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Original Paper

Preservice Elementary Teacher Self-Efficacy and Attitude towards Teaching Science

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Abstract

The present study investigated the status and relationship between preservice elementary teacher self-efficacy and attitude towards teaching science. The researcher employed a mixed-method approach to collect both quantitative and qualitative data. The researcher used a questionnaire responded by 125 undergraduates who major in elementary education to collect quantitative data. The self-efficacy regarding teaching science includes five aspects, and the attitude towards teaching science consists of three aspects. Results show that preservice elementary teachers have both high self-efficacy regarding teaching science and positive attitudes towards teaching science. All the aspects of self-efficacy regarding teaching science are demonstrated to have a positive correlation with attitude towards teaching science and its corresponding aspects. A formula model was also constructed to predict the preservice elementary teachers' attitude towards teaching science based on their self-efficacy regarding teaching science.

Keywords

preservice elementary teacher, self-efficacy, attitude, teaching science

1. Introduction

Nowadays, science education plays a key role in providing a sufficient competent workforce to citizens for the twenty-first century, featured by a globalized science -driven society. (Yilmaz & Kaya, 2018, Rudolph, 2020) To offer a successful science education, well-prepared and high-qualified teachers are of great necessity, especially in elementary school. Preservice Elementary Teacher (PET) will teach science in elementary schools after graduation. Their career attitudes are closely related to their behaviors in teaching. Research showed that individuals' beliefs in their abilities derive from the

motivational and emotional status as well as their actions on the basis of what they believe in rather than the situation they are in. (Norton, 2019) Self-efficacy, first raised by Bandura (Bandura, 1986), is described as the belief of one's ability to fulfill a particular task or achieve a particular outcome. (Bandura, 1992, Bandura, 1995) It is reported that self-efficacy beliefs regulate human functions involving four types of processes: cognitive, motivational, affective, and selective. (Bandura, 1992) Self-efficacy beliefs play a crucial part in an individual's level of motivation and performance. As a result, it is of importance to understand the status and correlation of PET's self-efficacy and attitude towards teaching science.

1.1 Teacher Self-Efficacy

Teacher self-efficacy has been broadly defined in literature differently. Ashton(Ashton 1984) defined teacher self-efficacy as teachers' confidence in their ability to fulfill all teaching responsibilities. Gibson et al. (Gibson & Dembo, 1984) explained teacher self-efficacy as teachers believe that they can positively influence students' learning. Hoover and coworkers (Hoover-Dempsey & Bassler et al., 1987) stated that teacher self-efficacy shows a teacher's confidence in his teaching ability, and teachers' teaching ability as well as professional knowledge can have an impact on students' belief in learning. Guskey (Guskey, 1988) pointed out that teachers with high self-efficacy normally like teaching and feel confident about their teaching abilities. In addition, these teachers are more willing to receive new instructional practices like those related to mastery learning. Skaalvik (Skaalvik & Skaalvik, 2010) conceptualized teacher self-efficacy as individual teachers' beliefs in their own ability to arrange, organize and do activities to achieve given teaching goals, based on social cognitive theory. To sum up, most researchers thought the concept of teacher self-efficacy contains both cognitive and emotional components.

The assessment of teacher self-efficacy is generally conducted by self-report questionnaire. The earliest measurements can be traced back to the Rand Research Group in 1970s, based on Rotter's social learning theory (Rotter, 1954). Two questions were designed to measure teacher self-efficacy. One is that teachers could not play a very important role because students' motivation and achievement were largely determined by their home environment. The second question is if I teach hard, even the worst or least willing students can be well taught. Teachers who believe this statement confirmed confidence in their ability to overwhelm factors that will build students learn troublesomely. Each statement give a score for teacher effectiveness. (A & B, 2001) On this basis, the assessment tools of teachers' self-efficacy were further refined and expanded. For example, Rose and Medway (Rose & Medway, 1981) developed a 28-item scale to measure teachers' generalized expectancies for internal-external control over student success and failure in the classroom. This scale can well predict teachers' behaviors in the classroom, including their willingness to adopt new educational techniques following inservice training. With the development of self-efficacy theory, the assessment questionnaire for teachers' self-efficacy was raised by Bandura's social cognitive theory. (Ba Ndura, 1977) For instance, Gibson and Dembo (Gibson & Dembo, 1984) developed an instrument with 30 items to measure

teacher efficacy. Using this instrument, it was found that there are two factors (individual teaching effectiveness and general teaching effectiveness) that corresponded to the concept of efficacy expectation and outcome expectation proposed by Bandura.

