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School Factors on the Self-Efficacy of Science Teaching Among Primary Teachers in the Western Province, Sri Lanka

Vipula Kulathunga[1], Dr. Indang Ariati Binti Ariffin[2], Dr. Jacquline Tham[3]

[1]Management and Science University, Malaysia
[2]Professor, Management and Science University, Malaysia
[3] Associate Professor, Management and Science University, Malaysia

Abstract

School organizational factors influencing self-efficacy of science teaching of primary teachers in the Western Province of Sri Lanka was under studied. A cross-sectional research design employing a descriptive quantitative survey with stratified random sampling was deployed to evaluate the pertinent factors in a school organizational setting. A five-point Likert scale questionnaire was administered among 427 primary grade teachers from schools in the western province of Sri Lanka. The sample included teachers from all three stages of primary education. Data analysis was done using both descriptive and inferential statistics. The sample includes teachers from all three stages of primary education in Sri Lanka. Data analysis was done using descriptive and inferential statistics. The primary teacher attributes had a very high positive impact ($r = 0.90$, $p > 0.05$) on their science teaching self-efficacy. Teachers' experience had the highest impact. Teaching strategies and their process skills are also very influential. The scientific knowledge had a significant but low influence. The teachers' qualification wasn't a significant influence. The principal influence ($r = 0.15$, $p>0.05$) and school-related other resources ($r = 0.07$, $p >0.05$) had a significant but very weak positive influence. The proposed model for primary teachers' science teaching self-efficacy is considered acceptable, as indicated by the model fit indices: parsimonious fit—2.571, incremental fit—0.909, and absolute fit—0.061. The professional development programme needs to highly addressed to enhance teachers' various experiences in science background, science teaching strategies, and their science process skills.

Keywords:Primary teachers, Science teaching, Self-efficacy, Principal influence, School-related factors.

1. Introduction

Since most new discoveries and changes in technology are based on science, science education is an important part of any country's development (Coffie & Doe, 2019). Jean Piaget's theory of cognitive development says that most cognitive development happens in the first 12 years of life (Cherry, 2023). If science literacy can be created by providing the child with science knowledge and skills in the primary stage, it is a reason for success in STEM (Science, Technology, Engineering, and Mathematics) later in life (Husaini et al., 2019). Because of this, there is a relationship between the child's self-efficacy and success in science education (Kirbulut & Uzuntiryaki-Kondakci, 2019). McLeod (2022) asserts that Vygotsky's sociocultural theory necessitates a professional teacher for a child to learn effectively. A successful science education is based on how confident the primary teacher feels about teaching science (Husaini et al., 2019). This makes it challenging to teach science well because most primary school teachers don't have a background in science and aren't trained to teach it (Hong, 2018). A primary teacher's confidence in his or her ability to teach science is an important part of putting science education into practice in lower grades. The self-efficacy of the primary teacher in teaching science in primary school is very important for the successful implementation of science education (Tyas et al., 2020). The factors can be categorized as internal and external factors that are influencing teachers' self-efficacy (Loach, 2021). Factors related to the teacher can be called internal factors, and factors affecting the teacher that are external to the teacher can be called external factors. When the effect of certain factors increases, self-efficacy increases, which is a positive effect, while due to the effect of other factors, self-efficacy decreases, which is a negative effect. The study examines the factors that affect the science teaching self-efficacy of primary teachers in the Western Province of Sri Lanka. The finding will fill the gaps in the literature and guide the implementation of a new curriculum reform in Sri Lanka in 2026.

