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Science And Mathematics Teachers' Self-Efficacy Beliefs in Enacting Learner-Centred Instructional Practices in Secondary Schools

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Abstract

Background/purpose. Since teachers' self-efficacy (TSE) beliefs influence the instructional practices used in the classroom, investigating TSE beliefs in using learner-centred instructional practices may inform research, policy, and practice. Therefore, this study aimed to validate a survey questionnaire to measure science and mathematics teachers' self-efficacy beliefs regarding the enactment of learner-centred instructional practices, and to examine TSE beliefs and the extent to which teacher characteristics may influence them.

Materials/methods. A quantitative survey design was employed to measure the TSE beliefs of science and mathematics teachers regarding the enactment of learner-centred instructional practices. An online seven-point questionnaire was distributed to teachers enrolled at three Zambian universities, and 257 respondents completed it.

Results. Data analysis using SPSS shows that the questionnaire was reliable ($\alpha = .944$). Additionally, teachers report high TSE beliefs in being able to apply learner-centred instructional practices. Furthermore, differences in TSE beliefs between in-service and pre-service teachers were statistically significant ($p < .001$). Nevertheless, the statistical differences based on gender, age, teaching experience, specialisation, and highest qualification were not significant. The implications of these findings were discussed.

Conclusion. The study concluded that the questionnaire was valid and that teachers reported high self-efficacy beliefs, and that pre-service and in-service teachers' beliefs were statistically significant. However, self-efficacy beliefs were not influenced by their gender, age, years of teaching experience, specialisation, and highest qualifications. The study recommends comparing teachers' self-efficacy beliefs with their actual classroom enactment of learner-centred instructional practices. Research may collect data from different stakeholders, such as school administrators, learners, and parents, regarding teachers' enactment of learner-centred instructional practices.

1. Introduction

Teacher self-efficacy (TSE) beliefs have been correlated with positive classroom behavior and high student academic performance (Bray-Clark & Bates, 2003; Skaalvik & Skaalvik, 2010). Bandura (1977) described self-efficacy as a belief in one's ability to undertake the actions needed to attain particular performance outcomes. Concerning teaching, TSE refers to a teacher's belief in their ability to effectively plan and implement activities necessary to achieve teaching aims, especially the facilitation of students' learning (Pikk et al., 2025; Skaalvik & Skaalvik, 2010; Tschannen-Moran & Hoy, 2001; Yildiz, 2022). A key tenet of teacher self-efficacy is that teachers often perform activities they perceive they can successfully perform and avoid those they perceive they may not be able to successfully perform (Olawale & Hendricks, 2024). This belief strongly influences teaching behavior, instructional practices, student outcomes, and overall educational effectiveness (Holzberger & Prestele, 2021). Sasson and Malkinson (2021) add that TSE beliefs affect their effectiveness and ability to influence students' academic performance. Thus, teachers who hold higher TSE beliefs are highly likely to implement instructional practices that foster deeper learning and adapt instruction when students struggle (Lacks & Watson, 2018; Scalise et al., 2025). Furthermore, TSE beliefs can influence the extent to which learners engage in lessons (Emiru & Gedefaw, 2024; Zee & Koomen, 2016). A literature review by Zee (2016) identified positive correlations between TSE and several variables, including students' academic adjustment, teacher behavior patterns, classroom practice quality, individual achievement, job fulfillment, and commitment.

Additionally, teachers' self-efficacy beliefs depend on their knowledge, particularly pedagogical knowledge, which informs the instructional practices they can draw on. Thus, it can be inferred that teachers use their pedagogical knowledge to select instructional practices they perceive as best suited for the concepts they aim to teach (Auerbach & Andrews, 2018; Waugh et al., 2025). Teachers' choice of instructional practices can greatly impact their practice and learning outcomes. These instructional practices can either be learner-centred (i.e., the learner is in charge of the learning process) or teacher-centred (i.e., the teacher is in charge of the teaching process) (Freeman et al., 2014). Learner-centred instructional practices encourage active learning and have been associated with increased academic performance (Armbruster et al., 2009; Freeman et al., 2014; Pikk et al., 2025). Teachers' choice of instructional practice will depend on their beliefs about succeeding when they use the chosen instructional practices. Therefore, TSE beliefs about classroom instruction have the potential to influence their practice and students' learning.