1.2 Preservice Teacher Self-Efficacy

Preservice teacher self-efficacy refers to their belief in the capability to productively finish educational tasks. (Knobloch, 2001) It has been proved that preservice teacher self-efficacy have a remarkable influence on effective teaching practices and teaching knowledge. (Woolfolk & Hoy, 1990, Fives, Hamman et al., 2007, Savolainen, Engelbrecht et al., 2012) Woolfolk et al. (Woolfolk, Rosoff et al., 1990) found that preservice teacher self-efficacy in teaching strategies and skills is negatively correlated with their attitudes towards student management. Preservice teachers with high self-efficacy tend to be human in dealing with students' behavior. The influence of the school environment on teachers' self-efficacy was explored by Caver. (Cavers, 2010) Results showed that the organizational structure, atmosphere and interpersonal relationship of the school are of great importance to teachers' self-efficacy. More recently, the tools of assessing preservice teacher self-efficacy have been concerned. In recent research, Hodges and coworkers (Hodges, Wright et al., 2021) developed a rigorous, theoretically-grounded instrument to quantitatively measure self-efficacy for writing and writing instruction in preservice teachers. This instrument contains three scales: self-efficacy for writing; self-efficacy for teaching writing elements; and self-efficacy for writing instruction.

1.3 Attitude towards Teaching Science

Attitude is regarded as the way for an individual to have either a positive or negative view towards a person, object, event or place. (Gilovich, Keltner et al., 2006, Lecci, Beck et al., 2013) The initial research of attitude towards teaching focused on the motivation of pursuing teaching as a career. For example, a study was carried out at an Australian university to find reasons why graduates decided to become a teacher. (Richardson & Watt, 2005) Results indicated that the crucial factors in graduates' choice of teaching as a career are prior considerations, career fit, time for family and income. In another study, Tang et al. (Tang, Wong et al., 2018) did a comparative study to find the similarity and differences in preservice student teachers' motivation to become teachers between Hong Kong and Macau. Sense of vocation was found to be the common altruistic and intrinsic motivations of preservice student teachers in both societies.

Furthermore, some work has been already published related to the tools for assessing attitude towards teaching science. Watt (Watt & Richardson, 2007) developed the comprehensive factors affecting teaching choice scale to measure factors affecting the choice to teach for preservice teachers. Sahin (Şahin, 2010) surveyed the teacher candidates' attitudes towards the teaching profession and life satisfaction levels using Attude Towards Teaching Profession Scale developed by Aşkar and Erden. Van and Walma (van Aalderen-Smeets and Walma van der Molen 2013) reported Dimensions of Attitude Toward Science (DAS) Instrument to measures the attitude of in-service and preservice elementary teachers toward teaching science. Then 62 Dutch primary teachers were surveyed by these DAS

instruments to illustrate the effects on attitudes towards teaching science. (van Aalderen-Smeets, Walma van der Molen et al., 2017)

1.4 Research Questions

With these above understandings of PETs' self-efficacy and attitude towards teaching science, the following research questions were considered:

RQ1: What is the status of PETs' self-efficacy regarding teaching science?

RQ2: What are the PETs' attitudes towards teaching science?

RQ3: Is there a relation between PETs' self-efficacy and attitude towards teaching science?

RQ4: Can we predict the PETs' attitude towards teaching science based on PETs' self-efficacy regarding teaching science by using a formula model?

2. Methodology

2.1 Samples

The participants were 125 preservice elementary teachers aged between 18 and 24. The sampling group consists of first-, second-, third- and fourth-grade preservice teachers who major in elementary education in a university in China. This number of sampling size is considered to be manageable for quantitative research and able to achieve the research objectives. (Chuan, 2006) In addition (97.6%) of the respondents are female and it's because of the limited number of male students who major in elementary education due to some social, and cultural factors. Snowball sampling method was utilized to obtain the quantitative data, where preservice teachers are requested to share the questionnaire with their other schoolmates.

