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REGULAR ARTICLE

The Role of Belief Sources in Promoting Goal Orientation Beliefs, Self-Efficacy, and Beliefs About the Role of Teachers in Mathematics Learning

Achmad Hidayatullah[1,3] · **Csaba Csíkos**[2] · **Radius Setiyawan**[3]

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Abstract Goal orientation beliefs, self-efficacy, and beliefs about the role of the teacher in mathematics learning have been known as important factors in promoting students' success in mathematics. Beliefs can be shaped through four principles: mastery experience, vicarious experience, social persuasion, and physiological state. This study examined the structural relationship between belief sources, goal orientation beliefs, self-efficacy, and beliefs about the role of mathematics teachers. Seventeen classes were selected randomly within 35 classes from fifth and sixth grade, four private schools in Surabaya, Indonesia. Five hundred-five students participated in the present study. Partial Least Square structural equation modeling was performed to analyze the data. The result showed that mastery experience and vicarious experience positively predicted students' goal orientation beliefs, self-efficacy, and beliefs about the role of the teachers. Social persuasion significantly influenced self-efficacy and beliefs about the role of mathematics teachers but not goal orientation beliefs. Among the belief sources, social persuasion is the strongest predictor for self-efficacy. Vicarious experience is the most powerful predicator for goal orientation beliefs and beliefs about the role of mathematics teachers. Meanwhile, the physiological state only negatively predicted goal orientation beliefs. The contribution of the findings of our study for mathematical teaching practices in Surabaya-Indonesia was discussed.

Keywords Goal orientation beliefs · Belief sources · Self-efficacy · Beliefs about the teacher

Introduction

In the history of mathematics education research, mathematical beliefs have been considered a critical factor in determining students' academic performance. Goal orientation beliefs, self-efficacy, and beliefs about the role of mathematics educator (De Corte, 2015; Op 't Eynde et al., 2006) were among the beliefs system in mathematics learning that has been known to influence mathematics performance (Csikos, 2011; Hidayatullah & Csíkos, 2023a; Wang et al., 2019). Goal orientation beliefs refer to students' motivational beliefs, intrinsically or extrinsically, to participate in particular activities (Lynch & Trujillo, 2011; Pintrich, 2015). Self-efficacy is people's judgment about their capability to organize and execute courses of action to produce a given attainment (Bandura, 1997). Beliefs about the role of the teacher refer to students' perception of the teacher's support in the mathematical class context (De Corte, 2015; Op 't Eynde et al., 2006). In the literature review, there was evidence showing mathematics performance was determined by goal orientation beliefs (Miller et al., 2021), self-efficacy (Öztürk et al., 2020), and beliefs about the role of the teacher (Gilbert et al., 2014). Accordingly, mathematics teachers need to assist students in developing goal orientation beliefs, self-efficacy, and beliefs about the role of their teachers.

✉ Achmad Hidayatullah
achmad.hidayatullah@edu.u-szeged.hu;
achmadhidayatullah@um-surabaya.ac.id

Csaba Csíkos
csikoscs@edpsy.u-szeged.hu

Radius Setiyawan
radius@um-surabaya.ac.id

1 Doctoral School of Education, University of Szeged, 32-34. Petőfi Sgt, Szeged 6722, Hungary

2 Institute of Education, University of Szeged, 32-34. Petőfi Sgt, Szeged 6722, Hungary

3 Universitas Muhammadiyah Surabaya, Jl. Sutorejo, 59, Surabaya, Indonesia

According to social cognitive theory (Bandura, 1997), self-efficacy grows under four principles: mastery experience, vicarious experience, social persuasion, and physiological state. Prior studies have provided evidence showing these belief sources' role in shaping students' beliefs. Arslan (2012) pointed out that mastery experience and social persuasion were stronger factors in explaining self-beliefs. In comparison, vicarious experience and physiological state also significantly predicted self-beliefs but at a lower level than other sources. At the same, research has shown that these belief sources also predict goal orientation beliefs (Ford et al., 2023; Howardson & Behrend, 2015) and beliefs about the role of the teachers (Özcan & Kültür, 2021; Pajares et al., 2007). The more students have good experience in mathematics learning, the stronger their beliefs about their ability and beliefs to participate in mathematics learning. Moreover, when students observe the way their teacher teaches and solves a mathematical task in class, it may have an impact on students' perception by means of how their teacher actually fulfils the role of a math teacher (Özcan & Kültür, 2021; Pajares et al., 2007). However, relevant studies adopting the predicting role of belief sources simultaneously in goal orientation beliefs, self-efficacy, and beliefs about the role of mathematics teachers, especially for primary education in the Indonesian context, are still scarce. Hence, the purpose of this study is to detect the effect of belief sources on students' goal orientation beliefs, self-efficacy, and beliefs about the role of the teacher in mathematics learning.