Instructional practices refer to the teaching methods, practices, or activities that teachers can use to deliver their lessons. A teacher may enact instructional practices when presenting a lesson, illustrating a skill, asking a question, and assessing learners. In the literature, instructional practices have been referred to by various terms, including pedagogical practices, instructor behavior, instructor practice, instructor quality, teaching-learning activities, learning environments, and teaching practices (Karamane et al., 2023; Mapulanga & Bwalya, 2024; Sasson & Malkinson, 2021; Wisniewski et al., 2020). These studies document a variety of instructional practices that teachers can/use such as assessing students' comprehension of the material, clearly explaining the objectives of the lesson, activating students' prior knowledge, providing experiments and clear examples, clearly explaining scientific concepts, using a variety of teaching resources and strategies giving homework or assignments, utilising reference books, various assessment methods, representations, and relating concepts to real-world situations. Recent research advocates the use of instructional practices that actively engage learners (Balta & Awedh, 2017; Oanh & Dang, 2025). Instructional practices that actively engage learners are referred to as learner/student-centred or active learning instructional practices (Armbruster et al., 2009; Freeman et al., 2014). Several studies report or support the assertion that active-learning instructional practices enhance students' academic performance and engagement, resulting in meaningful learning (Balta & Awedh, 2017; Freeman et al., 2014; Oanh &

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Dang, 2025). However, Johnson et al. (2025) found that these recommended instructional practices were rarely used in mathematics classes, despite abundant research supporting their effectiveness in teaching. As already mentioned, the ability of a teacher to use a given instructional practice reflects their pedagogical knowledge-the comprehension and use of instructional techniques and practices that promote learning. Pedagogical knowledge influences teachers' instructional choices and classroom practices (Auerbach & Andrews, 2018). Given the pivotal role that instructional practices play in the teaching-learning process, it may be helpful to investigate how teachers view their ability to apply selected instructional practices in their work.

The above discussion suggests a close relationship among pedagogical knowledge, self-efficacy beliefs, and instructional practices. Due to the impact these concepts have on the teaching and learning process, the present study investigated TSE beliefs in enacting learner-centred instructional practices in science and mathematics classes. In Zambia, this study is timely because the Ministry of Education recently launched the Competence-Based Curriculum (CBC), which emphasises the use of learner-centred instructional practices (Curriculum Development Centre, 2023). Understanding the TSE beliefs of science and mathematics teachers helps explore their preparedness to implement the CBC and may inform policy direction to improve teachers' instructional practices.

Although the above background shows that self-efficacy beliefs can influence teachers' choice of instructional practices, which can in turn affect students' learning (Emiru & Gedefaw, 2024; Holzberger & Prestele, 2021; Zee & Koomen, 2016), it is still uncertain whether secondary school mathematics and science teachers have the correct self-efficacy beliefs to use student-centred instructional practices effectively. Furthermore, there is insufficient data on science and mathematics TSE beliefs regarding the use of learner-centred instructional practices globally and in the African context. Since self-efficacy beliefs and instructional practices play a significant role in teaching (Johnson et al., 2025; Sasson & Malkinson, 2021), the current study contributes to the field by evaluating the self-efficacy beliefs of science and mathematics teachers in enacting learner-centred instructional practices at the secondary school level.

This study had two primary purposes: first, to validate a survey questionnaire for measuring TSE beliefs of science and mathematics teachers regarding the enactment of learner-centred instructional practices. Secondly, the study examined the TSE beliefs that influence the enactment of learner-centred instructional practices and how teacher factors/characteristics (e.g., gender, age, teaching experience, qualification, category, and specialisation) may affect these beliefs. The study raised three research questions:

1. To what extent does the self-efficacy questionnaire demonstrate reliability and validity among secondary school mathematics and science teachers?

2. What is the level of mathematics and science teachers' self-efficacy beliefs to enact learner-centred instruction in secondary schools?

3. Do the self-efficacy beliefs of mathematics and science teachers differ based on : (a) gender, (b) teaching experience (years), (c) highest qualification, (d) category of teacher, and (e) age?

This study contributes to the global discourse on science and mathematics education by increasing our understanding of TSE beliefs regarding the use of learner-centred instructional practices using the Zambian context. The focus on self-efficacy beliefs is significant because TSE beliefs tend to be context-specific; therefore, findings may help clarify how contextual factors shape research in this area (Hodges et al., 2016). On the other hand, the focus on learner-centred instructional practices is based on the understanding that such practices promote meaningful learning, resulting in increased academic performance (Balta & Awedh, 2017; Freeman et al., 2014). Additionally, the findings may inform science and mathematics education policy, research, and practice at the local and global levels. For Zambia, the findings offer insights into teachers' preparedness to implement CBC-based learner-centred instructional practices.

2. Literature Review

The idea of self-efficacy can be traced back to Bandura's (1977) Social Cognitive Theory. This theory views self-efficacy as a belief in one's capability to undertake the efforts/actions required to attain particular outcomes (Bandura, 1977). Within the education sector, TSE beliefs have been explored extensively (Bray-Clark & Bates, 2003; Klassen et al., 2011; von Knebel et al., 2023). For instance, Klassen et al. (2011) reported a spike in research concerning TSE, highlighting variation in methodology, subject/field specificity, globalisation, and an emphasis on overall efficacy. Nonetheless, they identified several challenges, including an insufficient focus on the sources of TSE, problems with the conception and measurement of TSE, inadequate support for the link between TSE and learning outcomes, and the uncertain applicability of TSE research to classroom settings. Additionally, Zee and Koomen (2016) identified positive correlations between TSE and students' academic adjustment, teacher behavior patterns, classroom practice quality, individual achievement, job fulfillment, and commitment.

