

Factors Influencing Students' Experiences of Mathematics Transitions from Primary to Post-Primary School

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This study presents the findings from a scoping review of literature (2016-2020) to explore factors that influence students' experiences of the mathematics transition from primary to post-primary education. Synthesis of findings identified three factors, namely student self-regulation, school and academic-related, and social factors that contribute to shape students' experiences. Findings suggest that no single factor can be attributed to influence students' experiences of mathematics transition and an interplay between various factors contributes to these experiences. The review also highlights a gap in research on the social factors influencing students' experiences of mathematics transitions.

Introduction

The transition from primary to post-primary school has been described as the most challenging phase in a student's education. This transition involves significant changes in many aspects, such as adjusting to new school environments, increased workload, change in teaching practices etc. Research studies mostly report on the challenges and negative experiences of students rather than the positive impacts of transition (Jindal-Snape et al., 2019). Such negative experiences impact not only on students' academic achievement but also on their psychological well-being and can affect their self-esteem and self-concept (Yao et al., 2018). In the context of mathematics education, a significant decline in students' mathematics achievement and mathematical identity has been associated with this transition. Students' interest and motivation for learning may decrease and they can develop negative attitudes towards mathematics (Yao et al., 2018). Negative transition experiences have also impacted on students' emotional health, e.g. mathematics anxiety increases in this transition to post-primary school (Suren & Kandemir, 2020). Such negative transition experiences can strongly impede the development of students' mathematical identities and impact on their academic achievement and progression in mathematics.

Many of the challenges faced by students across this transition are attributed to curricular and pedagogical discontinuities in mathematics education between levels. In particular, teachers' lack of knowledge about mathematics curriculum at the other level has been highlighted (O'Meara et al., 2020). Research on teachers' perceptions of transition-related issues identifies that teachers need additional support to facilitate students' mathematical learning during this phase and to enable collaboration between primary and post-primary school teachers (Prendergast et al., 2019). Given this, it is important that teachers are aware of the factors that contribute to students' negative or positive experiences

of mathematics learning as they transition to post-primary school. This study reports on a scoping literature review of studies that focus on primary to post-primary mathematics transition and were published in the past five years (2016-2020). The key objective of this review is to address the research question:

What factors influence students' experiences of mathematics transitions from primary to post-primary school?

Methodology

This scoping review was carried out using the EBSCOhost and Web of Science databases, with searches involving the use and combination of several keywords. For example, one of the search strings used was: (school trans*) AND (primary or elementary or junior or post-primary or secondary or middle or grade 7 or grade 8). The criteria used to identify studies to be included in this review were: peer-reviewed publications in the English language from 2016 to 2020 that included students aged 10-16 years. A period of five years was chosen as this scoping review was conducted as a precursor to a wider systematic review and to confirm the relevance of study criteria and potential scope of the study. Studies focusing on specialised or vulnerable groups or ethnic or racial groups were excluded from the selection as this review focused on normative transitions in mathematics from primary to post-primary school. The search process, followed by screening of titles, abstracts and full texts yielded 22 studies for inclusion.

Findings and Discussion

The scoping review identified three key factors influencing students' positive or negative experiences of mathematics transition from primary to post-primary school. The review analysis suggests that no single factor can be attributed to influence students' transition experiences - rather there is an interplay among three key factors, namely, student self-regulation factors, school and academic related factors, and social factors (Table 1).

Table 1

Studies reporting on factors influencing students' experiences of mathematics transition.