2.2 Survey Instrument

In order to collect quantitative data, an eclectic questionnaire instrument was employed. (Creswell, 2014) The questionnaire was designed based on previous reports (Tschannen-Moran & Johnson 2011; Braksiek, 2022), and was modified according to the characteristics of PET and science discipline. Section 1 consists of the items about the demographic details of the PETs. Section 2 aims to measure self-efficacy regarding teaching science, including five aspects: knowledge and skills, teaching strategies, class management, feelings, communication and interaction. Section 3 are designed to measure the attitudes of preservice teachers towards teaching science, including three aspects: professional perception, professional feelings and professional orientation. Each question ranges from 1(strongly disagree.) to 5 (strongly agree.) using a Likert scale. Cronbach's alpha coefficients were calculated for the evaluation of the internal consistency of the instrument (Cronbach's $\alpha = 0.971$).

2.3 Procedure

The researcher conducted the current study to find out the status and correlation of PET's self-efficacy and attitude towards teaching science. First, a questionnaire was designed and amended. Secondly, quantitative data was collected by distributing an eclectic questionnaire to 125 PETs who major in elementary education in China. The participants completed the questionnaire in about 10 min and did

not need external assistance for completing them. Finaly, the researcher analyzed the data to investigate the selected research questions. All the participants were informed that their personal information would be anonymous. In addition, they had a right to refuse this participation.

2.4 Data Analysis

All statistical analyses were run by an online data analysis platform SPSSAU (https://spssau.com/).

3. Results

3.1 PETs' Self-Efficacy Regarding Teaching Science

PET' self-efficacy regarding teaching science consists of five aspects: science knowledge and skills, teaching strategies, class management, feelings, interaction. Table 1 shows the data of the PETs' self-efficacy regarding teaching science which include mean value and standard deviation (Std.). The mean value of self-efficacy regarding teaching science is 3.506±0.476, greater than the median value. PETs have the highest self-efficacy of communication and interaction (3.787), following the aspects of feelings (3.634), teaching strategies (3.604) and class management (3.325). The mean value of PETs' self-efficacy of knowledge and skills is the lowest (3.052). Besides, PETs' self-efficacy of knowledge and skills presents a comparatively large difference, according to the results of standard deviation.

Table 1. Mean Value and Standard Deviation of PETs' Delf-Rfficacy Regarding Teaching Science

Aspects	Mean	Std.
Knowledge and skills	3.052	0.645
Teaching strategies	3.604	0.547
Class management	3.325	0.549
Feelings	3.634	0.537
Communication and interaction	3.787	0.591
Self-efficacy regarding teaching science	3.506	0.476

To identify the PETs' self-efficacy of knowledge and skills, 6 questions were asked. SD, D, N, A and SA refer to strongly disagree, disagree, uncertain, agree and strongly agree, respectively. Totally, it shows that (4.4%) strongly agreed and (18.3%) agreed that they have the self-efficacy of science knowledge and skills. Most PETs feel uncertain (58.4%). However, an evident number of respondents (16.0%) disagreed and (2.9%) strongly disagreed, and they think they are in the lower level of science knowledge and skills. The higher disagreement is in terms of "Among all the courses, I teach science best" and "I am proficient in operating the experimental instruments in science class".

Table 2. PETs' Self-Efficacy of Knowledge and Skills

No.	Items	SD(%)	D(%)	U(%)	A(%)	SA(%)
1	I have high science literacy.	1.6	4.0	77.6	13.6	3.2
2	Among all the courses, I teach science best.	4.8	32.8	53.6	4.8	4.0
3	I can explain phenomena scientifically in science class.	3.2	16.8	57.6	18.4	4.0
4	I am proficient in operating the experimental instruments in science class.	3.2	20.8	53.6	18.4	4.0
5	I am skilled in performing science experiments.	2.4	14.4	55.2	24.0	4.0
6	I can solve the problem in daily life using scientific knowledge.	2.4	7.2	52.8	30.4	7.2
	Total=	2.9	16.0	58.4	18.3	4.4

Teaching strategies are the key parts of teaching abilities. The following Table 3 outlines the descriptive statistics and percentages of the responses in regard to PETs' self-efficacy of teaching strategies. Results show that most of PETs' self-efficacy of teaching strategies is at a high level (50.5%). Only 4.3% and 0.5 % of the respondents have low and very low self-efficacy of teaching strategies, respectively. No one chose strongly disagree in item 5-11.