Theoretical Framework

The Source of Self-Efficacy in Mathematics

The principles of personal beliefs were first articulated by Bandura, which stated that four factors shaped individuals' beliefs: mastery experience, vicarious experience, social persuasion, and physiological state (De Vries et al., 1988; Usher & Pajares, 2009; Wray et al., 2022). Mastery experience refers to the student's success or failure in the previous attainment (Chereau & Meschi, 2022; De Vries et al., 1988; Usher & Pajares, 2009). For instance, when students succeed in finding several ways to solve mathematics problems and have a positive experience in mathematics, it increases their beliefs about mathematics. This source has been known as the most powerful aspect influencing personal beliefs (Ford et al., 2023; Pajares et al., 2007). Vicarious experiences related to social observation may contribute to students' judgment about their confidence (El-Abd & Chaaban, 2021; Hampel et al., 2023; Özcan & Kültür, 2021). Students have vicarious experiences through observation and social comparison (Özcan & Kültür, 2021). Lau et al. (2018) argued that students' self-efficacy becomes higher when they learn through observation and comparison of their abilities and their classmates' or adults' abilities.

Social persuasion is the persuasion from other people, which implies students' self-efficacy (De Vries et al., 1988; El-Abd & Chaaban, 2021). Students who are persuaded verbally become more motivated to do certain activities (De Vries et al., 1988). Students with negative persuasion from others would run a greater risk of reduced self-efficacy. In comparison, the physiological state refers to the individual troubled situation, which also influences individual beliefs (Ford et al., 2023; Howardson & Behrend, 2015). De Vries et al. (1988) stated that people tend to expect less success if they have much trouble. Nevertheless, the extent to which these belief sources for mathematics learning in the Indonesian context received little attention. Therefore, these belief sources in mathematics for primary education in the Indonesian context were discussed.

Goal Orientation Beliefs, Self-Efficacy, and Beliefs About the Teacher

Op't Eynde and De Corte (2003) proposed that beliefs in mathematics learning consisted of beliefs about mathematics education, beliefs about themselves as mathematics learners, and mathematics in the social context. Beliefs about mathematics education refer to the conceptions or epistemological beliefs in math, such as subtraction, fractions, and the flexibility of math (Yin et al., 2020). Beliefs about the self as a mathematics learner contained self-efficacy, goal orientation beliefs, task values, etc. (De Corte, 2015). Beliefs about social context relate to students' beliefs in mathematics classrooms, such as beliefs about the role of the teachers.

Op't Eynde and De Corte (2003) differentiated goal orientation beliefs into intrinsic and extrinsic goal orientation beliefs. Intrinsic goal orientation beliefs refer to the student's perception of the degree to which they can participate in a particular activity (Józsa & Molnár, 2013; Pintrich, 2015). Extrinsic goal orientation beliefs relate to students' motivation to participate in a particular activity because of certain factors, such as rewards or evaluation by others (Józsa & Molnár, 2013; Pintrich, 2015). Self-efficacy is students' judgment about their capability in mathematics learning and problem-solving (Bandura, 1997; Li et al., 2020; Pitsia et al., 2017). Beliefs about the teachers relate to students' perception of their mathematics teacher's role and function during mathematical class, such as how well mathematics teacher understand students' problem and their difficulties (De Corte, 2015). There were several empirical studies that elaborated on the extent to which students' mathematical beliefs in the Indonesian context. For instance, a study by Hidayatullah and Csíkos (2022) pointed out that students in secondary schools in Indonesia hold strong beliefs about the role of mathematics educators. Although the

study by Hidayatullah and Csíkos (2023b) found that there was a significant relationship between students' beliefs in mathematics and achievements in primary education, the researchers did not explain explicitly the level of goal orientation beliefs and beliefs about the role of the teachers in mathematics. It is rare to come across explicit explanations that address the extent of students' goal orientation beliefs, self-efficacy beliefs, and beliefs about the role of mathematics teachers, particularly in the context of primary education in Indonesia. Thus, in the present study, goal orientation beliefs, self-efficacy beliefs, and beliefs about the role of mathematics teachers were explored.

