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Primary Science Teachers' Self-Efficacy Beliefs about Teaching in Malaysia

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Abstract:
This research aimed to measure the primary science teachers' self-efficacy beliefs about teaching in Malaysia. A descriptive research design was used for this study. The sample consisted of 144 primary science teachers in Batang Padang, Perak. The instrument's items were adapted from three different instruments and modified for this study; the components of the subscales are "Pedagogical Knowledge," "Content Knowledge," "Teachers' Effort," and "Student Engagement." The study investigated the differences in teachers' self-efficacy according to gender, and education qualifications. A T-test was used to compare the mean differences between different groups. There was a statistically significant difference between male teachers (M = 4.08, SD = 0.42) and female teachers (M = 3.93, SD = 0.39). In contrast, t-test results showed no statistically significant difference between primary science teachers who possessed different education qualifications regarding their self-efficacy. This study redounded to science education by looking at the self-efficacy judgment of science teachers and providing information about the strengths and weaknesses of teachers' self-efficacy in Batang Padang, Perak. From this study, it emerged that female teachers have a lower level of self-efficacy. Therefore, because most of the teachers are female, it is crucial to determine why female teachers have lower efficacy and their difficulties. Research should further investigate and comprehend the differences in self-efficacy beliefs based on other demographic variables. Research should further investigate and comprehend the differences in self-efficacy beliefs based on other demographic variables.

Keywords: science teacher, self-efficacy beliefs, science education.

马来西亚小学科学教师对教学的自我效能信念

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摘要：
本研究旨在衡量马来西亚小学科学教师对教学的自我效能信念。本研究采用描述性研究设计。样本由霹雳州巴当巴东的 144 名小学科学教师组成。该仪器的项目改编自三种不同的仪器，并针对本研究进行了修改；子量表的组成部分是“教学知识”、“内容知识”、“教师的努力”和“学生参与”。该研究根据性别和教育资格调查了教师自我效能感的差异。吨检验用于比较不同组之间的平均差异。男教师（米 = 4.08，标清 = 0.42）与女教师（米 = 3.93，标清 = 0.39）差异有统计学意义。相比之下，吨检验结果显示，具有不同教育资格的小学科学教师在自我效能感方面没有统计学上的显着差异。这项研究通过观察科学教师的自我效能判断并提供有关霹雳州巴当巴东教师自我效能优势和劣势的信息，为科学教育做出了贡献。从这项研究中可以看出，女教师的自我效能感水平较低。因此，由于大多数教师是女性，因此确定女教师效能较低的原因及其困难是至关重要的。研究应进一步调查和理解基于其他人口变量的自我效能感信念的差异。研究应进一步调查和理解基于其他人口变量的自我效能感信念的差异。

关键词：科学教师，自我效能信念，科学教育。

1. Introduction

Teacher efficacy refers to "the teacher's belief in his or her ability to plan and conduct the necessary actions to successfully complete a specific educational task in a given situation (Nikoçeviq-Kurti, 2022). Self-efficacy belief is a theoretically derived from the social learning theory, which was developed by the renowned Canadian psychologist Albert Bandura. Bandura, in his article on social learning theory, agreed upon the idea that the changes in a person's behavior correlate directly with his or her perceived self-efficacy (Bandura & Baumeister, 1999). Albert Bandura defined perceived self-efficacy as the beliefs of people about their personal capabilities to complete tasks and reach goals at designated levels (Ramachaudran, 1994). The interesting theory presented by Bandura stated that people with high self-efficacy have faith in themselves that they can achieve a target, and they are prone to interpret challenging tasks as something that they will be proficient at but not something to be avoided. The expanded social learning theory was renamed as social cognitive theory mainly to emphasize that personal factors in three forms, namely cognitive, affective and biological events, behavioral, and environment influences are the three major molds of human behavior (Levin et al., 2001).