Table 3. PETs' Self-Efficacy of Reaching Strategies

No.	Items	SD(%)	D(%)	U(%)	A(%)	SA(%)
1	I can arouse students' thinking using well-prepared questions.	0.8	8.8	39.2	46.4	4.8
2	I can use different assessment methods and tools to evaluate students' progress.	1.6	2.4	32.0	56.0	8.0
3	I can explain or give examples in another way, when students are confused.	1.6	4.8	36.0	51.2	6.4
4	I can attract students' attention by diverse teaching methods.	1.6	4.8	41.6	43.2	8.8
5	I can design science activities which are close to student life.	0	3.2	42.4	48.8	5.6
6	I can prepare and implement lessons taking advantage of various teaching resources.	0	1.6	28.8	56.8	12.8
7	I can design learning activities which are suitable for students.	0	3.2	34.4	55.2	7.2

8	I can encourage students to put forward their ideas.	0	2.4	28.8	54.4	14.4
9	I can solve all the problems students facing in science learning process.	0	5.6	46.4	44.8	3.2
10	I can teach science using multimedia technologies.	0	5.6	32.0	51.2	11.2
11	I can develop students' methods to study science.	0	4.8	46.4	47.2	1.6
	Total	0.5	4.3	37.1	50.5	7.6

Table 4 outlines the descriptive statistics and percentages of the responses in regard to the self-efficacy of class management. The results show that (33.8%) of the respondents have high self-efficacy of class management. Most respondents (55.4%) are in a state of neutrality in terms of class management.

Table 4. PETs' Self-Efficacy of Class Management

No.	Items	SD(%)	D(%)	U(%)	A(%)	SA(%)
1	I can quickly let the noise down in class.	1.6	7.2	60.8	28.8	1.6
2	I can make naughty students observe class order.	0.8	11.2	63.2	22.4	2.4
3	I can handle emergent problems in class.	0.8	8.8	52.8	33.6	4.0
4	I can keep the pace of teaching fluent.	0.8	3.2	52.0	37.6	6.4
5	I can help students complete experiments by arranging teaching activities in order.	0.8	1.6	48.0	46.4	3.2
	Total	1.0	6.4	55.4	33.8	3.5

Table 5 summarizes the descriptive statistics and percentages of the responses in regard to self-efficacy of feelings. Self-efficacy of feelings evaluates the belief of whether a PET can arise learning motivation and interests. Results show that (8.4%) and (49.3%) of the respondents believe that they have the abilities to arise students' learning motivation and interests. Surprisingly, nobody chose strongly disagree in this aspect.

Table 5. PETs' Self-Efficacy of Feelings

No.	Items	SD(%)	D(%)	U(%)	A(%)	SA(%)
1	I can inspire students' interest in science.	0	3.2	46.4	48	2.4
2	I can clearly express the expectations to students.	0	1.6	41.6	51.2	5.6

3	I can get the attention of distracted students.	0	7.2	54.4	34.4	4.0
4	I can prompt students to complete experiments cooperatively.	0	2.4	35.2	56.8	5.6
5	I can let students understand the importance of studying science.	0	1.6	32.8	57.6	8.0
6	I can make students believe that they must be able to learn science well.	0	1.6	41.6	46.4	10.4
7	I respect all the students' characteristics.	0	1.6	30.4	51.2	16.8
8	I can help students' construct the self-confidence of studying science.	0	1.6	32.8	52.8	12.8
9	I can make science class interesting and arouse students' enthusiasm of learning science.	0	3.2	41.6	45.6	9.6
	Total	0	2.7	39.6	49.3	8.4

The results of PETs' self-efficacy of communication and interaction are summarized in Table 6. Among the five aspects, the mean value of communication and interaction is the highest. Totally, (14.2%) of the respondents strongly agreed and (51.8%) of the respondents agreed that they have the self-efficacy of communication and interaction. No one chose strongly disagree in this aspect.