Teachers' self-efficacy shapes their perceptions and responses to the teaching process (Seneviratne et al., 2019). Educators with high TSE beliefs are more likely to experiment with novel teaching methods, incorporate cutting-edge technology, and persevere in the face of challenges related to curriculum reform (Pikk et al., 2025; von Knebel et al., 2023). Such teachers are likely to employ creative teaching practices and foster a good learning environment. Therefore, self-efficacy determines how teachers approach objectives, tasks, and challenges. Self-efficacy is extremely important in educational contexts, especially in scientific and mathematics instruction.

In science and mathematics, where conceptual understanding and problem-solving are critical, TSE beliefs may significantly impact teachers' and students' motivation, engagement, and academic success (Fidan & Tuncel, 2021; Tanel, 2013). Furthermore, if teachers and students have strong self-efficacy, they are more likely to connect deeply with science concepts, persevere through challenging experiments, and persist in the face of setbacks (Fidan & Tuncel, 2021). Additionally, interdisciplinary science instruction, which combines different scientific fields, requires teachers to have strong self-efficacy beliefs to communicate knowledge effectively (von Knebel et al., 2023). von Knebel et al. (2023) assert that TSE beliefs are positively influenced by factors such as teaching experience, willingness to teach interdisciplinary science, and the number of science disciplines studied. Understanding the significance of TSE in teaching science and mathematics has implications for classroom practices, as TSE beliefs influence instructional behaviour. Ongoing research and targeted interventions are required to understand and support the enhancement of TSE beliefs and science and mathematics education. In the Zambian context, Bwalya and Rutegwa (2023) explored pre-service TSE regarding their technological pedagogical content knowledge (TPACK). They reported moderate TSE levels, as well as influences of gender, specialisation, and year of study on some TPACK constructs. According to a recent Ethiopian study by Emiru and Gedefaw (2024), teachers reported having higher self-efficacy in engaging learners, managing educational settings, and using diverse instructional practices. However, learners' behavioral and mental engagement were significantly lower than usual. Nonetheless, the study revealed that a shift in pupil involvement was significantly related to TSE.

From the above, it can be inferred that TSE beliefs may influence how teachers approach their work, which, in turn, may affect students' attainment of learning outcomes. It is therefore worthwhile to explore teachers' self-efficacy beliefs across various contexts. This study assumes that teacher TSE beliefs would influence their confidence and ability to enact learner-centred instructional practices, which are likely to positively influence students' learning. The central idea in this framework is

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grounded in the literature, which asserts that higher levels of TSE beliefs enhance teachers' confidence in enacting effective instruction and students' academic performance (Fidan & Tuncel, 2021; Seneviratne et al., 2019; von Knebel et al., 2023).

3. Methodology

This study employed a quantitative research approach, utilising a cross-sectional descriptive survey design. The quantitative approach was suitable for this research because it aimed to collect data from a relatively large sample within a short period (Creswell, 2014). Therefore, quantitative data were collected at a single point in time using an online survey, distributed to secondary school science and mathematics teachers from three Zambian universities. These universities were purposefully selected because they train a large number of science and mathematics teachers.

3.1. Research Participants

The participants comprised secondary school science and mathematics in-service (upgrading their qualifications) and pre-service teachers. The selection of participants was based on a convenient purposive sampling approach, and the inclusion criteria for the sample were that they were enrolled at one of the three universities and specialising in science (biology, chemistry, and/or physics) or mathematics as a teaching subject. A total of 257 participants responded to the survey. Table 1 shows the demographics of the participants.

3.2. Instrument, Procedures, and Ethical Considerations

Data were collected using an online-based seven-point Likert-scale survey. The questionnaire items were adapted from the literature. Fifteen (15) items were adapted from Hodges et al. (2016), while ten (10) items were adapted from Mapulanga et al. (2022). The questionnaire comprised two sections: Part A required respondents to provide their demographic information, while Part B requested responses to prompts about their self-efficacy beliefs in utilising learner-centred instructional practices. Participants responded by selecting a number from 1 to 7, where 1 = Not at all confident, 2 = Slightly confident, 3 = Somewhat confident, 4 = Moderately confident, 5 = Fairly confident, 6 = Very confident, and 7 = Completely confident. A description of what the items/practices in the questionnaire measure is included in Appendix I.

To ascertain the questionnaire's content validity, the researchers reviewed the theoretical literature on TSE beliefs and instructional practices in science and mathematics education. Furthermore, the questionnaire was validated by two science and two mathematics education specialists, who assessed the items' suitability, relevance, language use, clarity, and appropriateness for measuring TSE beliefs about the use of learner-centred instructional practices. The experts' feedback was used to improve the questionnaire and its items (Waltner et al., 2019). The reliability test results are included in the results section.