Self-efficacy beliefs are so powerful that they gain control of human thought, feelings, and actions. Human motivation, well-being, and personal accomplishment are much decided by self-efficacy beliefs (Supandi et al., 2021). This is because people will persevere when facing predicaments only if they believe that their actions can bring about the consequences they aspire. Bandura (1986) stated that self-efficacy beliefs cover nearly every aspect of our lives, deciding whether we think optimistically, or become vulnerable to stress and depression. People who have a high level of efficacy establish a higher goal to be achieved and show endurance while facing challenges. They view failure as the consequence of having insufficient knowledge or effort which can be overcome. Nonetheless, people who have low self-efficacy beliefs will give up easily and fall easy victims to stress and depression. Persistent with the original idea of self-efficacy, Tschannen-Moran and Hoy (1998) explained teacher's self-efficacy as how teachers judge their ability to engage their students in learning, including students who have low motivation. Researchers have discovered that the behavior and learning of students are related to the characteristics of teachers.

Primary education in Malaysia is divided into two stages, where stage one comprises Years 1-3, while stage two comprises Years 4-6. In KBSR, subject Science was not included in Stage 1, but was only taught to the students in Stage 2. Nevertheless, the introduction of KSSR led to the introduction of the subject Science and Technology into both stages of primary education. The subject Science and Technology is a combination of Science, Design and Technology, and Information and Communication Technology. It aims to foster students' interest in Science and Technology and develops creativity and innovation through experience and investigation. Students are expected to have mastered scientific skills, thinking skills and practice scientific attitudes and values after learning through this subject. However, teachers have dissimilar teaching efficacy beliefs and thus some agree to the reform practice while others unable to alter their classroom environment to execute the curriculum reform (Abdelmoneim & Hassan, 2012).

Teachers with high self-efficacy beliefs generally have the capability to guide their students to outperform the students in other classes. Teachers who are high in self-efficacy use inquiry methods, small group learning activities and open-ended questions more than low self-efficacious teachers. High-efficacious teachers are also more open to new ideas, more willing to innovate, they pay more attention to low motivate students, and they are also less likely to experience stress and burnout (Tschannen-Moran & Hoy, 1998). Therefore, the researchers feel the urge to examine the level of Science Teachers' Self-Efficacy in the district that I am working now in Malaysia.

2. Literature Review

The adjustments required to support real and significant educational improvement are fundamental and systemic. For policymakers and administrators around the nation, new difficulties are arising as change and reform in education continue to be at the political fore. By its very nature, teaching entails dealing with unclear problems that are dynamic, non-linear, and complex. As a result, a key factor in determining a teacher's efficacy is a personal agency, or how they define their responsibilities, use tactics, assess their chances of success, and finally resolve issues and challenges. This idea of personal agency, which refers to teachers' capacity for self-organization, self-reflection, self-regulation, and proactive conduct, serves as the foundation for the significance of self-efficacy as a crucial element in teacher effectiveness. The relationship between personal agency and a teacher's efficacy beliefs is based on personal experience and the teacher's capacity for reflection and decision-making (Bray-Clark & Bates, 2003). Teacher self-efficacy reveals the extent to which a person has confidence/belief in their own abilities to teach effectively (Rorimpandey & Midun, 2021). A high level of teacher self-efficacy is a sign that they will support, implement, and generate positive change, persevere through difficulties, be receptive to new ideas, and try teaching methods even if they are deemed dangerous (Gordon et al., 2022). Studies on teacher self-efficacy have been conducted for more than 20 years. As the field has developed, a plethora of data has emerged suggesting that self-efficacy influence teacher effectiveness. Research reveals that having strong self-efficacy beliefs can influence how likely teachers are to apply the skills they have gained in in-service training in the classroom. According to studies involving instructors, people with high levels of teaching self-efficacy tend to explore more alternative teaching strategies, look for better teaching techniques, and experiment more with instructional materials (Bray-Clark & Bates, 2003). To sum up, teaching self-efficacy beliefs are considered as the "key motivational beliefs influencing professional behavior" (Nikoçeviq-Kurti, 2022).