2. Literature

According to Sutjonong et al. (2022), the teacher's willingness and inclination towards teaching science can increase the self-efficacy of teaching scientific subjects. Turan-Oluk et al. (2022) state that if a teacher has confidence in his/her skills, he or she is ready to face the challenges of the learning process. Credibility arises when the teacher possesses knowledge and skills related to science and subject content (Yang & Wang, 2019). The attitudinal change that occurs in the teacher also encourages the teacher to teach science (McDonald et al. 2019). Perrin (2022) showed in his study with primary teachers that motivation to do science activities is higher when self-efficacy is high. Furthermore, self-efficacy motivates teachers to respond to students' questions and engage in more science-related activities. This indicates the need to improve teachers' self-efficacy in teaching science. With knowledge of pedagogy, the teacher will correctly choose the appropriate methods of teaching and use them effectively to teach the science content (Lord, 2022). This facilitates the teacher's ability to teach the relevant subject areas accurately and also simplifies classroom management. This procedure also increases the teacher's self-efficacy. High knowledge enables the teacher to apply science concepts correctly (Catalano et al., 2019). Turan-Oluk et al. (2022) suggest that the identification of incorrect concepts in students occurs when the teacher fails to comprehend scientific concepts. Another study indicates that the amount of experience the teacher has gained affects the increase in teaching self-efficacy (Handtke & Bögeholz, 2019). A teacher's self-efficacy also increases with the number of years taught and makes the experience gained under different conditions and contexts (Schwarshaupt et al., 2021). Experience with environmental activities in teaching science to primary teachers will help in this regard. The study of Yang and Wang (2019) shows that there is a relationship between a teacher's educational background, educational qualifications, and self-efficacy in teaching science. Having a science education background increases the teacher's willingness and confidence to teach science (Ujulu et al., 2019), and by developing professionalism in the teacher, their self-efficacy can be improved (Sharp et al., 2022). Thus, science knowledge and skills, knowledge of pedagogy, educational qualifications, and experience affect teacher professionalism, which in turn increases science teacher self-efficacy (Catalano et al., 2019). It motivates the teacher to teach science and the student to learn it. This leads to successful outcomes in the child's academic performance. This results in the teacher's self-regulation and self-awareness (Kozcu Çakır, 2020) and thereby improves metacognition (Sulaiman et al., 2021). The development of metacognition leads to the development of self-efficacy (Kozcu Çakır, 2020). As self-efficacy increases, the willingness to teach science and the tendency to engage in science activities are more likely (Özdemir & Hastürk, 2021). Then the effectiveness of primary science teaching increases. However, other factors, such as stress and boredom, can negatively affect this. Although some studies have shown that gender affects self-efficacy (Hong, 2018; Coffie & Doe, 2019), other studies have shown that sex has no effect (Shahat et al., 2022; Koutsianou & Emvalotis, 2019). According to a study by Harding (2016), increasing elementary teachers' self-efficacy in teaching science gives students the chance to learn it more effectively. Al Sultan et al. (2018) say that if the science literacy of the primary teacher can be developed, then the credibility of the teacher will create the necessary environment to provide a successful science education to the child. Sharp et al.'s (2022) studies also show that teachers' high-trust behaviors have a positive effect on children's successful outcomes.

When a teacher has a high level of self-efficacy in mathematics, the reliability of science is also high, and the influence of such teachers is the reason for the increase in children's achievement levels (Demir & Cetin, 2022). Catalano et al. (2019), Kozcu Cakr (2020), and Deehan et al. (2018) all confirm that as a teacher's self-efficacy grows, so does the success of the children. If a teacher has confidence in the teaching and learning task, they successfully manage the challenges they face and maintain an environment that motivates the students to learn, thereby achieving high achievement levels for them (Barni et al., 2019). The positive relationship between high self-efficacy and the ultimate goal are necessary factors for successful science teaching (Shahat et al., 2022). Harding (2016) says teachers' self-perception affects their behavior in class. Developing their science content knowledge and understanding can mitigate misconceptions through training, like a professional development program among primary teachers (Catalano et al., 2019). The study by Özdemir and Hastürk (2021) shows that a child's interest in science

can be enhanced by the teacher's confidence in teaching it. Therefore, we can enhance children's science learning by developing primary teachers and boosting their self-efficacy. The studies of Kozcu Çakır (2020) show that if self-efficacy is high, teachers' ability to explain is also high. Further, McDonald et al. (2019) indicated that teachers were motivated to include science activities in the lesson.

