to recognize patterns and made generalizations, graphing tools in combination with motion sensors enabled students to efficiently move among tabular, graphical and symbolic representation to analyse patterns. In conclusion, results showed that technology allows teachers to design experiences where graphs can be presented in a dynamical and genetic way supporting students in the transition to a meaningful managing of algebraic language. In fact, there is need for further research to explore how math teachers independently can integrate motion sensors into their classrooms and to compare the effectiveness of the use of motion sensors in relation to traditional math classroom teaching.

The keywords:
Motion sensors, math classroom, meaning of slope, rate of change, algebraic language