2.1. Research Framework

Tracing back the theoretical framework of self-efficacy leads us to the work of a social cognitive psychologist, Albert Bandura, who believed that human behavior is influenced by both internal and external factors (Bandura, 1986, 1997; Bandura & Baumeister, 1999). Bandura proposed that human be an agent who deliberately makes changes in life by taking actions. The behavior shown by a person is affected by triadic reciprocal determinism, as shown in Figure 1. According to this model, human achievement is determined by the interactions between one's behavior, thoughts, beliefs, and environmental conditions (Bandura, 1997). The triadic reciprocal explains the relationship between the three factors as the following:

2.1.1. Personal Factors ↔ Behavior

The model shows that personal factors, behavior and the environment interact and influence one another bidirectionally. The relationship between personal factors and behavior explains that thought and belief shape a person's behavior. The effects brought about by these actions subsequently regulate the emotional reactions.

2.1.2. Environment ↔ Personal Factors

The interactive relation between the environment and personal characteristics indicates that people establish their prospects, beliefs and feeling through modeling, instruction, and social persuasion. Individuals of dissimilar age, size, race, sex, and physical attractiveness also receive different reactions from their social environment.

2.1.3. Behavior ↔ Environment

This bidirectional relationship indicates that behavior changes environmental conditions and is then changed by the environment it creates. Due to the bidirectional relationship, people influence the environment and at the same time being influenced by the environment. People who are aggressive create a hostile environment, while people who are friendly create an amiable environment. The environment then decides the behavior of people.

The following figure presents the triadic reciprocal relationship between personal factors, behavior, and environment (Bandura & Baumeister, 1999).

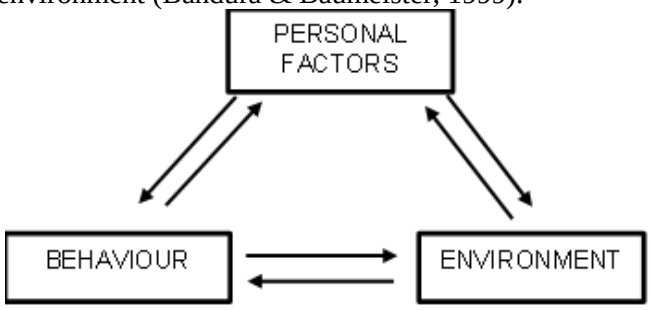

Figure 1. The triadic reciprocal relationship between personal factors, behavior, and the environment

3. Problem Statement

From the TIMSS and PISA international assessment, it is obvious that students must strengthen their thinking skills. The government launched the Primary School Standard Curriculum (KSSR), which determines embedding a balanced set of knowledge and skills such as creative thinking, innovation, problem-solving, and leadership (Tschannen-Moran & Hoy, 1998). The Ministry of Education has entrusted teachers to improve the quality of our students. To build a class of excellent students, we need excellent teachers who always seek out new ideas and keep refreshing their own knowledge.

Ever since the idea of teachers' self-efficacy was introduced, researchers have been interested in finding the relationship of self-efficacy and students'

achievement, and many researchers agreed upon the idea that students' motivation and achievement are highly influenced by teachers' efficacy beliefs (Bandura, 1997; Tschannen-Moran & Hoy, 1998; Mahmoee & Pirkamali, 2013). Mojavezi and Tamiz (2012) proved the effectiveness of teachers' self-efficacy in increasing students' motivation and achievement. The abundance of research evidence suggests that teachers' efficacy act as an important factor in determining students' achievement. We need teachers who have high efficacy to keep our pace up with the other countries. Teachers who have high qualities in subject matter knowledge, skills and competencies are severely in need to instruct our young generation. The importance of having teachers with a high sense of efficacy cannot be overlooked. The first step to be taken, surely, is to check the level of teachers' efficacy.