Table 6. PETs' Self-Efficacy of Communication and Interaction

No.	Items	SD(%)	D(%)	U(%)	A(%)	SA(%)
1	I can share learning experience with students frequently.	0	1.6	35.2	52.0	11.2
2	I can discuss problems with students in an equal way.	0	1.6	26.4	52.0	20.0
3	I can give chance of self-expression to students.	0	0.8	28.0	50.4	20.8
4	I can effectively communicate with parents of students.	0	2.4	40.0	49.6	8.0
5	I can assist parents in making their children learn better.	0	1.6	32.0	55.2	11.2
	Total	0	1.6	32.3	51.8	14.2

3.2 PETs' Attitude towards Teaching Science

PETs' attitude towards teaching science consists of three aspects: professional perception, professional feelings and professional orientation. Table 7 presents the data of the PETs' attitude towards teaching science which include mean value and standard deviation (Std.). The mean value of self-efficacy regarding teaching science is 3.676±0.495, greater than the median value. PETs have the most positive attitude in the aspect of professional perception (3.895), following the aspects of professional feelings (3.503) and professional orientation (3.405). The aspect of professional perception shows a comparatively small difference, according to the results of standard deviation.

Table 7. Mean Value and Standard Deviation of Aspects in PETs' Attitude towards Teaching Science

Aspects	Mean	Std.
Professional perception	3.895	0.537
Professional feelings	3.503	0.608
Professional orientation	3.405	0.655
Attitude towards teaching science	3.676	0.495

* $p<0.05$ ** $p<0.01$

The results of PETs' attitude towards teaching science in the aspect of professional perception are displayed in Table 8. Totally, more than half of PETs present a positive attitude in this aspect. For example, (40.8%) of the respondents strongly agree that science teachers are important in elementary schools. And (42.4%) of the respondents strongly agree that Science is as important as Chinese, Mathematics and English. Also, (84.2%) of the respondents think that it is not easy to be an excellent science teacher. Generally, perception is the basis of feelings, and further affects the professional perception.

Table 8. PETs' Attitude towards Teaching Science in the Aspect of Professional Perception

No.	Items	SD(%)	D(%)	U(%)	A(%)	SA(%)
1	Science teachers are important in elementary schools.	0	0.8	20.0	38.4	40.8
2	Science is as important as Chinese, Mathematics and English.	0	0.8	17.6	39.2	42.4
3	Science teachers contribute a lot in society.	0	0	20.8	44.8	34.4
4	Science teachers have high social status.	0.8	7.2	47.2	31.2	13.6
5	I will have higher sense of achievement, if I was a science teacher.	0	0.8	28.0	46.4	24.8

6	Teaching science is more important than teaching other subjects.	0	1.6	29.6	49.6	19.2
7	It is significant for a student to learn science.	0	1.6	16.0	48.0	34.4
8	It is not easy to be an excellent science teacher.	0.8	0.8	14.4	37.6	46.4
9	Teaching science is a well-paid job.	2.4	18.4	67.2	9.6	2.4
10	Science teachers work hard.	0	2.4	30.4	45.6	21.6
11	Science teachers suffer from high stress.	0	2.4	37.6	41.6	18.4
	Total	0.4	3.7	29.9	39.3	27.1

Table 9 presents the data of PETs' attitude towards teaching science in the aspect of professional feelings. Overall, PETs do not show an extremely positive attitude in the aspect of professional feelings, and most PETs feel uncertain. For instance, only (8.8%) of the respondents think they like science very much, but the majorities keep neutral. However, over half of the respondents like doing experiments with students, which represents the discipline peculiarity of science.