Studies by Upadhyaya (2019) have shown that teacher self-efficacy affects student motivation. The influence of the teacher is profound in creating interest in students, building curiosity, and seeing connections between science concepts. The evidence shows that the teacher's self-efficacy affects the children's emotional motivation rather than their behavior or cognitive motivation. Tyas et al. (2020) point out that the credibility of the teacher in teaching science is necessary for an effective learning and teaching process. Arslan-Cansever et al. (2021) found that when elementary teachers have confidence in problem-solving, logical thinking, collaboration, and communication, they tend to create an inquiry-based learning environment for students. Shahat et al. (2022) and Pazin et al. (2022)'s studies suggest that this reliability is necessary to creatively and appropriately use technology in the teaching-learning process. Also, the effect of self-efficacy on the teacher's activity, autonomy, and willingness to work is positive and related (Sokmen and Kilic, 2016). There is a high correlation between a teacher's self-efficacy and the learning methods, technologies, and classroom management they use. Sulaiman et al.'s (2021) studies also show this relationship.

Wood and Bandura (1989) introduced the social cognitive theory of organizational management, elucidating organizational dynamics via the lens of social cognitive theory, which articulates psychosocial functioning via triadic reciprocal causation. The social cognitive theory of organizational management delineates the factors—behavioral, cognitive, personal, and environmental—that influence organizational performance (Wood and Bandura, 1989). As a result, the theory explains what affects how well primary teachers teach science, including the teacher's personal traits, the principal's management style, the school's resources, and the teachers' confidence in their abilities.

Self-efficacy theory

Albert Bandura came up with the self-efficacy theory in 1977 to explain how a person thinks about his or her ability to reach a goal in a certain setting. According to Bandura, "self-efficacy is an individual's confidence in their capacity to perform a target or a goal" (Cherry, 2023). A person's self-system, comprising their attitudes, skills, and mental abilities, includes self-efficacy. Self-efficacy includes a person's belief in their skills, influence over their environment, and motivation in pursuit of a goal. The essence of a person's beliefs is how they think, behave, and feel. The self-efficacy of a person can vary with contexts and domains, which include education, relationships, a job, and other socio-economic contexts. Bandura (1977) highlighted that the four sources of self-efficacy are performance accomplishments, vicarious experiences, social persuasion, and physiological states. We can induce each source of self-efficacy using an appropriate mode of induction. The four (4) sources influence a person's self-efficacy development, which in turn influences the person's behavior and performance. Among these sources, mastery from experience as a major factor influencing self-efficacy has been shown in the conceptual framework of self-efficacy developed by Bandura (1977). This is also according to the findings of the studies by Schwarzhaupt et al. (2021), Catalano et al. (2019), Chan & Lay (2021), Haatainen et al. (2021), and Demir & Çetin (2022) that mastering the experiences leads to improved teaching self-efficacy. Schwarzhaupt et al. (2021) demonstrate that the creation of personalized mastery experiences, along with their exposure and handling, can result in increased self-efficacy.

Identifying research problem

The literature survey shows that primary teachers' science teaching self-efficacy depends on various variables, and it is reflected in students' learning achievement as a teacher's performance indicator. Primary-stage science learning impacts later achievement in science education, according to research. However, the primary teachers are not readily trained for science teaching when science is taught through the integrated curriculum, such as environment-related activities in Sri Lanka. Therefore, studying primary teachers' self-efficacy in science teaching is crucial. The study examines whether primary teachers believe they are teaching science

effectively and whether they know the steps necessary to do so. It's necessary to find out whether primary teachers encourage students to ask questions related to scientific problems and whether they can help students think scientifically. If so, teachers can motivate students who show more interest in science learning. The literature lacks information on assessment strategies, confidence in the appropriateness of science content and process skills, and suitable science teaching pedagogies.

In Sri Lanka, formal science education begins in the sixth grade. Primary grades provide basic science knowledge and skills through environment-related activities, treating science as an integrated subject. This knowledge and these skills provide the beginning of the formal science curriculum introduced from the sixth grade onwards. Therefore, it is necessary to provide the basic knowledge and skills of science accurately and adequately in the primary grades. However, there are no science teachers trained in the primary grades, and it is done by the general primary teachers themselves. Therefore, according to the knowledge and skills of those teachers, it will be decided to provide accurate and adequate science knowledge and skills in environmental activities. There is no previous study on the factors affecting the self-efficacy of primary teachers' science teaching in Sri Lanka. Therefore, examining the effect of the primary teacher's characteristics, principal influence, and other resources of the school on his credibility in a single model will help identify what needs to be done to develop science education in the primary grades. The school's other resources, which include things like electricity, water, laboratories, parents, and teacher manuals, play a crucial role. In Sri Lanka, science is taught in primary education as an integrated subject, and it is taught by ordinary primary teachers who are not trained for it. Therefore, identifying the factors affecting the self-efficacy of their science teaching will be of particular importance at this time for carrying out educational reform. The research problem is: what influential factors impact the primary teachers in science teaching self-efficacy?