Although, self-efficacy has a great influence on many attitudes and behaviors, in the workplace, and at school (Barni et al., 2019), it has crucial influence on the way teachers manage stress. Teachers who have low self-efficacy have higher levels of stress (Betoret, 2006); therefore, improved teacher self-efficacy can result in improved teacher mental health and job satisfaction. Research has found that teachers who have lower self-efficacy tend to quit teaching carrier. Moreover, self-efficacy is a deciding factor in teachers' job satisfaction. Teachers with high self-efficacy have a great ability to cope with stress (Betoret, 2006), thus can help reduce the number of teachers resigning from their position. It has also been reported that teachers who have high efficacy have less chance of experiencing burnout (Zee & Koomen, 2016). Therefore, the current study examines the differences in teachers' efficacy related to their gender and qualification levels. Three research questions defined this study:

1. What is the level of Self-efficacy among science teachers?
2. Are there any differences in the level of science teachers' self-efficacy according to their gender?
3. Are there any differences in the level of science teachers' self-efficacy according to their education qualifications?

4. Research Methods

This study aims to investigate primary science teachers' self-efficacy beliefs about teaching in Malaysia. Of all accessible research design, to find the level of science teachers' self-efficacy, descriptive research will be used to answer the research questions. People use descriptive research to portray the participants precisely (Polit & Hungler, 1999).

4.1. Population and Sampling

The population of the research comprised the science teachers from the Batang Padang District, Perak. The district has 95 national primary schools, including 53 Malay schools, 23 Chinese schools and 18 Tamil schools. The primary schools in Malaysia comprise national and national-type schools. To ensure that the sample chosen can accurately represent the population, stratified sampling is used to guarantee representation of the subgroups of the schools. Stratified sampling involves intentionally choosing participants from every subgroup.

The researcher referred to the steps of stratified sampling suggested by Gay et al. (2012):

1. Identify and define a population;
2. Determine desired sample size;
3. Identify the variables and subgroups for which you want to guarantee a specific representation;
4. Classify all members of the population as members of one of the identified subgroups;
5. Randomly select (using a table of random numbers) an equal number of individuals from each subgroup.

The estimated sample composed of 159 teachers from 53 schools as, thus the data will be collected from 29 Malay schools, 17 Chinese schools and 7 Tamil schools, where I assumed that each school has three Science teachers available. Among the estimated 159 teachers as the sample, 144 of them have responded. The respond rate was 66.67%.

4.2. Instrument

A little literature has been reviewed to guide the researchers in developing the instrument. Table 1 shows the information on the instruments that were designed to examine teachers' efficacy. These instruments have presented an impression for the researcher to include the conceivable items and factor structures for the newly developed primary science teacher self-efficacy scale. Since the researchers derived most questions from STEBI, 5 point-Likert scale questionnaires have been employed. The instrument of this research is an instrument with items derived from three scales related to science teachers' self-efficacy. The three scales are Science Teachers Self-Efficacy Beliefs instrument (STEBI – form A), Teachers' Efficacy Beliefs Scale (TSES), and Technological Pedagogical Content Knowledge Survey (TPACK). The construct validity of a questionnaire can be tested with factor analysis. While Conbrach's alpha will be used to test the reliability of the instrument, the results showed that the instrument has a good validity construct and that the instrument is a reliable instrument, with Cronbach's $\alpha = 0.94$. The four factors included in this questionnaire all had high reliability, with Cronbach's $\alpha = 0.89$, 0.89, 0.77, and 0.82 respectively.

5. Findings

5.1. Research Question 1: What is the Level of Efficacy among Primary Science Teachers in Batang Padang, Perak?

This question was answered by looking at the mean score of each item; the mean scores were then

converted into percentages of mean, with 100% as the highest mark. The same was done for "Primary Science Teachers' Self-Efficacy Scale" and the other four subscales. Table 1 shows the percentage of mean of each item.