Factor	Reference
Student self-regulation	Evans & Field, 2020a; Field et al., 2019; Klee & Miller, 2019; Madjar et al., 2018; Metsapelto et al., 2017; Murphy & Weinhardt, 2020; Semeraro et al., 2020; Skilling, Bobis & Martin, 2020; Widlund, et al., 2018
School and academic related	Arens & Moller, 2016; Deieso & Fraser, 2019; Demonty et al., 2018; Evans & Field, 2020; Fryer & Oga-Baldwin, 2019; Johnson et al., 2020; Lazarides, et al., 2019; O'Meara, Prendergast, Cantley, et al., 2020; O'Meara, Johnson, & Leavy, 2020; Prendergast et al., 2019
Social	Evans & Field, 2020b; Evans et al., 2020; Lazarides et al., 2019; Semeraro et al., 2020; Yao et al., 2018

Student self-regulation factors include aspects related to students' beliefs and/or emotions that influence an individual's experiences (positive or negative) in transitions such as self-concept, self-esteem, motivation and engagement. *School and academic factors*

include aspects relating to the learning environment, curriculum content, instructional and pedagogical practices. *Social factors* relate to the home and family environment and students' relationships with family, peers and teachers. An overview of the 22 studies that reported on factors that influence students' experiences of mathematics transition from primary to post-primary education is presented in Table 1.

Student Self-Regulation Factors

Student self-regulation factors, such as students' attitudes towards mathematics learning and their beliefs about their own abilities are reported to influence their transition experiences. Studies investigating students' perceptions of transition experiences report that post-primary school students show more negative attitudes to mathematical inquiry and reduced enjoyment and engagement in mathematics as compared to primary school students (Deieso & Fraser, 2019).

The level of students' mathematics engagement also predicts the value they attach to mathematics learning. Skilling et al. (2020) reported that 'engaged' students believed mathematics to be important for their future education and valued mathematics learning. These students had a preference for understanding over performance and had high levels of self-efficacy. In contrast, 'disengaged' students placed a lower value on mathematics learning and rated performance over understanding. Such students exhibited lower self-efficacy and negative emotions such as mathematics anxiety.

Studies report that mathematics anxiety is increased as students transition to post-primary school, but it stabilises or drops to initial levels towards the end of the first year of transition (Madjar et al., 2018). Other studies have reported on gender differences in mathematics anxiety, with girls experiencing higher mathematics anxiety and lower self-efficacy than boys (Deieso & Fraser, 2019; Klee & Miller, 2019; Madjar et al., 2018). It is a matter of international concern that mathematics anxiety not only influences the school transitional phase, but it can have long lasting consequences. Field et al. (2019) report that pre-transition levels of anxiety and changes during transition are significant predictors of mathematics anxiety at age 18. Additionally, they reported that mathematics attainment (prior to transition and its trajectories across the transition) also predict later mathematics anxiety. However, the effect size was small which suggests the influence of other contextual factors.

School Related and Academic Factors

Studies examining school related factors mainly focussed on the influence of the learning environment and its implications on students' mathematics learning. Findings from these studies suggest that the aspects such as perceived teacher support, teacher enthusiasm, student perceived autonomy and perceived performance are significantly related with post-primary students' mathematics learning (Deieso & Fraser, 2019; Evans & Field, 2020a; Fryer & Oga-Baldwin, 2019; Lazarides et al., 2018). These studies highlighted that declined levels of interest in mathematics and perceived support from teachers negatively impacted on students' enjoyment and involvement in mathematics learning in post-primary school.

Students' perceptions of the instructional practices used in mathematics classrooms also influence their mathematics learning and achievement. In a study of 4926 primary and post-primary students, Arens & Moller (2016) explored the relationship between achievement in mathematics and language and two aspects of classroom environment – perceived instructional quality and student-teacher relationships. They reported that student-perceived instructional quality was more strongly (positively) associated with mathematics achievement as compared to the perceptions of student-teacher relationships. Evans & Field (2020a) found a negative association between student-reported school belonging and their mathematical attainment suggesting high-achieving students' dissatisfaction with the school climate.