Table 9. PETs' Attitude towards Teaching Science in the Aspect of Professional Feelings

No.	Items	SD(%)	D(%)	U(%)	A(%)	SA(%)
1	I like science very mush.	0	4.0	56.0	31.2	8.8
2	I like teaching science very mush.	0	3.2	54.4	32.0	10.4
3	I like the group images of science teacher very much.	0	1.6	44.0	42.4	12.0
4	Teaching science is in accordance with my personality and hobbies.	0	8.0	52.0	29.6	10.4
5	I like doing experiments with students.	0	5.6	36.8	43.2	14.4
6	I am satisfied with the working environment of science teacher.	0	10.4	52.8	29.6	7.2
	Total	0	5.5	49.3	34.7	10.5

The survey results of PETs' attitude towards teaching science in the aspect of professional orientation are depicted in Table 10. The respondents don't show a strong desire to become a science teacher in the future. Only (7.2%) of them are resolved to become a science teacher, and (6.4%) of them strongly agree that science would be one of the preferred subjects to teach if given a choice. Even so, most PETs would integrate science into their class, if they do not become a science teacher.

Table 10. PETs' Attitude towards Teaching Science in the Aspect of Professional Orientation

No.	Items	SD(%)	D(%)	U(%)	A(%)	SA(%)
1	Science would be one of my preferred subjects to teach if given a choice.	1.6	24.8	54.4	12.8	6.4
2	I am willing to actively learn skills related to teaching science.	0.8	4.8	39.2	42.4	12.8
3	I am resolved to become a science teacher.	2.4	11.2	54.4	24.8	7.2
4	I am resolved to become a teacher and devote myself to teaching science.	0	10.4	46.4	35.2	8.0
5	I plan to integrate science into my class, if I did not become a science teacher.	0	4.0	32.0	44.8	19.2
	Total	1.0	11.0	45.3	32.0	10.7

3.3 The Relationship between PETs' Eelf-Efficacy and Attitude towards Teaching Science

Pearson's correlation is employed to estimate the linear relationship between two variables. (Arndt, Turvey et al., 1999, Hauke & Kossowski, 2011; Schneider Dich et al., 2020) Correlations among PETs' self-efficacy regarding teaching science, attitude towards teaching science and their corresponding aspects are shown in Table 11. All the correlations presented in Table 11 are statistically significant. On the whole, self-efficacy regarding teaching science shows a strong positive correlation with attitude towards teaching science ($r = 0.693$, $p < 0.01$). All the aspects (knowledge and skills, teaching strategies, class management, feelings, communication and interaction) of self-efficacy regarding teaching science have a positive correlation with attitude towards teaching science and its corresponding aspects (professional perception, professional feelings and professional orientation).

Table 11. Correlations among PET' Self-Efficacy Regarding Teaching Science, Attitude towards Teaching Science and Their Corresponding Aspects

	Attitude towards teaching science	Professional feelings	Professional perception	Professional orientation
Self-efficacy regarding teaching science	0.693**	0.663**	0.570**	0.539**
Knowledge and skills	0.524**	0.604**	0.316**	0.500**
Teaching strategies	0.609**	0.558**	0.513**	0.478**
Class management	0.476**	0.455**	0.368**	0.412**
Communication and interaction	0.645**	0.521**	0.648**	0.396**
Feelings	0.614**	0.594**	0.523**	0.439**

*$p<0.05$ **$p<0.01$.

Regression analysis is a statistical method to further study the explanatory and predictive relationship between variables based on the linear relationship between two variables. (Dao-de, 2000; Fiebig, 2007) In order to understand the predictive effect of PETs' self-efficacy on their attitude towards teaching science, PETs' self-efficacy of knowledge and skills (x_1), teaching strategies (x_2), class management (x_3), feelings (x_4), communication and interaction (x_5) are taken as independent variables, and their attitude towards teaching science (y) are taken as dependent variables. As can be seen from the data in Table 12, the independent variables have a signifcantly effect on predicting the level and accounted for 53.6% of PETs' attitude towards teaching science (R^2=0.536, F=27.473, p=0.000<0.05). All values of VIF are less than 5, which indicated that there is no multicollinearity. In addition, the D-W value is around 2 (1.967), which illustrates that the model does not have autocorrelation and there is no correlation between sample data. All of which suggests the model is desirable.