The research problem leads to three specific research questions, as below:

1. What are the attributes of primary teachers that can be determined by their self-efficacy in teaching science?
2. What impact does the principal's influence have on primary teachers' self-efficacy in teaching science?
3. Is there an impact of school-related resources on primary teachers' science teaching self-efficacy?

The unit of analysis is primary general teachers of the schools in the western province of Sri Lanka. Sri Lanka intends to make reforms to education in 2026; thus, the findings of this study will be crucial for formulating and implementing policy. Also, the findings of this study will be useful for improving science education in primary schools in all countries with teachers not specially trained for science teaching, as well as implementing an integrated curriculum.

3. Methodology

The study conducted a comprehensive analysis of the self-efficacy of public primary school teachers in the Western Province of Sri Lanka. The investigation employed a quantitative and survey method to collect raw data from primary school teachers. This was done using a questionnaire in a blended mode. The data collection process utilized a blended method to ensure equal opportunities for responses from the three districts: Colombo, Kalutara, and Gampaha of the Western Province. The target population for this study comprised primary general cadre teachers from grades 1 to 5 in the primary schools of the Western Province of Sri Lanka. The researchers utilized a stratified proportional random sampling strategy, taking into consideration the representativeness, generalizability, time limitations, and study objective (Azam et al., 2021). The primary unit of analysis was a general primary cadre teacher in the primary grades. The study employed a cross-sectional design, collecting data only once. The sample frame consists of the Ministry of Education's National Educational Management Information System (NEMIS) 2020 database of institutions. The research's sample size of 625 was determined by utilizing the Krejcie and Morgan (1970) table. A questionnaire was distributed to 625 primary (general) teachers in the schools of Sri Lanka's western province. The response rate to the sample size was determined to be 60%. The researcher chose descriptive and inferential statistics for correlation and regression analysis based on the existing literature, previous research, and the objective of the investigation. The data was currently being effectively analyzed using statistical software applications, namely AMOS and SPSS. Initially,

descriptive statistics, particularly weighted mean procedures, were employed to quantitatively assess teaching proficiency across different dimensions. Subsequently, correlation and regression analyses were conducted to ascertain the relationships between the primary teacher, principal, and teachers' performance. These analyses aimed to determine how much the primary teacher, the principal, and school-related factors affect the overall efficacy of science instruction. Furthermore, it offered pragmatic recommendations for improving science education and enhancing educational methodologies in the area. Prior to giving consent to participate as a subject in the present study, the teacher must be informed about the purpose, objectives, methods, significance, privacy, and confidentiality of the information.

A theoretical framework was constructed based on the findings of the literature reviews.

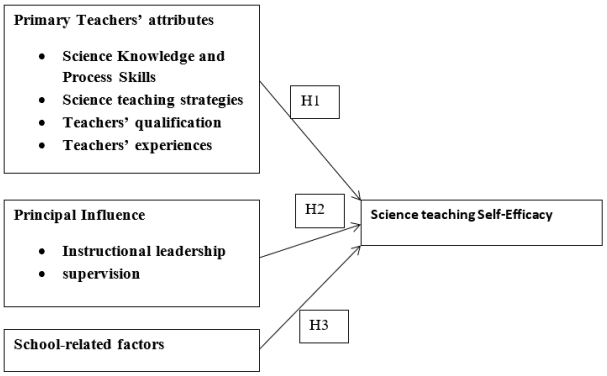

Figure 1. The conceptual framework for the study

The following hypotheses were developed based on the conceptual framework of the study.

H1: There is a relationship between the primary teachers' attributes and science teaching Self-Efficacy.

H2: There is a relationship between the principal influence and science teaching Self-Efficacy.

H3: There is a relationship between the school-related factors and science teaching Self-Efficacy.

