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Quantifying correspondence between the intended and the implemented intervention in educational design research

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ABSTRACT

In educational design research it is common practice to develop and implement curriculum materials in order to address a particular educational problem. The intended instruction is usually hypothesised in so called hypothetical learning trajectories. After implementation in real life classrooms, the use of the materials is evaluated. One of the main criticisms of educational design research is that the report of the evaluation is qualitative, and only qualitative, and could lead to conclusions which are very dependent on the conditions in a very specific part of the sample.

In this study a method is developed and implemented to overcome this criticism. A systematic coding approach is described and applied, both on the hypothetical learning trajectories and on the implemented curriculum. Subsequently an index is presented in which the correspondence between the intended curriculum (as described in the hypothetical learning trajectories) and the implemented curriculum (as observed in the classroom) is expressed.

The suggested method was developed during an educational design research project on the optimisation of feedback in statistics education, utilising a classroom network.

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Introduction

Roughly, curriculum development research develops from the small scale design, development and in depth evaluation of an educational intervention in the beginning of a new curriculum to large scale efficacy testing from an educational black box perspective in the end of its development. The former approach focuses on the question 'what should be done and how', the latter on 'how well does it do what it promises', usually in terms of learning achievements. The latter studies can rely on a robust methodology in order to answer their thus formatted research questions. The method of randomised control trials (Torgerson & Torgerson, 2001), for example, offers such a well-accepted approach, as introduced by medical science (Medical Research Council, 1948).

But what if an educational researcher wants to measure how well the intentions of a very detailed intervention, implemented on a small scale, are met? The coding scheme (CS) and correspondence index (CI), as presented in this article, are tools that offer educational design researchers a broad overview of how well the intentions of an intervention, as designed and developed in an educational design research project, are implemented. The coding scheme and correspondence index were developed during an educational design research project called "The potential of a classroom network to support teacher feedback" (Tolboom, 2012). This research will be further outlined in the section *Context of this study*. First, educational design research is described, in particular, how this research approach has been applied in this study and what the contribution of the coding scheme and correspondence index (CS-CI) method is to this field of research.

A systematic approach to educational design activities and a thorough evaluation of them is perhaps first discussed by Brown (1992). During the 1990s, educational design research gained momentum amongst educational researchers (Gravemeijer, 1998; Richey & Nelson, 1996; van den Akker, 1999) which was extended during the first decade of the twenty-first century (Collins, Joseph, & Bielaczyc, 2004; Kelly, 2004; Kelly, Lesh, & Baek, 2008; van den Akker, Gravemeijer, McKenney, & Nieveen, 2006). Although there are different interpretations and articulations of the principles and

Abbreviations: HTT, hypothetical teaching trajectory; CS-CI, coding scheme–correspondence index; EDR, educational design research; DL, data literacy; ASS, algorithmic statistical skills; GC, graphing calculator; CN, classroom network; SLG, statistical learning goal; CAF, class analysis feedback; JAC, JustAnswerChecking; LPF, live presenter feedback; GSS, get students' screens; QP, quick poll; SII, students' interaction input; TC, teacher conclusion; CH, character.

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methods to be applied when conducting EDR, some key elements frequently occur. Five of these are listed below (van den Akker, 1999):

1. *Interventionist*: a particular intervention is designed and implemented in an actual setting of 'real life education';
2. *Iterative*: a cyclic process of design, evaluation and revision is followed;
3. *Process-oriented*: aimed at understanding the process and improving the intervention;
4. *Utility-oriented*: aimed at being as practical as possible;
5. *Theory-oriented*: based on existing theory and aiming at contributing to theory building in poorly understood contexts.