The questionnaire was distributed to participants through their WhatsApp groups from April to July 2025 at the three Zambian universities. Several reminders were given to the participants to complete the questionnaire through the same platform. On average, completing the survey took approximately 15 minutes. 259 respondents answered the questionnaire. Two respondents were excluded from the analysis because they provided incomplete responses. Research permits were obtained from the three institutions. The study's context was described to the participants, and they were informed that their participation was voluntary and that their identities would be anonymised. Also, consent was sought from the participants, who were assured of participant protection by not reporting their identities or the institutions they represent.

3.3. Data Analysis

To analyse the data, SPSS version 25 was applied to calculate descriptive and appropriate inferential statistics. Since the normality test indicated that the data deviated from normality ($W = .852$, $p < .001$), inferential statistics were computed using appropriate nonparametric tests. The results are presented in next section.

4. Results

This section reports the results of the study. Firstly, the participants' characteristics are summarised in Table 1. The results show that males accounted for the highest proportion of respondents (n = 184; 71.6%), while females (n = 72; 28.4%) accounted for the remaining participants, suggesting male dominance in science and mathematics education. It can also be seen that most participants were in-service teachers (72.4%), while only 27.6% were pre-service teachers. In terms of specialisation, results indicate that most participants were taking mathematics education (33.5%), followed by biology and chemistry education (24.5%). The least represented specialisations were physics education (4.7%) and chemistry education (7.4%). A majority of participants held a diploma (63.0%), followed by 22.6% with a bachelor's degree. Only 0.8% of the participants held Master's degrees.

Regarding the qualification level being pursued, the study revealed that 85.2% of the participants were pursuing bachelor's degrees, which is the minimum required teaching qualifications at the secondary school level. Three teachers (1.2%) indicated that they were pursuing a PhD qualification. Regarding teaching experience (in years), Table 1 shows that only 23% of the participants had no experience (0 years), the majority had 1-5 years (38.9%), and the rest (38.1%) had 6 or more years of teaching experience. Age-wise, most respondents (68.5%) were 35 years old or younger, indicating a relatively young teaching cohort. Only 31.5% of the participants were aged 36 years or older.

Table 1. Characteristics of the respondents (N=257)

Variable		N	%
1. Category of teachers	Pre-service	71	27.6
	In-service	186	72.4
2. Gender	Male	184	71.6
	Female	72	28.4
3. Specialisation	Biology education	38	14.8
	Chemistry education	19	7.4
	Physics education	12	4.7
	Mathematics education	86	33.5
	Biology and Chemistry education	63	24.5
	Mathematics and Biology education	39	15.2
4. Highest qualification	Master's degree	2	0.8
	Bachelor's Degree	58	22.6
	Diploma	162	63.0
	School certificate	35	13.6
	Diploma	2	0.8

5.	Qualification pursued	Bachelor's degree	219	85.2
		Master's degree	33	12.8
		PhD	3	1.2
6.	Teaching experience (years)	0	59	23.0
		1-5	100	38.9
		6-10	46	17.9
		11-15	27	10.5
		16-20	18	7.0
		21 and above	7	2.7
7.	Age (years)	25 and below	51	19.8
		26-30	53	20.6
		31-35	72	28.0
		36-40	34	13.2
		41-45	35	13.6
		46 and above	12	4.7

4.1. Validity and Reliability Tests

For the reliability test, the survey's internal consistency was determined using Cronbach's Alpha, and the result (α = .944) indicates that the survey items were internally very consistent and measured the same construct (Camacho-Tamayo & Bernal-Ballen, 2023; Taber, 2018).

4.2. Model Assessment- Exploratory Factor Analysis

The KMO value of 0.937 and Bartlett's test of Sphericity ($p < .001$) indicated that the data were suitable for performing a factor analysis (Arenas-Peñaloza et al., 2025). Therefore, an exploratory factor analysis was performed, and the results showed that the items loaded onto four factors/categories, explaining 63.67% of the total variance (see Table 2). Factor 1 had eight items, Factor 2 had eight items, Factor 3 had seven items, while Factor 4 had two items. The highest loading scores for each item were used to group items according to their loadings; the minimum loading coefficient was set at 0.4. Since differences may occur between experts' grouping of questionnaire items and the factor analysis outcome, the items in the initial questionnaire were not grouped based on experts' opinions (Mapulanga et al., 2024).