4. Results and Discussion

Demographic information

The studied sample is represented by grade 1 to 5 primary teachers from the schools of three (3) districts: Colombo, Gampaha, and Kalutara of the Western Province of Sri Lanka. Collected data shows that 95.1% of the primary teachers are female teachers. It is very closely matched with the gender representation of the primary teachers in the information system of the Ministry of Education. So, it is shown that a correct sample representation has been selected gender-wise. The studies of Chen, Wu, and Hsin (2022) and Shi, Chen, and Zhou (2022) show that the female teacher representation in primary education is much higher compared to the male teachers. The mean value for grades is 3.054, which is very close to 3.0, showing that there is almost good proportional representation from each stratum of the studied sample. Moreover, the mean value for the districts is 1.993, which is very close to 2, which shows that the sample is represented by almost equal percentages from the three districts of Colombo, Gampaha, and Kalutara, where these studies were conducted. The study's sample representation was appropriate across gender, grade, and district categories. Then the data was analyzed for whether they are normally distributed or not by considering the skewness values and kurtosis values of grade and district. Table 1 shows that the skewness value is -0.047 and the kurtosis value is -1.181 for the grades. Although the skewness value has a negative bias, it is a very small value and close to zero. This value is much lower than ±1.96 (p> 0.05) (Hair, Black, and Babin, 2019), so it is a normal distribution. Also, for the three districts, the skewness value is 0.013, which is a positive bias that is less than 1.96 and close to zero, so the sample is normally distributed by district as well. Thus, the teachers' representation for the study shows a normal distribution in grade-wise and district-wise.

The science results in the ordinary level (O/L) examination reveal the primary teachers' prior science learning experience. The teachers passed the science subject in the O/L examination with a general pass or above of more than 98.6%. The mean value of the O/L science result, which is very close to 3, reveals that the majority of the teachers have credit passes or above, and all of them have excellent basic science knowledge and science process skills. The results of the Norris, Morris, and Lummis (2018) study show that many pre-service teachers are either enthusiastic or successful in science, and they are confident to teach primary grades science. Additionally, the study by Norris, Morris, and Lummis (2018) indicates that a teacher's lack of science knowledge and concepts negatively impacts their confidence in teaching science. Menon et al. (2023) study also described that teachers' prior learning experiences at college influence their present science teaching confidence. The value of 91% of teachers having high

science teaching self-efficacy reveals that their prior science learning experience has an influence, and the finding is tied with the previous studies. The mean value of 1.461 for the A/L subject stream reveals that the majority of primary teachers (92.7%) have learned the art or commerce subject stream in their A/L examination. This means the primary teachers learned A/L subjects that do not impact their science teaching self-efficacy in the primary grades. The findings were the same throughout the sample, whether in a teaching grade or in a district. No studies could find the teachers' prior learning experience in O/L and A/L comparisons. Therefore, the study added new knowledge to the literature on primary science teaching confidence. The sample had over 20 years of teaching experience in primary education. The experience has a significant and very high correlation (0.875, $p > 0.05$) with the primary teachers' attributes. The experiences of primary teachers significantly influence their science teaching self-efficacy (Schwarzhaupt et al., 2021, and Ramakrishnan and Salleh, 2018).

Table 1: Demographic statistics for the sample

	Grade	Gender	District	O/L science results	A/L stream
Valid	427	427	427	427	427
Mean	3.054	1.951	1.993	2.972	1.461
Skewness	-0.047	-4.184	0.013	-	-
Kurtosis	-1.181	15.581	-1.546	-	-
Minimum	1.0	1.0	1.0	1.0	1.0
Maximum	5.0	2.0	3.0	5.0	5.0