The first element, that of an EDR study having an interventionist character, was at the heart of this study. The developed intervention is used and evaluated during real life mathematics education. The second element of EDR (iterative) was also key to this study. Each time we piloted our prototype of the intervention, the experiences of the use of this prototype were evaluated and the prototype was adapted according to this evaluation. We conducted an initial study (Tolboom, 2005) to determine the key concept, which consisted of teacher feedback on students' work. The prototype of the intervention was piloted in three stages. The third element of EDR (process-oriented) we tried to meet very closely too. In fact, the whole context of the pilot of the prototype was constantly evaluated, in order to be able to research the teaching process, prompted by the prototype. The fourth element (utility-oriented) we followed in this study by concentrating on an urgent problem in real life education: a lack of teaching time in upper secondary mathematics education. By cooperating with practising mathematics teachers, we constantly evaluated the practical relevance and usability of the intervention. This is the most important reason why EDR is considered by educational practitioners (e.g. teachers) to be the most useful type of research (Vanderlinde & van Braak, 2010). Current research on how to improve the interconnection between research and educational practice (Levin, 2013) confirms the potential of EDR to contribute to educational improvement. The fifth element as formulated by van den Akker (1999) (*theory-oriented*) we had express intent to meet in this study by examining theoretical reviews of the concept of feedback, of statistics education and of the use of information and communication technology (ICT) in design principles. These principles were compared with the analysis of the collected data and evaluated in order to contribute to a theoretical understanding of how to support teachers in statistics education utilising a wireless classroom network. We aim thus to *build on* as well as to *contribute to* theory.

Context of this study

The development of the correspondence scheme and correspondence index as presented in this article was done during an educational design research project investigating the role of feedback in statistics education using a wireless network (Tolboom, 2012). This study was led by the research question "What is the potential of a classroom network in supporting teachers to provide feedback in statistics education?"

The students' learning goals were twofold:

1. reasoning and sense making (Martin et al., 2009) with and about data (Cobb's (1991) 'data and concepts'), later to be called *data literacy* (DL);
2. algorithmic statistical skills (ASS) (Cobb's (1991) recipes).

The network hardware was comprised of graphing calculators (GC) on the students' side, a laptop computer on the teacher's side and an access point and hubs (see Fig. 1).

Software enabled functional interaction between the teacher's computer and the students' graphing calculator (GC). Technically,

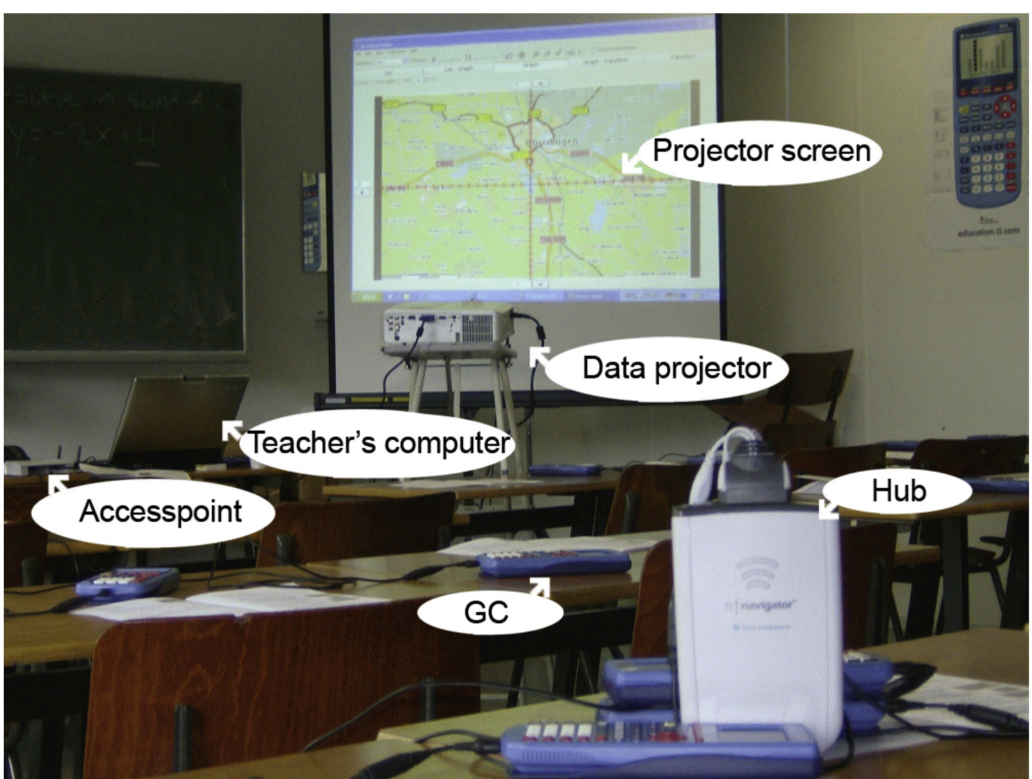

Fig. 1. An overview of the components of the classroom network.