The Role of Beliefs Sources in Mathematical Beliefs

The social cognitive theory proposes that much human learning and behavior occurs in the social environment (Schunk & Usher, 2019). Through interaction with other people, students gain information and build knowledge, skills, strategies, beliefs, and attitudes (Schunk & Usher, 2019). There has been empirical evidence showing the role of belief sources in goal orientation beliefs and self-efficacy beliefs. Howardson and Behrend (2015) showed that mastery experience, vicarious experience, and social persuasion have a positive relation with goal orientation beliefs. For example, when students mastery their experience, observe others solve mathematics problems, and received verbal persuasion, their motivation in mathematics increased. At the same time, a physiological state in this study has been found to reduce the goal orientation level. This finding was consistent with Usher and Pajares (2009), who found that among four of the beliefs, sources were positively related to goal orientation beliefs, except physiological state, which was negatively associated with goal orientation beliefs. Lau et al. (2018) suggested that the source of self-efficacy can predict math self-efficacy and perceived responsibility in academic performance. Similarly, Arslan (2012) found that mastery and vicarious experiences predict self-efficacy beliefs, while social persuasion and physiological state predict self-beliefs, although to a lesser extent. Since there was inconsistency in the empirical evidence of the contributions of physiological states on goal orientation beliefs and self-efficacy beliefs, the relationship among these variables needs to be clarified. In line with the tenet of the beliefs sources theory, we assumed that psychological states would negatively predict goal orientation beliefs and self-efficacy beliefs. In comparison, we hypothesize that mastery experience, vicarious experience, and social persuasion positively predict goal orientation beliefs and self-efficacy beliefs.

Furthermore, there is a chance that the students' beliefs sources can also predict their beliefs about the role of math teachers. According to social cognitive theory (Bandura, 2002), beliefs, attitudes, motivation, and behavior are influenced by environment and social interactions. As we have previously discussed, beliefs about the role of mathematics teacher is related to how students perceive their teacher's care and understanding towards them (De Corte, 2015). Therefore, a student's beliefs about their math teacher's role are formed by their environment and social interactions. For example, if a math teacher verbally encourages their students, it can not only enhance their self-efficacy but also strengthen their perception of their teacher's care for them. Additionally, a student's negative emotional responses during math learning can also impact their beliefs (Loo & Choy, 2013; Özcan & Kültür, 2021) and their beliefs about their teacher's role. However, there is limited empirical evidence that directly links the two. Therefore, further empirical studies are necessary to confirm this hypothesis. Given the importance of belief sources in goal orientation beliefs, self-efficacy, and beliefs about the role of math teachers, more empirical evidence is needed to provide relevant insights and contribute to theory and practice.

Research Hypothesis

In keeping with the theoretical tenets of social cognitive theory and previous studies, this study aimed to examine the prediction of belief sources on goal orientation beliefs, self-efficacy, and beliefs about the role of mathematics teachers in primary education. Therefore, the hypotheses below guided our investigations:

1. Mastery experience positively predicted goal orientation beliefs, self-efficacy, and beliefs about the role of mathematics teachers.
2. Vicarious experience positively predicted goal orientation beliefs, self-efficacy, and beliefs about the role of mathematics teachers.
3. Social persuasion positively predicted goal orientation beliefs, self-efficacy, and beliefs about the role of mathematics teachers.
4. The physiological state negatively predicted goal orientation beliefs, self-efficacy, and beliefs about the role of mathematics teachers.

Methods

Participants

This cross-sectional study took place in the December of 2022 in Surabaya-Indonesia. Seventeen classes were selected randomly among 35 classes from fifth to sixth grades of four private schools. Within each grade in the school, 2–3 classes were randomly selected. Five hundred-five students

participated in the present study. They were 52.5% fifth-grade and 47.5% sixth grade students. The data were collected using paper–pencil tests. The data collection took place for two weeks. Private schools are run by non-government organizations. In terms of mathematics achievements, many schools (public and private schools) adopted the minimum completeness criteria for mathematics 75 out of 100 (0–100). This criterion is part of the implementation of the Ministry of Education regulation number 41 of 2007 about educational assessment standards. Accordingly, there may be a possibility students obtained good grades in mathematics schools (lowest = 75 and highest = 100) based on their school report cards.

Instruments

During the data collection process, participants were asked to complete two questionnaires: the source of the self-efficacy questionnaire and the beliefs about mathematics education questionnaire. In this study, students were also asked to complete the questions about their profile, like their gender, age, and grade. Each instrument was rated with 5-point Likert scale (1 = strongly disagree, 2 = disagree, 3 = neutral, 4 = agree, 5 = strongly agree).

The Source of Self-Efficacy

This study investigated the source of students' beliefs in mathematics. Eighteen items were adapted from the source of the self-efficacy mathematics questionnaire (Usher & Pajares, 2009). This questionnaire consisted of four dimensions. Four items were used to measure *Mastery Experience* ($\alpha = 0.88$). For example: "I got a good grade in mathematics "and "I do well in mathematics learning." *Vicarious Experience* ($\alpha = 0.84$) entailed six items. For instance: "Seeing other students do better than me in math pushes me to do better" and "When I see math teacher solve math problems, encourage me to do the same ways." *Social persuasion* ($\alpha = 0.88$) consisted of three items, for example: "My teacher told me that I am good at math" and "My parents told me that I am good at math." The *Physiological state* ($\alpha = 0.88$) contained five items, such as "Doing math work takes all of my energy" and "My mind goes blank when doing math work."