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Table 2. Rotated factor matrix

	Factor/ loading			
Item	**1**	**2**	**3**	**4**
SE24	.730			
SE17	.686			
SE18	.674			
SE23	.665			
SE22	.602			
SE16	.568			
SE25	.526			
SE11	.521			
SE1		.721		
SE2		.702		
SE3		.680		
SE5		.648		
SE6		.641		
SE4		.630		
SE7		.493		
SE15		.428		
SE10			.700	
SE8			.515	
SE12			.509	
SE13			.474	
SE9			.467	
SE14			.439	
SE21			.423	
SE20				.786
SE19				.537

Note: The principal axis factoring extraction method was used while the Varimax with Kaiser normalisation was adopted as the rotation method. The rotation converged in 7 iterations.

A qualitative analysis of the item loadings/groups revealed that the items could be grouped into four themes, with their names, descriptions, and item composition illustrated in Table 3.

Table 3. Description of factors/themes

Factor/Theme	Theme description	Respective items
Efficacy for enacting learner-centred learning through inquiry and real-world connections	Items in this theme focus on guiding learners to explore, ask questions, connect to real-world experiences, and other subjects.	SE1, SE2, SE3, SE4, SE5, SE6, SE7, SE15
Efficacy for developing scientific/mathematical reasoning and evidence-based thinking	Items focus on helping students to justify claims, persist in solving problems, and interrogate content in meaningful ways.	SE8, SE9, SE10, SE12, SE13, SE14, SE21
Efficacy for using effective teaching strategies and assessment techniques	Using varied instructional methods and assessment tools to enhance and measure learning	SE11, SE16, SE17, SE18, SE22, SE23, SE24, SE25
Efficacy for identifying learners' learning difficulties in real time	Identifying and understanding learners' learning difficulties as they occur	SE19, SE20

4.3. Level of Teachers' Self-Efficacy (TSE) Beliefs to Enact Learner-centred Instructional Practices

The level of TSE beliefs about enacting learner-centred classroom practices is presented in Table 4. Teachers' self-efficacy levels were interpreted based on item frequencies (%) and mean responses per item. It was important to report teachers' awareness/readiness to implement each learner-centred teaching practice. The level of TSE beliefs can be determined by interpreting the mean response scores as follows;

a) 6.50-7.00 = very high confidence,
b) 5.50-6.49 = high confidence,
c) 4.5-5.49 = somewhat high confidence,
d) 3.50-4.49 = moderate confidence,
e) 2.50-3.49 = somewhat low confidence,
f) 1.50-2.49 = low confidence, and
g) 1.00-1.49 = very low confidence.

Based on the above scale, Table 4 shows that TSE beliefs were somewhat high for SE9 and SE21 and high for the remaining items. This implies that the teachers' self-efficacy beliefs were generally high. In other words, the teachers were very confident they would implement learner-centred instructional practices in the future.

Table 4. Teachers' confidence level to enact learner-centred teaching practices (N=257)

	Confidence level - Frequency (%)								
	Not at all Confident [1]	Slightly Confident [2]	Somewhat Confident [3]	Moderately Confident [4]	Fairly Confident [5]	Very Confident [6]	Completely Confident [7]	Mean	SD
SE1	3 (1.3)	9 (3.5)	3 (1.2)	22 (8.6)	49 (19.1)	142 (55.3)	29 (11.3)	5.52	1.17
SE2	1 (0.4)	10 (3.9)	3 (1.2)	18 (7.0)	44 (17.1)	143 (55.6)	38 (14.8)	5.63	1.14
SE3	1 (0.4)	7 (2.7)	4 (1.6)	23 (8.9)	59 (23.0)	121 (47.1)	42 (16.3)	5.58	1.12
SE4	1 (0.4)	12 (4.7)	3 (1.2)	16 (6.2)	59 (23.0)	133 (51.8)	33 (12.8)	5.53	1.16
SE5	1 (0.4)	4 (1.6)	8 (3.1)	6 (2.3)	38 (14.8)	146 (56.8)	54 (21.0)	5.84	1.03
SE6	1 (0.4)	3 (1.2)	11 (4.3)	2 (0.8)	28 (10.9)	133 (51.8)	79 (30.7)	6.02	.97
SE7	1 (0.4)	4 (1.6)	4 (1.6)	9 (3.5)	36 (14.0)	133 (51.8)	70 (27.2)	5.93	1.02
SE15	2 (0.8)	9 (3.5)	10 (3.9)	37 (14.4)	0 (0)	133 (51.8)	66 (25.7)	5.67	1.36
SE8	1 (0.4)	6 (2.3)	9 (3.5)	18 (7.0)	52 (20.2)	123 (47.9)	48 (18.7)	5.63	1.15
SE9	24 (9.3)	12 (4.7)	10 (3.9)	20 (7.8)	52 (20.2)	100 (38.9)	39 (15.2)	5.02	1.78
SE10	9 (3.5)	6 (2.3)	4 (1.6)	16 (6.2)	43 (16.7)	138 (53.7)	41 (16.0)	5.55	1.33
SE12	2 (0.8)	2 (1.2)	3 (1.6)	18 (7.0)	39 (15.2)	132 (51.4)	59 (23.0)	5.81	1.07
SE13	4 (1.6)	4 (1.6)	5 (1.9)	16 (6.2)	42 (16.3)	135 (52.5)	51 (19.8)	5.71	1.16
SE14	3 (1.2)	5 (1.9)	11 (4.3)	42 (16.3)	0 (0)	150 (58.4)	46 (17.9)	5.59	1.29
SE21	21 (8.2)	7 (2.7)	4 (1.6)	18 (7.0)	47 (18.3)	106 (41.2)	54 (21.0)	5.32	1.69
SE19	2 (0.8)	3 (1.2)	1 (0.4)	7 (2.7)	31 (12.1)	130 (50.6)	83 (32.3)	6.05	.99
SE20	2 (0.8)	6 (2.3)	1 (0.4)	7 (2.7)	37 (14.4)	125 (48.6)	79 (30.7)	5.96	1.08
SE11	2 (0.8)	6 (2.3)	2 (0.8)	9 (3.5)	29 (11.3)	139 (54.1)	70 (27.2)	5.93	1.08
SE16	1 (0.4)	3 (1.2)	4 (1.6)	10 (3.9)	35 (13.6)	127 (49.4)	77 (30.0)	5.97	1.01
SE17	1 (0.4)	2 (0.8)	1 (0.4)	12 (4.7)	33 (12.8)	118 (45.9)	90 (35)	6.07	.96
SE18	2 (0.8)	5 (1.9)	1 (0.4)	11 (4.3)	46 (17.9)	126 (49)	66 (25.7)	5.86	1.07
SE22	3 (1.2)	5 (1.9)	2 (0.8)	8 (3.1)	33 (12.8)	123 (47.9)	83 (32.3)	5.97	1.12
SE23	2 (0.8)	3 (1.2)	3 (1.2)	8 (3.1)	30 (11.7)	133 (51.8)	78 (30.4)	6.00	1.02
SE24	1 (0.4)	2 (0.8)	5 (1.9)	6 (2.3)	26 (10.1)	116 (45.1)	101 (39.3)	6.14	.99
SE25	2 (0.8)	4 (1.6)	3 (1.2)	7 (2.7)	28 (10.9)	138 (53.7)	75 (29.2)	5.99	1.03

