Simulationen und Randomisierungstests mit der Software TinkerPlots

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Theoretische Werkzeuganalyse zur stochastischen Simulation und explorative Fallstudie zum statistischen Schließen mit Randomisierungstests

[English: Simulations and randomization tests with TinkerPlots

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Theoretical tool analysis for stochastic simulation, and an exploratory case study on statistical reasoning with randomization tests]

Dissertation

Zur Erlangung des Grades eines Doktors der Naturwissenschaften (Dr. rer. nat.)

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Susanne Podworny

an der Fakultät für Elektrotechnik, Informatik und Mathematik der Universität Paderborn

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Abstract

This work starts with the widespread view that learning processes benefit from computer-supported simulations. The software TinkerPlots™, which is used nationally and internationally, provides easy access to modeling and to performing stochastic simulations. For this reason, in order to show the possibilities and limitations of the software, the first part of this thesis examines how TinkerPlots supports stochastic simulations.

Based on this tool analysis, the software has been widely used in recent years in courses at the Paderborn University for data analysis and simulation, especially in the course „Modellieren, Größen, Daten und Zufall I“ (Modeling, Magnitudes, Data and Chance I). This is a course in mathematics education for primary school preservice teachers concentrating on basic data analysis, combinatorics, and probability. A learning trajectory on statistical inference with randomization tests was developed for this course using a design-based research approach. This short sequence of lessons – a completely new topic for most participants – was incorporated at the end of the course. The design of the learning trajectory will be presented in the second part of the thesis together with an exploratory case study.

After they experienced the new lessons, six of the preservice teachers participated in an exploratory case study in which they conducted, in pairs, a randomization test using TinkerPlots. The evaluation of this study is also explained in detail in the second part of this thesis. From this, factors for successful collaborative working processes are derived and the exact usage of the software TinkerPlots in these processes is examined. Based on findings about ideas and difficulties in carrying out randomization tests with TinkerPlots, hints for the further development of the learning trajectory are developed and general recommendations for dealing with this topic are generated.

Thus, the present work contributes to the state of mathematics education research, firstly through the analysis of the TinkerPlots software, and secondly by examining an introduction to the logic of inference with randomization tests using TinkerPlots.