Beliefs in Mathematics Learning

Eleven items were selected from the mathematics-related beliefs systems questionnaire (MRBQ]; Op't Eynde & De Corte, 2003) to measure goal orientation beliefs, self-efficacy, and beliefs about the role of mathematics teachers. As discussed above, *extrinsic goal orientation beliefs* relate to students' motivation to participate in a particular activity because of certain factors, such as rewards and evaluation by others. In this study, we used two items to measure these beliefs, such as "I want to show to the teacher I am good at math." *Intrinsic goal orientation beliefs* refer to the student's perception of the degree to which they can participate in a particular activity. Two items were selected to measure these beliefs, such as "When I have the opportunity, I choose mathematical assignments that I can learn." *Self-efficacy* consists of four items. For example, "I like doing mathematics" and "I am confident that I will get a good grade for mathematics." *Beliefs about the role of mathematic teachers* consisted of three items such as "My teacher showed me a step-by-step explanation" and "My teacher understands my problems and difficulties."

Data Analysis

In the present study, there are two steps to analyzing our data. First, descriptive statistics and Pearson correlation were performed to describe students' responses, the source of self-efficacy, and mathematics education beliefs. In the second step, partial least square structural equation modeling was performed (PLS-SEM) to examine our hypotheses. During the PLS-SEM analysis, the measurement model should be evaluated. For the evaluation model, there are two steps. The first step is a reflective model evaluation, which involves internal reliability, convergent validity, and discriminant validity. The second step is a structural model evaluation involving the indicator weight's statistical significance and relevance (Kwong-Kay Wong, 2013; Ramayah et al., 2016).

Procedures

Our study used a quantitative approach, which involved several steps. The researcher translated the items of the questionnaire into the Indonesian language. Afterwards, two mathematics experts and two primary mathematics teachers reviewed this questionnaire before the questionnaire was administered to the students. The researchers have coordinated with the principals of the schools regarding permission. After the researchers gained approval from the schools, data were collected. The data collection process took place for two weeks in December of 2022. Mathematics teachers in each of the schools helped with the process of data collection.

Results

Preliminary Analysis

Table 1 describes the descriptive and the correlation among the dimensions of the source of self-efficacy and the dimensions of students' mathematical beliefs in education. Students hold strong beliefs about their capability ($M = 3.94$, $SD = 0.67$) and beliefs about the teacher ($M = 3.82$,

SD = 0.67). Students hold moderate goal orientation beliefs (*M* = 3.40, *SD* = 0.75). With respect to the belief sources, students expressed that they had abundant mastery experience (*M* = 3.91, *SD* = 0.75), high vicarious experience (*M* = 3.62, *SD* = 0.72), and received social persuasion (*M* = 3.71, *SD* = 0.71). Students also expressed they rarely had negative emotions (*M* = 2.84, *SD* = 0.91).

Concerning the correlation among latent variables, Table 1 data showed that all the belief sources, except the physiological state, positively correlate with goal orientation beliefs, self-efficacy beliefs, and beliefs about the role of mathematics teachers. Meanwhile, physiological state negatively correlates with goal orientation beliefs and self-efficacy beliefs, but it was insignificant to beliefs about the role of mathematics teachers.

Evaluation of the Measurements Model

Partial least square structural equation modeling (PLS-SEM) was used to analyze our data. A reflective measurement model was conducted by evaluating the indicator reliability, internal reliability, convergent validity, and discriminant validity (Hair et al., 2019). For indicator reliability, outer loading > 0.7 is suggested, and 0.4 or higher is acceptable (Kwong-Kay Wong, 2013). The outer loading value (see Table 2) ranges from 0.476–0.90, which is above the recommendation threshold of 0.4. Then, we evaluated the internal reliability of the model based on the Composite Reliability (CR). The value range between 0.6 and 0.7 is acceptable in exploratory research, and the value range between 0.7 and 0.9 is satisfactory good (Hair et al., 2019). The CR value (see Table 2) for each latent variable ranges between 0.618 and 0.943, which meet with the recommendation guideline.