Table 1. Results of the descriptive statistics

Scale	Mean	% of mean	Std. deviation
Science Teachers' Self-efficacy	3.97	79%	0.32
Subscales			
Pedagogical Knowledge	4.00	80%	0.31
Content Knowledge	3.86	77%	0.46
Teacher's Efforts	4.24	85%	0.40
Students' Engagement	3.87	77%	0.40

The two highest scored items by primary science teachers in Batang Padang, Perak, were items one and two with 88%, which represents the item in the subscale "Teachers' Effort." However, the lowest scored item was Item 25 with 73%, which represents the subscale "Student Engagement." Mean score and percentage of mean of "Primary Science Teachers' Self-Efficacy Scale" and its subscale are presented in Table 1. Teachers in Batang Padang scored an average of 79% in the "Primary Science Teachers' Self-Efficacy Scale." Among the 4 subscales that are included in the questionnaire, teachers scored the highest in "Teacher's Effort," which was 85%. The second highest was "Pedagogical Knowledge', 80%. While teachers scored equally on both "Content Knowledge" and "Student's Engagement," which was 77%.

5.2. Research Question 2: Are There Any Differences in the Level of Primary Science Teachers' Self-Efficacy in Batang Padang According to Their Gender?

Table 2 shows the T-test for comparisons of primary science teachers' self-efficacy in Batang Padang, Perak, by gender. Independent sample t-test indicated that male teachers had a slightly higher self-efficacy (M = 4.08, SD = 0.42) compared to the female teachers (M = 3.93, SD = 0.39). The difference was statistically significant t (142) = 2.40, p < .05. The effect size was medium, d = 0.5. Male teachers were also reported to have statistically significant higher scores in instructional strategy (M = 4.13, SD = 0.32) than female teachers (M = 3.96, SD = 0.30), t (142) = 2.75, p < .05. The other scale that male teachers have statistically significantly higher scores than female was the content knowledge scale, with the result of males (M = 4.01, SD = 0.41) and females (M = 3.82, SD = 0.47), t (142) = 2.10, p < .05. Among the four factors in the questionnaire, male teachers scored the highest in the teachers' effort (M = 4.29, SE = 0.39) compared with the female teachers (M = 4.23, SE = 0.41). However, the difference is not statistically significant t (142) = 0.70, p > .05. Results also showed that there was no statistically significant difference between males (M = 3.97, SD = 0.33) and females (M = 3.84, SD = 0.31), t (142) = 1.71, p > .05 in the students' engagement expectancy scale.

Table 2. Independent sample t-test for comparison of primary science teachers' self-efficacy by gender

Scale	Gender	Mean	SD	df	t	Sig.
Science Teachers' Self-Efficacy	Male	4.08	0.42	142	2.40	0.018
	Female	3.93	0.39			
Subscales						
Pedagogical Knowledge	Male	4.13	0.32	142	2.75	0.007
	Female	3.96	0.30			
Content Knowledge	Male	4.01	0.41	142	2.10	0.038
	Female	3.82	0.47			
Teachers' Effort	Male	4.29	0.39	142	0.70	0.483
	Female	4.23	0.41			
Students' Engagement	Male	3.97	0.33	142	1.71	0.090
	Female	3.84	0.31			

5.3. Research Question 3: Are There Any Differences in the Level of Science Teachers' Self-Efficacy According to Their Education Qualifications?

T-test was used to compare the differences in the level of science teachers' self-efficacy according to their education qualifications (Table 3).