Several studies have focussed on investigating the relationship between teachers' knowledge base and the instructional and pedagogical practices used in mathematics classrooms. Studies have reported curricular and pedagogical inconsistencies between primary and post-primary school mathematics. Prendergast et al. (2019) report that Irish teachers at both primary and post-primary level identified issues such as lack of knowledge of each other's curriculum and lack of communication between teachers at both levels as important factors influencing mathematics transitions. A study of 100 teachers by Demonty et al. (2018) also noted significant gaps in primary and post-primary teachers' content knowledge for teaching algebra. A mismatch of pedagogical practices in primary and post-primary mathematics classrooms has also been reported. O'Meara et al. (2020) found a more frequent use of manipulatives in primary classrooms than in the post-primary classrooms. There were also significant differences between primary and post-primary teachers' confidence in the use of manipulatives, and this was related to the different levels of support provided to teachers.

Social Factors

Social factors that influence students' experiences of mathematics transitions are less reported. Parental influence and student-teacher relationships are the most identified of these factors. Studies suggest that parental factors and home environment are strong predictors of mathematics achievement across transition (Evans & Field, 2020b; Evans et al., 2020). Using a secondary analysis of data from a national longitudinal study in the UK, Evans & Field (2020b) found that positive relationships with parents, level of parents' education and their school involvement play an influential role in mathematics attainment of 11-year-olds. The level of parental education was reported to be the strongest predictor of students' mathematical attainment trajectories from primary to post-primary school.

Another influential construct in students' experiences of mathematics transition is student-teacher relationships. The quality of these relationships have been found to have a direct influence on students' mathematics achievement and levels of mathematics anxiety (Semeraro et al., 2020). Positive relationships with teachers are also important in the development of students' socio-emotional skills and can lead to increased mathematics attainment and positive attitudes for mathematics learning (Evans & Field, 2020a; Semeraro et al., 2020). Students' relationship with peers can also influence their experiences. However,

only one study that focussed on this aspect was found in this review and the authors reported a decline in peer relationships as students transition to post-primary school (Yao et al., 2018).

Conclusions and Implications

This review identifies three key factors that influence students' experiences in mathematics transition from primary to post-primary school - *student self-regulation factors*, *school and academic related factors* and *social factors*. Findings suggest that students' experiences of mathematics transition cannot be attributed to any single factor as various contextual factors may combine to shape these experiences. The trajectories of mathematics attainment of students as they transition to post-primary school have been reported to be impacted by a variety of factors such as mathematics attitudes, school affect, teacher characteristics and working memory (Evans et al., 2020a, 2020b). A significant impact of these combined factors is a shift in students' attitudes and motivation in mathematics which results in decline in academic achievement. More than half of the studies presented evidence of a decrease in student motivation and engagement and an increase in mathematics anxiety among post-primary school students. Long lasting impacts of the levels of mathematics attainment and anxiety from this transition have also been reported (Field et al., 2019).

Studies focussing on *student related factors* report mostly on the influence of negative student experiences. Negative experiences act as barriers to student learning and result in disinterest, disengagement and negative attitudes towards mathematics. Addressing these negative factors requires a greater focus on the continuity between the primary and post-primary mathematics curricula, improved coherence in teaching and learning approaches at both levels and enabling meaningful student engagement in mathematics through rich learning tasks. *School related factors*, such as communication and collaboration between teachers, curricular and pedagogical inconsistencies have significant influence on transitions in mathematics. Further research is needed to examine the impact of greater continuity between pedagogical approaches used in primary and post-primary mathematics. Establishing and supporting professional learning communities that bring together primary and post-primary mathematics teachers could lead to increased collaboration and communication between teachers and enable sharing of instructional and pedagogical practices in mathematics. Finally, interventions that focus on addressing *social factors* such as peer relationships, parental influences and student-teacher relationships are needed. These may include measures such as increased parental involvement in mathematical activities and measures that provide greater emotional support to students. Promoting student and teacher engagement in reflective practices may also help to develop positive mathematical identities.

This scoping review is the first part of a systematic review to identify what factors influence students' experiences of mathematics transitions. It will also examine successful interventions for supporting student learning, and provide evidence-based recommendations for the mathematics classroom and mathematics teacher education.

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