Convergent validity was evaluated based on the value of Average Variance Extracted (AVE). Hair et al. (2019) suggested that the cut-off value for AVE should be AVE ≥ 0.50. The AVE result range between 0.506 and 0.672. Accordingly, our model fulfilled the criterion of convergent validity (see Table 2). In the last step, we evaluated the discriminant validity by performing the Heterotrait-Monotrait ratio (HTMT). According to Hair et al. (2019), when the constructs are conceptually more distinct, lower, and conservative, the threshold value is suggested, such as 0.85. Table 3 showed that all the coefficient value of HTMT was lower than 0.85. It means that all the constructs confirmed the discriminant validity requirements. Overall, the results of the reliability and validity tests conducted on the measurement models were satisfactory.

Evaluation of the Structural Equation Modeling

Figure 1 describes the result of the evaluation of the structural equation modeling. First, we evaluated the coefficient determination. The result showed that beliefs about the role of mathematics teachers were explained by the source of self-efficacy, 28.9% ($R^2 = 0.289$). All the source self-efficacy explained goal orientation beliefs at 37.5% ($R^2 = 0.375$) and self-efficacy at 45.2% ($R^2 = 0.452$). Another predictive accuracy was evaluated by calculating the value of Q^2. By calculating blindfolding, we obtained the Q^2 value. According to Hair et al. (2019), Q^2 value greater than 0, 0.25, and 0.5 depicts small, medium, and large predictive accuracy. The result indicated that the predictive accuracy of belief sources was medium on goal orientation beliefs ($Q^2 = 0.246$), medium on self-efficacy ($Q^2 = 0.228$), and small on beliefs about the role of mathematics teachers ($Q^2 = 0.147$).

In the second step, we evaluated the significance and relevance of the path coefficient from belief sources to the goal orientation beliefs, self-efficacy, and beliefs about the role of mathematics teachers. Mastery experience positively predicted goal orientation beliefs ($\beta = 0.257$, $p < .001$), beliefs about the role of mathematics teachers ($\beta = 0.225$, $p < .001$), and self-efficacy ($\beta = 0.208$, $p < .001$). Vicarious experience positively predicted goal orientation beliefs ($\beta = 0.319$, $p < .001$), beliefs about the role of mathematics teachers ($\beta = 0.227$, $p < .001$), and self-efficacy ($\beta = 0.273$, $p < .001$). Social persuasion predicted beliefs about the role of mathematics teachers ($\beta = 0.192$, $p < .001$) and

Table 1 Descriptive and correlation of variables

Variables	Mean	SD	ME	VE	SP	PS	OB	SE	BT
ME	3.91	0.75	–						
VE	3.62	0.72	.64**	–					
SP	3.71	0.71	.50**	.53**	–				
PS	2.84	0.91	− .20**	− .22**	.02	–			
OB	3.40	0.75	.53**	.55**	.37**	− .22**	–		
SE	3.94	0.66	.54**	.57**	.51**	− .16**	.60**	–	
BT	3.92	0.71	.46**	.47**	.40**	− .07	.58**	.55**	–

ME Mastery Experience, *VE* Vicarious Experience, *SP* Social Persuasion, *PS* Physiological State, *OB* goal orientation beliefs, *SE* Self-efficacy, *BT* Beliefs about the role of mathematics teachers

**significant at level .001 ($p < .001$), *significant at level .05 ($p < .05$)

Table 2 Measurement model

Constructs	Items	loadings	Alpha	CR	AVE
Mastery experience			0.788	0.793	0.613
	Me1	0.812			
	Me2	0.838			
	Me3	0.771			
	Me4	0.704			
Vicarious experience			0.802	0.809	0.506
	Ve1	0.756			
	Ve2	0.740			
	Ve3	0.790			
	Ve4	0.731			
	Ve5	0.626			
	Ve6	0.606			
Social persuasion			0.606	0.641	0.556
	Sp1	0.782			
	Sp2	0.822			
	Sp3	0.617			
Physiological state			0.806	0.943	0.513
	Ps1	0.476			
	Ps2	0.667			
	Ps3	0.611			
	Ps4	0.859			
	Ps5	0.901			
Goal orientation beliefs			0.836	0.841	0.672
	NM1	0.814			
	NM2	0.829			
	NM3	0.876			
	NM4	0.757			
Self-efficacy			0.704	0.731	0.530
	BS1	0.696			
	BS2	0.816			
	BS3	0.782			
	BS4	0.598			
Beliefs about the role of mathematics teachers			0.606	0.618	0.566
	BC1	0.801			
	BC2	0.814			
	BC4	0.627			

self-efficacy ($\beta = 0.294$, $p < .001$). At the same time, the prediction of social persuasion on goal orientation beliefs was insignificant ($\beta = 0.066$, $p = .303$). Physiological states negatively predicted goal orientation beliefs ($\beta = -0.132$, $p < .001$). In contrast, the prediction of this belief source on self-efficacy ($\beta = -0.070$, $p = .233$) and beliefs about the role of mathematics teachers ($\beta = 0.022$, $p = .391$) was not significant. Table 4 summarizes the result of structural equation modeling evaluations.