4.4. Influence of Demographic Characteristics on TSE Beliefs

The normality test results revealed that the data were not normally distributed ($W = .852$, $p < .001$). Therefore, appropriate inferential statistics were carried out using nonparametric tests to explore whether demographics influenced participants' TSE beliefs. Using the overall mean score for the TSE beliefs questionnaire obtained using the 'compute variable' function in SPSS. Non-parametric tests were performed to determine whether demographic characteristics influenced participants' self-efficacy beliefs. The Independent-Samples Mann-Whitney (U) test was used for gender and respondents' category (Table 5), while the Independent-Samples Kruskal-Wallis (H) test was used for teaching experience-years, highest qualification, specialisation, and age (Table 6). Table 5 indicates statistically significant differences by teacher category (in-service and pre-service) [$p < 0.05$], with a small effect size ($d = .186$), suggesting that the groups are similar (Aarts et al., 2014). However, based on gender (Table 5) and all the other variables—specialisation, highest qualification, qualification pursued, teaching experience (in years), and age (see Table 6)—the differences were not statistically significant [$p > .05$], implying that these characteristics did not influence the teachers' self-efficacy beliefs.

Table 5. Influence of gender and teachers' category on participants' self-efficacy beliefs (N=257)

Variable		N (%)	M (SD)	U	df	*p*
Category of teachers	Pre-service	71 (27.6)	5.67 (0.72)	5,513.500	-	.041*
	In-service	186 (72.4)	5.81 (0.78)			
Gender	Male	184 (71.6)	5.79 (0.79)	5,968.500	-	.196
	Female	72 (28.0)	5.72 (0.69)			

Note: (*) = significant at p = .05.

Table 6. Influence of demographic characteristics on participants' self-efficacy beliefs (N=257)

Variable		N (%)	M (SD)	H	df	*p*
Specialisation	Biology education	38 (14.8)	5.79 (0.56)	3.784	5	.581
	Chemistry education	19 (7.4)	5.63 (0.75)			
	Physics education	12 (4.7)	5.63 (1.52)			
	Mathematics education	86 (33.5)	5.86 (0.63)			
	Biology and Chemistry education	63 (24.5)	5.73 (0.91)			
	Mathematics and Biology education	39 (15.2)	5.73 (0.64)			
Highest qualification	Master's degree	2 (0.8)	6.02 (0.48)	3.100	3	.376
	Bachelor's degree	58 (22.6)	5.74 (0.84)			
	Diploma	162 (63.0)	5.80 (0.77)			
	School certificate	35 (13.6)	5.67 (0.61)			
Qualification pursued	Diploma	2 (0.8)	5.34 (0.48)	2.34	3	.505
	Bachelor's degree	219 (85.2)	5.79 (0.69)			
	Master's degree	33 (12.8)	5.79 (0.81)			
	PhD	3 (1.2)	4.35 (2.91)			
Teaching experience (years)	0	59 (23.0)	5.77 (0.76)	8.374	5	.137
	1-5	100 (38.9)	5.90 (0.58)			
	6-10	46 (17.9)	5.64 (0.99)			

