Authentic practices as contexts for learning to draw conclusions from correlated data

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Introduction and research question

Many researchers aim to improve science and mathematics education by searching for methods that make scientific concepts and activities more meaningful to students. Over the past decades various approaches have been proposed and tested, for example context-based science and mathematics education. Gilbert (2006) classifies four canonical models of "context" used in chemical education and argues on theoretical grounds that the model of interpreting context as an authentic practice is the most promising one.

Examples of recent research in which the design of science units is based on authentic practices are Prins et al. (2007), Westbroek (2005) and Westra (2008). Their goal was to investigate how elements from authentic practices could be converted to elements of a learning environment in which students experience the concepts learned and the learning itself as functional. Relevant elements are goals of an authentic practice, motives to perform certain actions, and procedures and knowledge used as tools to achieve particular goals. Such elements from an authentic practice can inspire the design of an "educational version" of that practice.

It is a challenge to transform elements from a scientific authentic practice to an educational version of such a practice such that actions can be carried out by students and the knowledge and skills they gain are functional in reaching a meaningful goal.

Building on this research, the question in this study is how authentic practices can be used to design a learning environment in which students of grade 11 (age 16-17 years, pre-university track) learn statistical modelling in such a way that they can use it in different contexts.

Theoretical framework

The theoretical basis of this study draws primarily on two lines of research in science education: the use of authentic practices as contexts, and statistical modelling.

Authentic Practices

The use of authentic practices is inspired by Activity Theory (Leont'ev, 1978, Vygotsky, 1978). This theory describes society in terms of social practices as manifestations of connected activities. When authentic practices are taken as the source of inspiration for design, it can be expected that students get a better view of those authentic practices and are more motivated to learn because they experience the utility of what they learn in reaching particular goals. If the unit based on authentic practices is designed well, it might give students access to a network of concepts, methods and situations of which they probably have rudimentary prior knowledge that they can build upon. However, authentic practices are not immediately appropriate for the implementation to educational contexts, because they are often too complex for implementation at once (Westbroek, 2005). Moreover, an instructional version of a practice has other objectives than the authentic practice itself: the main goal of an instructional unit is to *learn* something.

Statistical Modelling
Based on many studies, Lesh and Zawojewski (2007) argued that modelling should play an important role in the learning of mathematics and science. Making sense of real-life situations often involves for modelling. Inevitably, modelling is a process of simplification of reality and statistical modelling is a suitable focus for inquiry-based learning. In this research I adopt a definition of modelling by Andrew Izsák (2004): *Mathematical modelling consists of (a) examining various attributes of a particular mathematical, physical, or social context; (b) relating a subset of those attributes through arithmetic operations, functions, or other mathematical structures; and (c) using resulting representations to solve problems.*

For this study I have chosen (a) scientific contexts (b) in which students can use statistical modelling (c) resulting in solutions to solve the given problems.

Research questions

The purpose of this study is to contribute to an empirically and theoretically grounded instruction theory for statistics education in secondary school science. It must bring insights into the characteristics of a learning arrangement which is based on authentic practices so that students learn concepts which they can use in many different contexts. The above leads to the following research questions:

1. How can students learn statistical modelling within different educational versions of authentic practices?
2. Which characteristics should the learning arrangements have so that students can apply what they have learned to other situations?

I expect that the answers to these questions lead to learning arrangements in which students experience the meaningfulness of modelling activities; know why they take particular actions; and flexibly choose a correct modelling activity to handle a problem in a scientific context.

Methods

For the development of an empirically and theoretically grounded instruction theory I planned an instructional design research (Van den Akker, Gravemeijer, McKenny & Nieveen, 2006) .
First I carried out a literature review and approached researchers, teachers and students to find suitable authentic practices. This led to the development of a new instructional unit.

In July 2008 I used a questionnaire to investigate students' (N = 198, students 11th grade) views on using authentic practices. Most students (93 %) indicated that they would enjoy authentic practices as a basis for the unit, because they then realise the usefulness of the unit. This questionnaire has been adapted and given to a new group of students (N=164, 11th grade) in November 2008. It gave the similar result.

In the next phase 12 students (11th grade) worked with the unit as part of NLT (Nature Life Technique). To monitor the learning processes, lessons were observed and recorded by audio-visual devices. Data collection further includes student work, interviews, questionnaires and tests. In the analyses, the observations will be compared with the predictions from the HLT, which will lead to a revision of the unit and improvement of the theoretical and empirical foundations (research questions 1 and 2).

To analyze the video data I used Videograph, a multimedia player, with which digitalized videos can be played and at the same time be evaluated ("videographed").

In December 2008 I used another questionnaire to investigate the students experience with the unit. They gave a very positive feedback. Another questionnaire and some interviews in January 2009 led to the adaptation of the teaching material.

The next teaching experiment with a bigger sample students (N=28) will be carried out in April 2009.

Literature

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