Table 3. Independent sample t-test for comparison of primary science teachers' self-efficacy by education qualification

Scale	Gender	Mean	SD	df	t	Sig.
Science Teachers' Self-Efficacy	Diploma or lower	3.96	0.22	101.2	-0.42	0.967
	Degree or higher	3.97	0.35			
Subscales						
Pedagogical Knowledge	Diploma or lower	4.00	0.21	142	-0.15	0.881
	Degree or higher	4.00	0.34			
Content Knowledge	Diploma or lower	3.86	0.34	93.78	-0.10	0.924
	Degree or higher	3.86	0.50			

Continuation of Table 3

Teachers' Effort	Diploma or lower	4.24	0.41	142	0.00	0.997
	Degree or higher	4.24	0.40			
Students' Engagement	Diploma or lower	3.86	0.28	142	0.15	0.879
	Degree or higher	3.86	0.44			

Table 3 shows the result of T-test for comparison of primary science teachers' self-efficacy in Batang Padang, Perak, by education qualification. Independent sample t-test indicated that there are no statistically significant differences between teachers holding diploma or lower qualification and degree or higher qualification, with the results (M = 3.96, SE = 0.22) and (M = 3.97, SE = 0.35), respectively, t (142) = -0.42, p > .05. Results also showed that there was no statistically significant difference between teachers with diploma or lower and degree or higher in the four subscales.

6. Discussion and Conclusion

The main purpose of this research is to investigate primary science teachers' self-efficacy beliefs about teaching in Malaysia. The results showed that the overall score of primary Science teachers in this Primary Science Self-efficacy scale was 79%. They scored the best in teachers' effort at 85%, followed by pedagogical knowledge at 80%. The respondents scored the least in both content knowledge and students' engagement expectation at 77%. The same result was obtained from the study by Mart (2013) and Azar (2002), showing that teachers always try to find better ways to teach science. The results of the independent sample T-test for comparing teachers of different genders and education qualifications indicated that male teachers had statistically higher science teacher's self-efficacy scores (M = 4.08, SD = 0.42) than the female teachers (M = 3.93, SD = 0.39) respectively, t (142) = 2.40, p ≤ .05. Similarly, Yang and Wang (2019) found that the efficacy of males is stronger than females in science teaching. Another comparison made between degree and non-degree holders showed no difference between their self-efficacy, with the results (M = 3.96, SE = 0.22) and (M = 3.97, SE = 0.35), respectively, t (142) = -0.42, p > .05, suggesting that degree and non-degree holders were on the same level of self-efficacy. However, other studies have found statistically significant differences in the self-efficacy of teachers of different educational levels; the difference in the results of the studies may result from cultural differences (Yang & Wang, 2019).

To conclude, this study exposed the two subscales that primary science teachers in Batang Padang had the lowest self-efficacy beliefs, which were "Content Knowledge" and "Student engagement." Teachers' content knowledge affects their confidence in teaching. When teachers are not efficient in the science concept, their misconception has a great possibility to carry on towards the students. However, primary science teachers in Batang Padang were found to have low efficacy in enhancing students' engagement. Independent sample t-test indicated that male teachers had a slightly higher self-efficacy than female teachers. Research results also indicated that male teachers scored higher in all four factors presented in the questionnaire: pedagogical knowledge, content knowledge, teachers' effort, and student engagement. This is not a good thing as most science teachers in Batang Padang are females. Although teachers hold different education qualifications, they've gone through the same procedure to become a teacher in Malaysia. Degree or non-degree holders, teachers in Malaysia must undergo training under the wing of the Institute of Teacher Education. The same level of efficacy found in degree and non-degree holders suggested that all these programs have equal affection toward the teachers in terms of teaching efficacy. Even though Science-major teachers in Batang Padang possess higher self-efficacy, there were more non-mojor teachers in Batang Padang. Teachers' shortages often caused the education authorities to appoint teachers to teach in the areas that they are not familiar with, which then worsens the quality of teaching. Thus, education authorities are urged to consider assigning teachers to teach the subjects that they were trained.

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Authors' Contributions

All the authors were involved in conducting this research by doing literature review, designing the research, collecting, and analyzing data, and reviewing the paper as one research team.

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