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	11-15	27 (10.5)	5.86 (0.79)			
	16-20	18 (7.0)	5.92 (0.73)			
	21 and above	7 (2.7)	5.31 (1.20)			
Age (years)	25 and below	51 (19.8)	5.71 (0.62)	5.391	5	.495
	26-30	53 (20.6)	5.87 (0.76)			
	31-35	72 (28.0)	5.76 (0.83)			
	36-40	34 (13.2)	5.83 (0.80)			
	41-45	35 (13.6)	5.70 (0.82)			
	46 and above	12 (4.7)	5.77 (0.76)			

5. Discussion

This study contributes to the literature on TSE beliefs and pedagogical knowledge by presenting a validated instrument to measure TSE beliefs and support the enactment of student-centred instructional practices in the context of developing countries. Based on the reliability and validity test results, this study presents a validated questionnaire organised into four factors/categories that can be used to determine science and mathematics TSE beliefs regarding learner-centred instructional practices. Furthermore, the study has described the TSE beliefs of secondary school teachers regarding the enactment of learner-centred instructional practices in science and mathematics. It also gives insight into the influence of teachers' demographics on TSE beliefs. The implications of these findings are discussed below.

The finding that participants reported high TSE beliefs to enact learner-centred instructional practices supports previous studies. For instance, Olawale and Hendricks (2024) also found that participants had higher confidence in enacting teaching strategies. As previous studies (e.g., Fidan & Tuncel, 2021; von Knebel et al., 2023) have reported that instructors with high TSE beliefs may be effective teachers, this finding may have positive implications for teaching and learning in Zambia. Since Zambia recently launched the Competence-Based Curriculum (CBC), which requires teachers to use learner-centred teaching practices, the findings may suggest teachers' readiness to enact the CBC. However, it is necessary to investigate actual classroom teaching to ascertain this association. This is particularly important, since self-efficacy beliefs may differ from actual classroom enactment, as teachers may not necessarily enact what they report being able to enact. For instance, Johnson et al. (2025) found that recommended instructional practices were rarely used in college mathematics classes. Also, Tanel. (2013) found that whilst pre-service TSE beliefs about teaching force and motion were high, their conceptual understanding of the concepts was low. This discrepancy may affect teachers' actual classroom instruction, but may be explained by several factors other than TSE beliefs. For example, individuals may have a tendency to overestimate themselves or their abilities, especially in self-reported situations. Additionally, teachers' classroom enactment may be limited by contextual factors, such as teaching-learning environments, infrastructure, school environments, leadership style, and opportunities for professional development. Therefore, research may need to be extended to actual classroom instruction to observe learning environments and how teachers utilise available teaching-learning resources, and support their classroom enactment if necessary. Furthermore, research may investigate the influence of contextual factors by comparing findings across contexts.

The study's revelation that gender, years of teaching experience, and level of qualification did not influence teachers' self-efficacy beliefs can be explained by the professional socialisation inherent in teaching through standardised training, shared curricula, and common professional norms, which tend to equalise teachers' efficacy. Furthermore, formal qualifications and years of experience are only indirect proxies for efficacy, which can be predicted by other contextual factors such as school climate, resilience, and burnout. The finding that the highest teaching qualification did not influence TSE beliefs contradicts Olawale and Hendricks' (2024) conclusion that the level of education influenced self-efficacy beliefs. Regarding the teachers' category, our study's findings support von Knebel et al. (2023), who reported higher TSE beliefs among in-service teachers compared to pre-service teachers. Nonetheless, similar to Muamaroh and Thoyibi (2025), our study revealed no influence of teaching experience on TSE beliefs among in-service teachers. However, this contradicts von Knebel et al. (2023), who concluded that teaching experience influenced teachers' self-efficacy.

Our results, which indicate that gender did not influence teachers' self-efficacy beliefs, concur with a recent study by Muamaroh and Thoyibi (2025). Nonetheless, this result contradicts previous studies (e.g., Bottomley et al., 2024; Bwalya & Rutegwa, 2023), which found that males had higher self-efficacy beliefs than females. For example, Bwalya and Rutegwa (2023) reported higher self-efficacy in technological pedagogical content knowledge constructs among male teachers than female ones.

The above discussion supports the recent assertion that studies on self-efficacy beliefs in education have yielded mixed findings (Pikk et al., 2025), suggesting the possibility of influence from contextual factors, such as learning environments, teacher education programs, and resource availability. Therefore, it may be important for future research to control for and explore how contextual factors may be affecting TSE beliefs.