Table 2: The independent variables of the study are primary teacher's attributes, principal influence, and school-related factors. The study records high mean values for the independent variables. All variables are significant and have an impact on teachers' self-efficacy. The primary teacher's attributes consisted of five dimensions: science knowledge, science process skills, teaching strategies and methods, teachers' qualifications, and teachers' experience. The average values for all dimensions are over 3, showing their importance in teaching. Out of the dimensions, the lowest mean value of 3.16 for science knowledge reveals that science knowledge is the least important. The finding is supported by Amy Catalano, Asselta, and Durkin's (2019) study, which found that the relationship between science content knowledge and science teaching self-efficacy is negative. The highest mean value of 3.81 for teaching strategies indicates high importance in primary teaching. Ramakrishnan and Salleh's (2018) study also found that there is a positive relationship between teaching strategies and teachers' science-teaching self-efficacy. Similar results of Chan and Lay's (2021) study show that science knowledge and pedagogical skills are important factors in the improvement of teaching self-efficacy. If teachers have more experience and are highly competent in teaching strategies, they'll be fit to teach primary science. The impact of each dimension shows more or less the same distribution grade-wise and district-wise. Therefore, the primary teachers' attributes do not significantly change due to their teaching grades or districts in the context of the study. The study of Schwarzhaupt et al.'s (2021) findings on the relevant grade impact is not matched with these findings. Some of the items for the teacher's qualification were removed when the dimension reduction was done in the exploratory factor analysis, and the rest of the items were removed because they showed low loading factors (below 0.5, $p > 0.05$) in the measurement model. Therefore, teacher qualifications such as degrees and master's degrees were not an impactful dimension for the primary science teaching self-efficacy in the proposed model of the study. The mean value for the school-related factors is 3.26, and the mean value for the principal influence is 3.67, which indicates all the independent variables have an important impact on the primary teachers' science teaching self-efficacy. The impact of the principals' influence and school-related factors also shows no differences grade-wise or district-wise in the studied context. Therefore, the findings of the study may be crucial for implementing new strategies to enhance science education in the primary grades of the Western Province of Sri Lanka.

Table 2:The mean value and standard deviation for the studied variables

Variables/ Dimensions	Mean	Std. Deviation
Primary teacher	3.48	0.53
Science Knowledge	3.16	0.66
Science Process Skills	3.68	0.79
Strategies and Methods	3.81	0.81
Teacher Qualification	3.24	0.72
Teacher Experience	3.48	0.74
Principal Influence	3.67	0.74
School related factors	3.26	0.65
Other resources	3.48	0.72
Physical resources	3.03	0.85
Teachers' self-efficacy	3.48	0.76

Exploratory Factor Analysis (EFA)

Multivariate statistics employ the EFA statistical technique to identify potential connections between measured variables or factors. The dimension reduction implied in SPSS on the dataset is that it streamlines intricate datasets by diminishing the quantity of variables. Consequently, some items were removed and categorized into new subsets. The subsets for the primary teacher were science knowledge, science process skills, teaching strategies, teacher qualification, and teacher experience. The two dimensions—instructional leadership and supervision of the principal's influence—were extracted into one component by the principal component method in the studied context. The school-related factors were extracted by the principal component method into two (2) subsets, and they were renamed as physical resources and the rest of the resources.

The values in Table 3 shows that all KMO values for each variable are higher than 0.7, indicating that the sample is adequate for the analysis, and due to the fact that the Cronbach's alpha value for each variable is higher than 0.7, the internal reliability of the items in the sample can be accepted (Hair, Black and Babin, 2019).

Table 3: The KMO value and Cronbach's alpha

Variable	Dimension	KMO value	Cronbach's Alpha	No. of Items
Primary Teacher (PT)	Science Knowledge (SK)	0.947	0.937	6
	Science Process Skills (SP)			9
	Teaching Strategies (TSM)			6
	Teachers' Qualification (TQ)			5
	Teachers' experience (PTE)			8
Principal Influences (PI)		0.947	0.945	11
School Related Factors (ISRs)	Physical Resources (PR)	0.736	0.801	4
	Other Resources (ORs)			3
Teachers' Self-efficacy (TSE)		0.940	0.949	10

The results of the exploratory factor analysis were analysed with the structural equation method of the confirmatory factor analysis.

Confirmatory Factor Analysis (CFA)

The EFA is followed by the CFA to test, examine, and validate hypotheses regarding the identified variables or factors. The CFA is done by the structural equation method. The structural equation modelling (SEM) is a collection of statistical models that aim to elucidate the connections between multiple variables (Hair, Black and Babin, 2019). The SEM incorporates measurement model and structural model.

Step 1: The measurement model is constructed with the observed and latent variables and modification indices were applied to the measurement model.

