

Design principles for tasks to support student learning in mathematics across primary-secondary transition: An iterative approach

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Background to the study

Transition from primary to secondary education is considered a challenging phase for many students as they experience a myriad of changes in various aspects of their social, emotional and intellectual environments. These challenges are particularly prevalent in mathematics where students' negative experiences sometimes act as barriers to their learning and they start to develop negative dispositions in mathematics. However, studies reporting on effective measures to address the challenges in relation to mathematics learning across primary-secondary transition are limited (Kaur et al., 2022). The overall aim of this study is to support student learning in mathematics across the transition from primary to secondary education. To achieve this, the study employs the use of rich tasks as a tool to enhance mathematics learning experiences and productive dispositions across the transition. This paper illustrates the process of development of design principles for tasks that have a specific focus on supporting student learning in mathematics across primary-secondary transition.

Methodology

The task design principles for this study were developed through an iterative process using an Educational Design Research (EDR) approach. The process of developing design principles matured through an amalgamation of research and practice (McKenney & Reeves, 2013). This amalgamation took place in three iterative cycles. The initial set of these design principles (Iteration 1) was developed from a synthesis of research literature on primary-secondary transition in mathematics, published during the period 1990-2020 (Kaur et al., 2022) and a review of literature around rich tasks. These design principles were refined (Iteration 2) using the data generated from a teacher professional learning programme that aimed at supporting mathematics learning across transitions (designed as part of the broader study). Over the course of the workshops, teachers engaged in co-designing rich tasks and explored the opportunities provided by a given task to enhance student learning. Johnston-Wilder and Mason's (2004) framework outlining the dimensions of rich tasks, provided the basis for critical appraisal of the tasks. A further refinement of the iteration 2 led to the iteration 3 of task design principles, which was carried out through a) an analysis of the tasks implemented by participating teachers with their students; b) teachers' reflections on their experiences of implementing these tasks and c) the findings from the influence of these tasks on students' learning. The resulting design principles are presented in Figure 1.

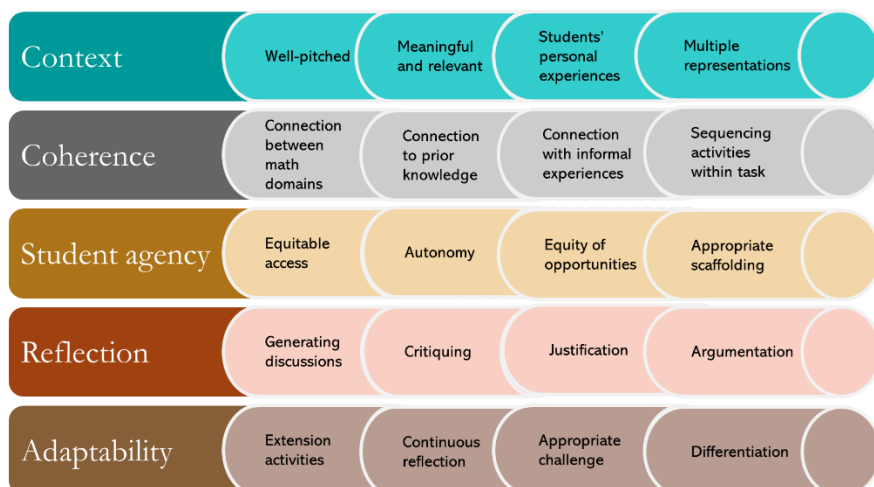


Figure 1: Task design principles to support mathematics learning across primary-secondary transition

In the current phase of the study, rich tasks based on these design principles are being implemented with primary and secondary students in four Irish schools.

Principles exemplified

Figure 2 shows an example of a task developed using these design principles. Students are given a route map for a shopping trail and a to-do list of a number of jobs. For each

job, students are required to decide the best shopping option and justify their decisions with reasoning. The task concludes with a whole class discussion on whether it is realistic to be home by the specified time, having completed the list of jobs. This task is based on a real-life context, providing opportunities for connecting new knowledge with existing prior knowledge and informal experiences. Many students used their personal experience of travelling in a bus to estimate the time taken by the bus to cover a given distance. The element of reflection embedded within the task helped address student misconceptions. Many students changed their decisions after listening to others' ideas and reasoning. The discussion also allowed the teacher to identify the challenges that students had in completing the task and differentiate the task accordingly.

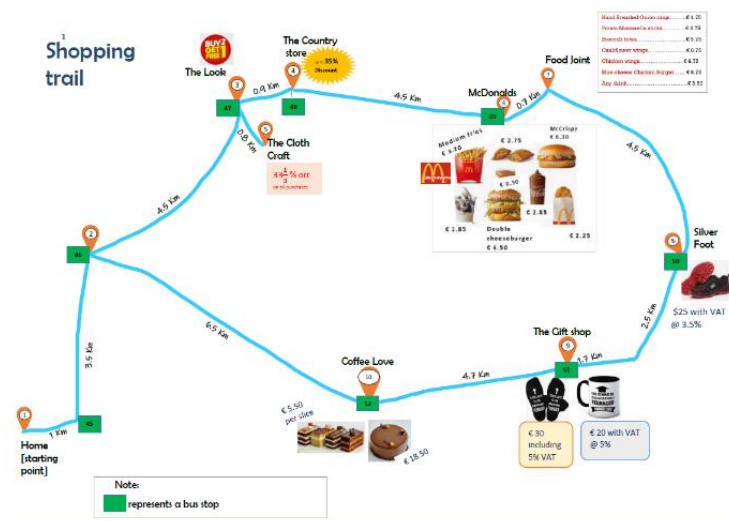


Figure 2: Task - The Shopping trail

The interim findings show a positive impact of such tasks on students' learning experiences. The design principles presented here have implications for teacher professional learning programmes and for task designers to support student learning in mathematics across the primary-secondary transition.

References

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