The contribution of attitudes toward school science in explanation of achievement in STEM school subjects

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Introduction

Background

Learning in the field of science, Technology, Engineering, and Mathematics (STEM) is promoted in educational policies of numerous countries. The achievement of students in Croatia in science and mathematics is low in comparison to other school subjects (Burušić, Babarović, Šakić, 2008), as well as in international studies (e.g., PISA). The debates about what determines achievement in STEM school subjects in primary school still persist. Several STEM-relevant variables show a significant association with achievement in science and mathematics, including student level variables, school level variables and variables of child’s broader social environment (Hattie, 2009).

A Transactional Framework of the Teaching/Learning Process

Context

All those factors outside of the classroom that might influence teaching and learning

Input

Those qualities or characteristics of teachers and students that they bring with them to the classroom experience

Classroom Processes

Teacher and student behaviours in the classroom as well as some other variables such as classroom climate and teacher/student relationships

Output

Measures of student learning taken apart from the normal instructional process.

The input variables

STUDENTS’ GENDER

- a small gender differences in school achievement are found in mathematics (Frost, Hyde, & Fennema, 1994; Hyde, Fennema, & Lamon, 1990) and in science (Murphy & Whitelegg, 2006), with girls outperforming boys.
- Girls’ and boys’ also differ in their motivational orientation to STEM subjects, with girls preferring biological sciences and chemistry, whereas boys are more motivated in physical sciences (e.g. Weinburgh, 1995) and in computer-related tasks (e.g. Hayward et al., 2003).

THE CONTEXT VARIABLES

FAMILY BACKGROUND

- research has shown that socioeconomic status (including parental education, employment status and income) is the best predictor of school achievement (Fuller & Mady, 2008; Sirin, 2005; Dahl & Lochner, 2005; Milne & Plourde, 2006).

PARENT’S BEHAVIOR

- parents’ involvement in their children’s schooling is a powerful predictor of academic success (Gutman & Midgley, 2000; Fan & Chen, 2001).

INFORMAL, OUT-OF-SCHOOL ACTIVITIES

- involvement in STEM out-of-school activities have considerable impact on STEM educational outcomes (Braund & Reiss, 2004).

The aim of the study

- To explain how school achievement in STEM school subjects is shaped by structurally different spheres of influence: student’s gender, characteristics of home environment and family influences, hobbies, and school activities.
- Taking into account the importance of gender, variation of school context and the family influences, in this research, we are looking for evidence that achievement can also be significantly improved by positive experience in formal school contexts.
- More specific aim: To identify the contribution of students’ attitudes to school science and experiences with STEM school subjects in explaining STEM school achievement, after controlling individual level effects, family influences, and experience in out-of-school activities.

Methodology
Respondents
- 880 primary school students attending grades 6 to 8 (age 12 to 15; M=13.32)
- 195 boys and 165 girls
- Convenient sample, three schools in one municipality (Duarvar area), 31 classes

Assessment
- Paper and pencil method was used
- Group assessment, in the classes during the regular school activities
- Data collection lasted 60 minutes

Measures
- Items used in the survey are mainly derived and adapted from the AMMOS project (Vicher, et al., 2013; Dawis, et al., 2013).
- Structural validity of all the used scales was checked and items that did not resemble expected and interpretation structure were removed to obtain clear factor structure with acceptable reliability.
- Output measure: STEM school achievement is measured as a composite of school marks (GPA) in different STEM school subjects in the previous grade.

Statistical analysis
- Hierarchical regression analysis was used to predict achievement in STEM school subjects.
- The first block of predictors: student's gender, parental education status, parental ambitions/support, parental attitudes to science, positive and negative images of scientists, and interest for science out of school.
- The second block: measures - predictors
- Measures - predictors
  - Measures: Attitudes toward school science, Interest for science out of school, Negative images of scientists, Parental attitudes to science, Parental ambitions/support, Parental education status, Student's gender
  - Predictors: Parental education status (four points scale) Average of mother and father education level, Output measure: STEM school achievement is measured as a composite of school marks (GPA) in different STEM school subjects in the previous grade.

Results
- Table 1: Descriptives
  - Variance: 5.9.2016.

Discussion
- Boys are slightly better than girls in STEM school achievement
- The STEM achievement is related to parental education, parental ambitions and support
- It is less related to out of school STEM activities, and perception of scientists attitude toward science is important predictor of STEM school achievement
- Attitude toward science as "Chanism process variable" has significant properties of STEM school level and context variables in explaining STEM school achievement.
Conclusions

- Findings stress importance of quality of teacher and student behaviour in the classroom, classroom climate and teacher/student relationships in STEM classes for enhancing STEM achievement.
- Students' STEM achievement is largely STEM teachers' responsibility.

Limitations

- Small and convenient sample
- Cross-sectional approach
- Pilot study
- Adaptation of the instruments
- Only student's level data were assessed
- JOBSTEM project
- Successful exploration of primary school students' and teachers' views on STEM education

References


Thank you for your attention!

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