Table 4 displays the parsimonious fit index (CMIN/Df) value of 2.028. If this value is less than or equal to 3, it indicates that the proposed model is a good fit and acceptable. A fit value of 0.910, which is higher than 0.900, indicates that the model has an acceptable fit.

The value of 0.049 is below the threshold of 0.07, indicating that the model has an acceptable fit. If the three indices, namely the parsimonious fit, the incremental fit, and the absolute fit, indicate a satisfactory level of fitness, it can be concluded that the measurement model is fit (Hair, Black and Babin, 2019).

Table 4: The fit indices of the measurement models

Name of category	Goodness of Fit	Threshold values	Result	Model evaluation
Parsimonions fit	CMIN/Df	≤ 3	2.028	Good fit
Incremenetal fit	CFI	≥ 0.8	0.910	Acceptable fit
Absolute fit	RMSEA	≤ 0.08	0.049	Acceptable fit

Step 2: Constructing the Structural Model

Prior to constructing the structural model, the subsequent analysis confirms the unidimensionality, validity, and reliability of all latent constructs. Unidimensionality is achieved when the measuring items demonstrate satisfactory factor loadings for the corresponding latent construct. All items in the measurement model have factor loadings that are higher than the specified cut-off point of 0.5 (Hair, Black and Babin, 2019). The items that had factor loadings below the threshold cut-off point of 0.5 were removed. The teachers' qualification dimension and the rest of the resources dimension were eliminated due to less than 3 items remaining after applying factor loading cut-off points.

The Structural Model

The final structural model was composed of 43 items dispersed as the Figure 1.

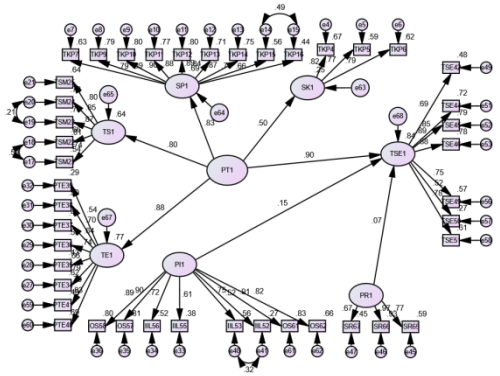

Figure 1. The structural model for the study

The fit indices of Table 5 indicate that all the indices: Parsimonions fit, Incremental fit and absolute fit are within the threshold values. Therefore, the hypothesized model is a satisfactory fit for the structural model of the study.

Table 5: The fit indices of the structural model

Name of category	Goodness of Fit	Threshold values	Result	Model evaluation
Parsimonions fit	CMIN/Df	≤ 3	2.571	Good fit
Incremenetal fit	CFI	≥ 0.8	0.909	Acceptable fit
Absolute fit	RMSEA	≤ 0.08	0.061	Acceptable fit

Table 6 shows that the standard error values for the primary teacher attribute, principal influence, and school-related other factors are tiny, which suggests the estimates are more precise (Hair et al., 2019). Researchers use the critical ratio (C.R.) to assess the significance of the relationship. Table 6 shows that the values of C.R. are greater than 1.96 for the relationship that can be considered statistically significant at 95% (Hair et al., 2019). Table 6 shows the H1, H2, and H3 hypotheses are significant and positive and therefore supported. Therefore, all correlations between variables are significant and positive. Teachers' self-efficacy is highly correlated with the primary teacher attributes, which is 0.90, and that is a very high positive correlation. The lowest correlation with the teachers' self-efficacy is school-related factors, which is 0.15; however, it is a very weak positive strength. The dimensions of the primary teacher—science knowledge, science process skills, teaching strategies, and teacher's experience—are