When we compare the path regression among the aforementioned variables, the prediction of belief sources on students' beliefs varied. For instance, we found vicarious experience was the strongest predictor for goal orientation beliefs and beliefs about the role of mathematics teachers. Also, we found that social persuasion was the strongest predictor for self-efficacy in mathematics.

Discussion

Our study's focus is to examine whether or not the fourth belief sources significantly predict students' beliefs in mathematics learning in the Indonesian context. Generally, the findings of this study revealed that the sources of the beliefs predicted goal orientation beliefs, self-efficacy, and students' beliefs about the function and the role of their mathematics educators. Our study told us that in Surabaya, students had abundant mastery experience, such as having a good score and success several times. Such a phenomenon occurs because many schools in Surabaya adopted the minimum completeness criteria for mathematics 75 out of 100. Most students observed other people, made a social comparison, and received social persuasion. Fewer of them had math problems, like nervousness or anxiety, during mathematics learning.

First, our finding supported the first hypothesis, which stated that the mastery experience positively predicted goal orientation beliefs, self-efficacy, and beliefs about the role of the teachers. This finding is in line with the prior research (Ford et al., 2023; Howardson & Behrend, 2015; Usher &

Table 3 Discriminant validity HTMT 0.85

	ME	VE	SP	PS	OB	SE
ME						
VE	0.812					
SP	0.726	0.767				
PS	0.257	0.286	0.175			
OB	0.647	0.674	0.525	0.268		
SE	0.725	0.757	0.797	0.230	0.785	
BT	0.577	0.587	0.653	0.323	0.713	0.788

ME Mastery Experience, *VE* Vicarious Experience, *SP* Social Persuasion, *PS* Physiological State, *OB* Goal orientation beliefs, *SE* Self-efficacy, *BT* Beliefs about the role of mathematics teacher

