The Interplay between Teachers' Beliefs and Self-Efficacy in Mathematics Teaching in Primary Schools

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OVERVIEW

Teacher beliefs have been a pivotal topic in mathematics education for over 30 years, significantly affecting students' learning opportunities and outcomes (Aljaberi & Gheith, 2018; Zee & Koomen, 2016).

This study investigates primary mathematics teachers' beliefs about the nature of mathematics, the learning of mathematics, and their self-efficacy in teaching mathematics.

Theoretical Framework

Beliefs about the Nature of Mathematics: Rule-based (static) perspective vs. Inquiry-based (dynamic) perspective (Grigutsch et al., 1998).

Beliefs about Learning Mathematics: Teacher direction (transmissive) vs. Active learning (constructivist) (Barkatsas & Malone, 2005).

Self-Efficacy Beliefs: Confidence in cognitive activation, motivating students, and goal setting (Bandura, 1997).

AIM

To explore different types of in-service primary teachers' beliefs related to teaching and learning mathematics.

RESEARCH QUESTION

What is the relationship between teachers' beliefs about the nature of mathematics, their beliefs about how students learn mathematics, their self-efficacy beliefs in teaching mathematics, teacher type (primary school teacher or subject teacher), and teaching experience?

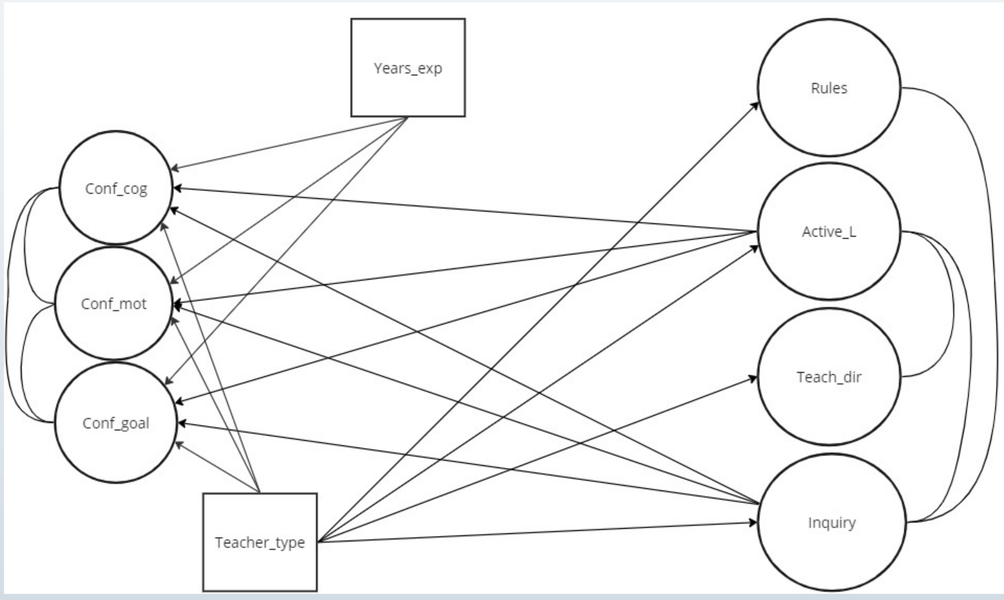

Fig. 1 Hypothesized Model

Note: Years_exp – Years of experience in teaching mathematics; Conf_cog – self-efficacy beliefs in mathematics related to cognitive activation; Conf_mot – self-efficacy beliefs in mathematics related to motivate students; Conf_goal– self- efficacy beliefs in mathematics related to goal settings; Active_L – belief on the learning of mathematics through active learning; Teach_dir – belief on the learning of mathematics through teacher directed instruction; Rules - beliefs on the nature of mathematics from a rules perspective; Inquiry – beliefs on the nature of mathematics from a inquiry perspective; Teacher_type – primary school teacher/subject teacher

METHODS

Sample:

- 127 mathematics teachers fromn 9 schools in Estonia.
- Age range: 23-75 years (M = 48.8, SD = 12.7).
- 70 primary school teachers, 57 subject teachers.

Data Collection:

- Surveys on teaching experience, educational background, and beliefs.
- Likert-scale items measuring beliefs about the nature of mathematics, learning of mathematics, and self-efficacy.

Measures:

Beliefs about the Nature of Mathematics:

- Subscales: Rules and Procedures (RULES), Process of Inquiry (INQUIRY)
- Fit Indices:

RULES: $\chi^2(8) = 9.171$, $\chi^2/df = 1.146$, CFI = 0.998, TLI = 0.996, RMSEA = 0.034, SRMR = 0.032

INQUIRY: $\chi^2(3) = 145.524$, $\chi^2/df = 48.508$, CFI = 1.000, TLI = 1.000, RMSEA = 0.000, SRMR = 0.000

Beliefs about the Learning of Mathematics:

- Subscales: Teacher Direction (TEACH_DIR), Active Learning (ACTIVE_L)
- Fit Indices:

TEACH_DIR: $\chi^2(2) = 2.814$, $\chi^2/df = 1.407$, CFI = 0.999, TLI = 0.996, RMSEA = 0.040, SRMR = 0.020

ACTIVE_L: $\chi^2(1) = 2.968$, $\chi^2/df = 2.968$, CFI = 0.999, TLI = 0.996, RMSEA = 0.088, SRMR = 0.017

Self-Efficacy in Teaching Mathematics:

- Subscales: Cognitive Activation (CONF_COG), Motivation (CONF_MOT), Goal Setting (CONF_GOAL)
- Fit Indices:

CONF_COG: $\chi^2(2) = 2.076$, $\chi^2/df = 1.038$, CFI = 1.000, TLI = 1.000, RMSEA = 0.017, SRMR = 0.013

CONF_MOT: $\chi^2(8) = 8.463$, $\chi^2/df = 1.058$, CFI = 0.999, TLI = 0.999, RMSEA = 0.021, SRMR = 0.029

CONF_GOAL: $\chi^2(5) = 12.519$, $\chi^2/df = 2.504$, CFI = 0.986, TLI = 0.973, SRMR = 0.048

Analysis:

- Confirmatory Factor Analysis (CFA). Structural Equation Modeling (SEM).
- Model fit criteria: RMSEA ≤ .05 for close fit, 0.05 – 0.08 for reasonable fit, CFI ≥ .95, TLI ≥ .95, normed chi-square index below 3 (Kline, 2016; Ullman, 2001)

RESULTS

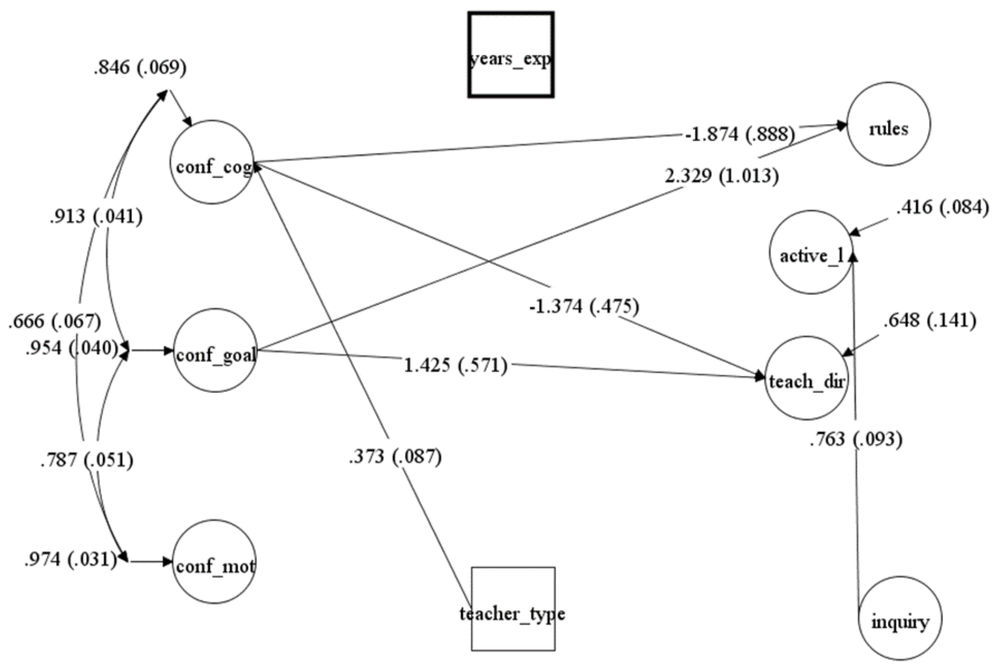

Fig. 2 SEM Model Note: Years_exp – Years of experience in teaching mathematics; Conf_cog – self-efficacy beliefs in mathematics related to cognitive activation; Conf_mot – self-efficacy beliefs in mathematics related to motivate students; Conf_goal– self- efficacy beliefs in mathematics related to goal settings; Active_L – belief on the learning of mathematics through active learning; Teach_dir – belief on the learning of mathematics through teacher directed instruction; Rules - beliefs on the nature of mathematics from a rules perspective; Inquiry – beliefs on the nature of mathematics from a inquiry perspective; Teacher_type - primary school teacher/subject teacher

Positive Relationships:

- Significant positive relationships among self-efficacy beliefs related to goal setting, motivating students, and cognitive activation.
- Positive associations between rule-based and teacher-directed instruction and self-efficacy in goal setting.

Negative Relationships:

- Significant negative relationships between rule-based approaches and cognitive activation beliefs.
- Negative correlations between teacher-directed learning and cognitive activation beliefs.

No Significant Relationships:

- No significant relationships between teaching experience and self-efficacy beliefs.
- Significant differences between primary school teachers and subject teachers in cognitive activation beliefs.

DISCUSSION

Implications:

- Teachers who emphasize structured approaches may feel less confident in fostering higher-order thinking.
- Professional development should balance structured and flexible teaching methods.
- Specific training for subject teachers to enhance self-efficacy in cognitive activities is needed.

Curriculum:

- The emphasis on rule-based and teacher-directed approaches in the curriculum might need re-evaluation to support inquiry-based learning.

Teacher Training:

- Universities and teacher training institutions should incorporate these findings into training programs to enhance both rule-based and inquiry-based teaching strategies.

CONCLUSION

Understanding the interplay of teachers' beliefs and self-efficacy can inform the development of more effective teacher training programs and instructional strategies, ultimately enhancing both teacher confidence and student achievement.

LIMITATIONS AND FUTURE RESEARCH:

- Sample Size: Limited to 127 teachers from a fraction of Estonian schools. Future studies should include larger and more diverse samples.
- Cross-Sectional Design: Captures only a snapshot in time. Longitudinal studies needed to examine changes over time.
- Self-Reported Data: Potential biases from self-report surveys. Future research should incorporate observational and performance-based measures.

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