significant and positively correlated with the primary teacher. Therefore, the teacher attributes that can be identified are science knowledge, science process skills, teaching strategies, and the teacher's experience. Science knowledge has a low positive impact (below 0.5), and the rest of the dimensions have a very high positive impact (above 0.80) on their science teaching abilities. Chan and Lay's (2021) study demonstrates that enhancing science knowledge does not correspondingly boost self-efficacy in science teaching. The teaching experience was a highly correlated factor (0.875) among the rest of the teacher-related factors. Chen, Wu, and Hsin's (2022) study also determined that the teachers' experience in science teaching was the most influential factor. While Chen, Wu, and Hsin (2022) did not propose a correlation between the principal's influence and school resources and their teaching self-efficacy, this study's findings indicate that for primary teachers already in service, their self-efficacy for teaching science is significantly correlated with the principal's influence and school-related resources as well. However, a primary teacher has a very strong influence, while the principal's influence and school-related factors have comparatively weak influences. All the independent variables—primary teacher, principal influence, and school-related factors—have a significantly important impact on the primary teachers' science teaching self-efficacy. The assumed model for the primary teachers' science teaching self-efficacy can be accepted. The study's findings indicate that primary teachers can leverage their professional development in science teaching to enhance science education in the primary grades. The professional development programs need to address teaching strategies, explore various experiences, and practice science process skills. The science knowledge relevant to the integrated curriculum is an essential part of the need to update the primary teachers. The basic requirements of the principal's influence and school-related factors are essential. However, they do not contribute much to science teaching self-efficacy. The table shows significant and positive correlations between primary teachers' attributes, science knowledge, process skills, teaching strategies, and their experience with science teaching self-efficacy. These relationships vary in terms of their strength. The influences of the principal and factors related to the school also have a positive impact on self-efficacy, although these relationships are relatively weak. All the hypotheses regarding the relationships have been confirmed. The data indicates that enhancing these factors has the potential to improve science teaching self-efficacy.

Table 6: The relationship between all the variables of the structural model

Relationship between	***p*>0.05**	**Estimate**	**Correlation**	**S.E.**	**C.R.**	**Hypothesis**
Primary teachers' attributes andScience teaching self-efficacy	0.000	0.81	0.90	0.06	12.87	Significant, very high strength and positive.Supported
Science Knowledge	0.000		0.50			
Science Process Skills	0.000		0.83			
Teaching Strategies	0.000		0.80			
Teacher's experience	0.000		0.88			
Principal influence andscience teaching self efficacy	0.000	0.15	0.15	0.03	4.75	Significant, very weak strength and positive.Supported.
School related factors andscience teaching self efficacy	0.020	0.05	0.07	0.02	2.33	Significant, very weak strength and positive.Supported.

The findings also have implications for the field of primary science education. To enhance the incorporation of science in primary grades, professional development programs and school environments could offer teachers interpersonal assistance and favorable learning and teaching opportunities (Haatainen & colleagues, 2021). With the assistance and favorable exposure to scientific

knowledge, primary teachers can enhance and cultivate their confidence in teaching science (Chan & Lay, 2021). This, in turn, may motivate them to include a greater amount of scientific material and engage in more science-related activities during their classroom instruction.

This study makes several distinct contributions to the current body of literature on primary teachers' self-efficacy in teaching science. The study investigates the factors that influence the overall development of self-efficacy in primary teachers. Furthermore, unlike previous research, this study took into account not only the characteristics of primary teachers but also the impact of principals and school-related factors.

5. Implication and Conclusion

This study found that primary teachers' self-efficacy in science teaching is mainly influenced by the teacher's attributes. Teachers' prior learning in science up to the O/L examination has an impact on their primary science teaching efficacy, and the A/L subject stream is not very important. The professional development program is sufficient to ensure the provision of necessary science education aligned with the O/L science curriculum. Especially, the program needs to plan for providing science process skills rather than science content. Therefore, the study proposes an activity-based or practical-based teacher professional program that can enhance science teaching efficacy among primary teachers. The impact of the school principal's leadership and supervision is significant. Furthermore, school-related factors such as electricity, water, laboratories, parents, and teacher manuals also affect the teacher's self-efficacy in teaching science. Therefore, it concludes that establishing the credibility of the primary teacher's science teaching requires three main approaches: the development of the teacher, the advancement of the school principal's role in science education, and the provision of various physical resources that enhance the quality and quantity of the learning and teaching process. It also requires implementing professional programs for teacher development, equipping them with experiences, learning methods, academic skills, and scientific knowledge. This study helps us understand how teachers' confidence in teaching science is linked to their own qualities, the influence of school principals, and the resources available at school, as described in the social cognitive theory of organizational management by Wood & Bandura (1989).

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