This study's major limitation is that it used self-reported data collected through only a quantitative approach. The findings could be enhanced by including interviews to obtain detailed information from participants. Furthermore, since the questionnaire was shared via WhatsApp, some potential respondents may not have accessed it during the period the link was active. This limitation reduces the generalisability of the study's findings to only those who had access to WhatsApp. However, this limitation was minimised by keeping the link active for a relatively long period (April to July 2025) and by sending several reminders to participants to respond. In the future, additional platforms could be used to distribute the survey, such as email- and paper-based surveys. Nonetheless, the findings are useful as they provide an overall sense of teachers' self-efficacy beliefs, which can serve as a foundation for planning large-scale research to enhance science and mathematics teaching. The use of a reliable and valid instrument further enhanced the study's findings.

6. Conclusion

This study tested the validity of a self-efficacy questionnaire and described the self-efficacy (TSE) beliefs of secondary school science and mathematics teachers regarding the enactment of learner-centred instructional practices. It determined that the questionnaire was reliable and valid for exploring TSE beliefs to enact learner-centred instructional practices. In addition, the study found that TSE beliefs were high, with their confidence ranging from fairly to very confident. Thus, both pre-service and in-service teachers feel confident in their ability to implement learner-centred instructional practices. Regarding the influence of demographic factors, the study found that TSE beliefs among in-service teachers were higher than those among pre-service teachers, highlighting the centrality of practical instruction in shaping self-efficacy beliefs. However, TSE beliefs were not influenced by gender, teaching experience, highest qualification, the qualification being pursued, specialisation, or age. This suggests that demographics are less effective in shaping confidence in teaching. Since TSE's beliefs in enacting learner-centred instructional practices were high, teachers are likely to continue enacting these instructional practices in the future. However, it may be useful to examine teachers' actual classroom instructional practices to determine whether self-efficacy beliefs translate into classroom implementation and how this can affect student learning.

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7. Suggestion

Teachers should recognise that their self-efficacy can be cultivated through reflective practice, seeking mentorship, collaborative peer observation, and exposure to learner-centred instructional approaches, supported by practice opportunities. For teacher educators, the findings suggest the need to embed rich, practice-based learning opportunities through microteaching, mentoring, and extended practicum experiences in teacher preparation programs. This may build pre-service teachers' confidence before transitioning into classroom teaching.

Researchers can use the questionnaire in large-scale studies involving more teachers to gain a better understanding of the state of science and mathematics teachers' self-efficacy beliefs in using learner-centred instructional practices in contexts similar to those in Zambia. Furthermore, research may investigate the actual classroom enactment of learner-centred instructional practices through classroom observation and interviews. Future work may also investigate how practical experiences shape teacher self-efficacy by employing longitudinal interventions and domain-specific measures to capture changes over time.

For policymakers, the findings underscore the importance of supporting mentoring and induction programs, as well as professional development programs that emphasise mastery experiences rather than demographic variations. The education system can enhance and sustain teachers' self-efficacy by focusing on professional growth through practical engagement.

Declarations

Author Contributions. TM: Conceptualisation, methodology, data collection and analysis, writing, original draft preparation, reviewing, and editing. LCJ: Supervision, writing, reviewing, and editing. AM: Conceptualisation, data collection, reviewing, and editing. EN: Data collection, reviewing, and editing.

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Appendices

Appendix I. Description of the items/practices in the questionnaire

Item	What the items measure
SE1	Encourage pupils to ask meaningful questions and start investigations
SE2	Address misconceptions through exploration and reflection
SE3	Recognize patterns and trends in data
SE4	Extract important information from problems or phenomena
SE5	Promote peer learning through sharing results
SE6	Link classroom learning to real-world applications
SE7	Relate learning to other subjects (cross-curricular connections)
SE8	Link evidence from investigations to claims made by pupils
SE9	Allow pupils to struggle productively without giving immediate answers
SE10	Encourage learners to use alternative approaches to problem-solving
SE11	Facilitate group activities and investigations
SE12	Support learners to reason using claims, evidence, and scientific/mathematical logic
SE13	Ensure pupils use content knowledge to support claims
SE14	Connect current content to previous investigations for deeper meaning
SE15	Support students in presenting investigation findings creatively
SE16	Use various visual and physical teaching aids (e.g., models, diagrams)
SE17	Use relatable, real-life examples to explain concepts
SE18	Organize hands-on activities and demonstrations for topic understanding
SE19	Identify when pupils struggle with concepts
SE20	Understand why pupils are struggling with specific topics
SE21	Warn pupils of challenging concepts to prepare them mentally
SE22	Use questioning to assess pupils' prior knowledge
SE23	Use questioning to evaluate learning outcomes
SE24	Utilise diverse assessment techniques/methods (e.g. assignments, tests, projects)
SE25	Assist learners to transfer knowledge to future topics and contexts