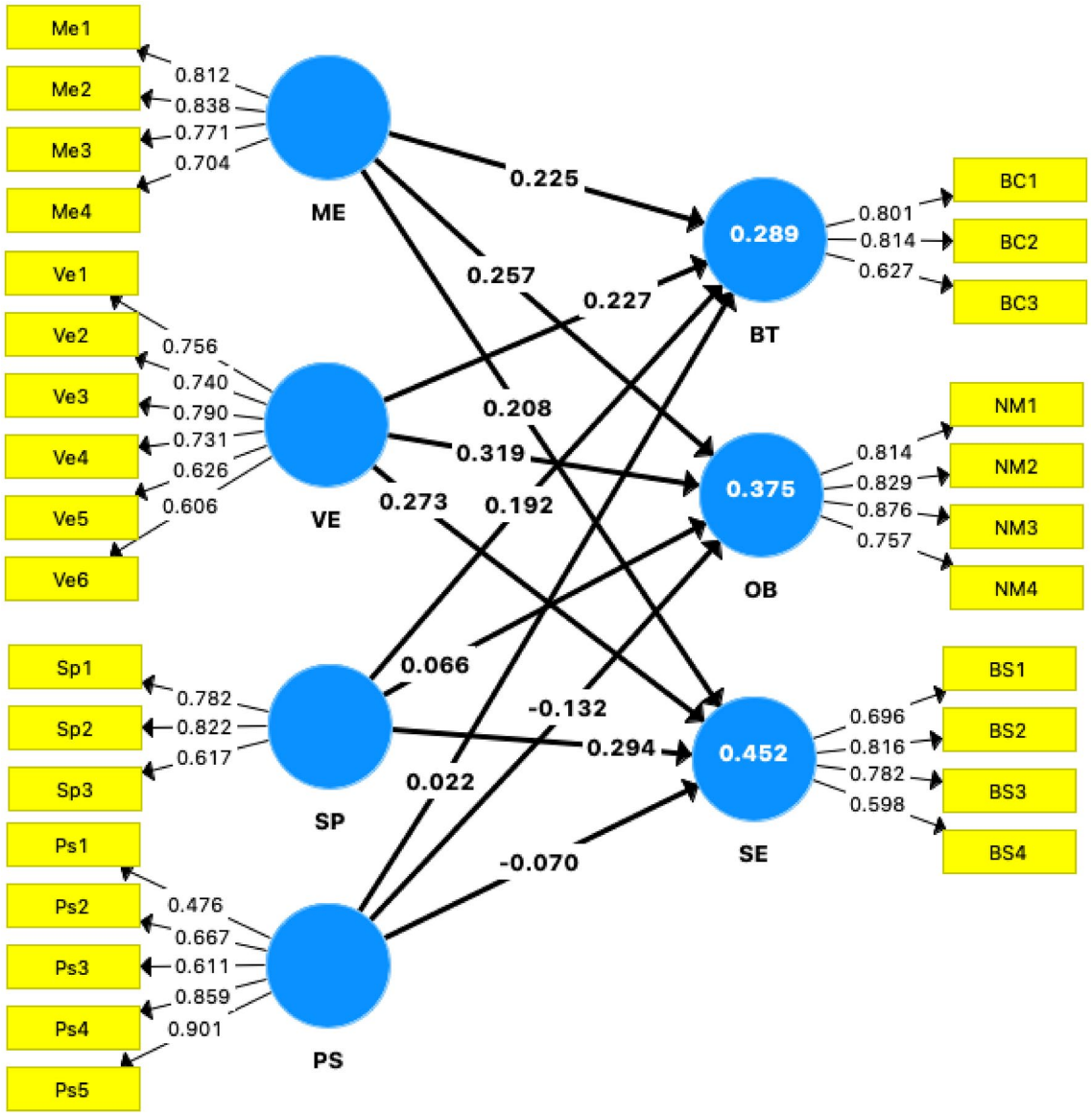

Fig. 1 The result of structural equation modeling evaluation. *ME* Mastery Experience, *VE* Vicarious Experience, *SP* Social Persuasion, *PS* Physiological State, *OB* Goal orientation beliefs, *SE* Self-efficacy, *BT* Beliefs about the role of mathematics teacher

Pajares, 2009), which suggested that belief sources predict self-efficacy beliefs and goal orientation beliefs. Accordingly, when students have abundant mastery experiences, such as positive experiences and repeated success in mathematics, it facilitates their self-efficacy and motivates them to participate in mathematics learning. Lastly, this study found that mastery experience predicted students' beliefs about the role of mathematics teachers. It can be interpreted that once the teacher teaches students well, such as explaining problem-solving step-by-step and comprehending the difficulties students have, it increases their beliefs about the role of their teacher.

Second, the finding of this study supported the second hypothesis, which holds that vicarious experience positively predicted goal orientation beliefs, self-efficacy, and beliefs about the role of mathematics teachers. This finding is in line with the prior research (Ford et al., 2023; Howardson & Behrend, 2015; Özcan & Kültür, 2021; Pajares et al., 2007), which reported that when students observed other people's success in math, it has been found to increase their judgment about self-ability, intrinsic-extrinsic goal orientation beliefs, and beliefs about the role of mathematics educator. Bandura (1997) argued that the fact observer is more motivated to attend to models who have status and credibility, such as their teacher. By observing other people like

Table 4 Hypothesis testing

Hypothesis path	Std Beta	t-value	*p*-value	Results
Mastery experience—> Beliefs about the role of mathematics teachers	0.225	3.408	.001	supported
Mastery experience—> Goal orientation beliefs	0.257	4.088	.000	supported
Mastery experience—> Self-efficacy	0.208	4.125	.000	supported
Vicarious experience—> Beliefs about the role of mathematics teachers	0.227	3.940	.000	supported
Vicarious experience—> Goal orientation beliefs	0.319	5.407	.000	supported
Vicarious experience—> Self-efficacy	0.273	5.182	.000	supported
Social persuasion—> Beliefs about the role of mathematics teachers	0.192	3.261	.001	supported
Social persuasion—> Goal orientation beliefs	0.066	1.031	.303	Not supported
Social persuasion—> Self-efficacy	0.294	5.403	.000	supported
Physiological state—> Beliefs about the role of mathematics teachers	0.022	0.858	.391	Not supported
Physiological state—> Goal orientation beliefs	− 0.132	2.740	.001	supported
Physiological state—> Self-efficacy	− 0.070	1.193	.233	Not supported

their mathematics teachers, students may learn some skills (Schunk & Usher, 2019) and, in turn, increase their motivation to participate actively, self-judgment capability and perception of the role of mathematics teachers. Our study yielded surprising results, differing from previous research (Loo & Choy, 2013; Pajares et al., 2007), which found mastery experience to be the most influential factor in predicting self-efficacy and achievements. Instead, our study showed that vicarious experience was the strongest predictor for goal orientation beliefs and beliefs about the role of mathematics teachers. This can be explained by the fact that observing others, such as classmates or math teachers, can provide concrete examples of how to solve math problems and improve one's goal orientation beliefs and beliefs about the role of their mathematics teachers. Therefore, among all sources, vicarious experience may have the greatest impact on predicting goal orientation beliefs and beliefs about the role of mathematics teachers.

Third, the findings of this study partially supported the third hypothesis. The findings of this study showed that social persuasion positively predicted self-efficacy and beliefs about the role of mathematics teachers. This finding revealed similar results with Özcan and Kültür (2021) and Usher and Pajares (2009), who suggested that when students obtained verbal persuasion from other people, like their parents and their mathematics teacher, their judgment about their ability in mathematics learning increased. Students feel valued when they receive social persuasion from others, such as their math teacher. This can lead to a positive perception of the teacher and increased confidence. However, social persuasion did not significantly predict students' goal orientation beliefs. This finding is in contrast with the findings by Ford et al. (2023) and Howardson and Behrend (2015), who found the prediction of these sources on students' achievement and certain beliefs. One possible explanation is that the persuasion from teachers or adults about students' capability may not be the single factor for the students' intrinsic-extrinsic goal orientation beliefs. Surprisingly, contrary to the previous studies (Loo & Choy, 2013; Pajares et al., 2007), our study showed that social persuasion was the strongest predictor of self-efficacy. It is possible that social persuasion has a stronger impact on students' self-judgment of their abilities than other sources. This is because receiving encouragement from influential figures, like math teachers, can directly boost their confidence. On the other hand, building self-efficacy through mastery experience may take more time.

Fourth, we discovered that physiological state has a negative correlation with goal orientation beliefs. Surprisingly, the predictions for self-efficacy and beliefs about the role of mathematics teachers were insignificant. This finding differs from Lau et al. (2018) and Özcan and Kültür (2021), who found a negative association with self-efficacy. One possible explanation for this is that self-efficacy is influenced by situational context (Schunk, 1995). Despite experiencing negative emotions like anxiety, students can still control their self-judgment about their ability in certain situations. Additionally, mastery experience, vicarious experience, and social persuasion are other variables that maintain self-efficacy and can help one to manage negative emotions.

To summarize, the finding of this study told us that mastery experience and vicarious experience positively predicted goal orientation beliefs, self-efficacy, and beliefs about the role of mathematics teachers. Social persuasion positively predicted beliefs about the role of mathematics teachers and self-efficacy but not for goal orientation beliefs. Meanwhile, the physiological state only negatively predicted goal orientation beliefs.

Limitations and Future Research

It was found that belief sources play significant roles in personal beliefs about mathematics, but there are limitations to this study that should be noted. Firstly, while the study showed that belief sources contribute to self-efficacy, goal orientation beliefs, and beliefs about the role of mathematics teachers, further investigation is needed to clarify these findings. Qualitative research would be helpful in strengthening these findings. Secondly, the study did not explore whether the belief sources have an impact on mathematics outcomes such as engagement, satisfaction, and achievements. Future research should examine the role of these belief sources in students' outcomes. Thirdly, the study directly predicted belief sources on students' beliefs without considering demographic factors. Therefore, it is important to consider personal factors such as socioeconomics, region, and type of schools in future research. Finally, the sample used in this study cannot represent the situation in Indonesia. Thus, future research needs to expand the representation of the sample in primary education.

Conclusion and Implication

The findings revealed that mastery experience and vicarious experience not only predicted self-efficacy but also beliefs about goal orientation and the role of teachers. On the other hand, social persuasion was found only to predict self-efficacy and physiological states were negatively significant for goal orientation beliefs. The study had both theoretical and practical implications. For the theoretical implications, these results enrich the literature on the importance of belief sources in students' mathematics beliefs, particularly for primary education in the Indonesian context. Additionally, this discovery can serve as literature for academic discussion on assessing the relevance of belief sources in self-efficacy. This is due to most of the previous studies confirming the influence of these sources on self-efficacy. On the other hand, this study revealed that belief sources can also predict goal orientation beliefs and beliefs regarding the role of mathematics teachers.

For practical contribution, teachers should focus on creating well-structured assignments and opportunities for their students to ensure students' mastery experience. Consistent success experiences will boost students' self-efficacy, goal orientation, and perceptions of their teachers' role. Teachers can facilitate learning experiences by demonstrating how to observe and compare oneself to others, teaching simple problem-solving strategies, and encouraging students to develop their own solutions. It's also beneficial for mathematics teachers to showcase inspirational role models to motivate their students. Although social persuasion may not significantly impact goal orientation beliefs, it is still essential for increasing self-efficacy and beliefs about the teacher's role. To prioritize verbal persuasion, mathematics educators should show appreciation and encouragement towards their students' hard work. Communicating with students' parents to persuade their kids verbally is also recommended. Although the physiological state did not predict self-efficacy and beliefs about the teacher, it significantly decreased goal orientation beliefs. Therefore, teachers should address negative emotions or anxiety in their students to prevent any decline in motivation to participate in mathematics learning. Educators should pay attention to students who feel anxious during mathematics learning, as this can negatively impact their goal orientation beliefs.

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Declarations

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