Table 12. Linear Regression Model Summary

Independent variable	VIF	R	R^2	Adj.R^2	F	D-W
x_1	1.541					
x_2	2.941					
x_3	2.362	0.732	0.536	0.516	F=27.473, *p*=0.000	1.967
x_4	4.702					
x_5	3.008					

Parameters of the linear regression model are summarized in Table 13. The model formula is as follows:

$$y=1.087+0.245x_1+0.113x_2-0.0004x_3-0.009x_4+0.391x_5 \quad (1)$$

According to the linear regression model, PETs' self-efficacy of knowledge and skills, as well as communication and interaction, has a significant positive influence on their attitude towards teaching science. The effect of communication and interaction is larger than that of knowledge and skills. PETs' self-efficacy of teaching strategies, class management and feelings has no significant influence on their attitude towards teaching science.

Table 13. Parameters of the Linear Regression Model

	Unstandardized Coefficients		Standardized Coefficients	t	*p*
	B	Std. Error	Beta		
Constant	1.087	0.232	-	4.685	0.000**
x_1	0.245	0.06	0.319	4.115	0.000**
x_2	0.113	0.097	0.125	1.167	0.246

x_3	-0.004	0.087	-0.005	-0.052	0.959
x_4	-0.009	0.125	-0.009	-0.069	0.945
x_5	0.391	0.091	0.466	4.305	0.000**

* $p<0.05$ ** $p<0.01$.

4. Discussion

We discuss the results of the current study based on the research questions in the following sections.

RQ1: What is the status of PETs' self-efficacy regarding teaching science?

According to the results obtained for the current study, PETs have high self-efficacy regarding teaching science. However, in terms of their knowledge and skill, the results of the current study show that most of the respondents do not think they are equipped with high science literacy science knowledge and skills. In terms of teaching strategies, most of PETs' self-efficacy of teaching strategies are at a high level. Most PETs fell uncertain in the aspect of class management. As for self-efficacy of feelings, most of the respondents believe that they have abilities to arise students' learning motivation and interests. PETs' self-efficacy of communication and interaction is the highest among the five aspects.

RQ2: What are the PETs' attitudes towards teaching science?

PETs have positive attitudes towards teaching science. PETs have the most positive attitude in the aspect of professional perception. Most of them think science teachers are important in elementary schools. However, they do not show an extremely positive attitude in the aspect of professional feelings. Few respondents think they like science very much. The respondents don't show a strong desire to become a science teacher in the future. Even so, most PETs would integrate science into their class, if they do not become a science teacher.

RQ3: Is there a relation between PETs' self-efficacy and attitude towards teaching science?

From the study, it is clear that PETs' self-efficacy regarding teaching science plays a significant role in their attitude towards teaching science. Results of Pearson's correlation show that all the aspects of self-efficacy regarding teaching science have a positive correlation with attitude towards teaching science and its corresponding aspects. Based on the results of regression analysis, PETs' self-efficacy regarding teaching science has a signifcantly effect on attitude towards teaching science.

RQ4: Can we predict the PETs' attitude towards teaching science based on PETs' self-efficacy regarding teaching science by using a formula model?

We have applied regression analysis and the models illustrated high coefficient of determination. PETs' towards teaching science can be predicted by the model formula:

$$y=1.087 +0.245x_1+0.113x_2-0.0004x_3-0.009x_4+0.391x_5 \quad (2)$$

where y is PETs' attitude towards teaching science. x_1, x_2, x_3, x_4 and x_5 are PETs' self-efficacy of knowledge and skills, teaching strategies, class management, feelings, communication and interaction, respectively.

5. Recommendations

Although the results show that PETs have high self-efficacy regarding teaching science and positive attitudes towards teaching science, it needs much more focus and commitment at the governmental and university level to further improve PETs the self-efficacy and attitudes. For the effective impovement, the participants of this study suggested the following recommendations to be considered:

1) The social status of science teachers is supposed to be improved. Science teachers play an important role in school education. It is suggested to arouse the public's affirmation of science teachers and improve science teachers' economic income, so that the social status of physical education teachers can be more recognized.

2) To better improve PETs' self-efficacy of knowledge and skills regarding teaching science, more science courses should be involved for undergraduates majoring in elementary education.

3) Early field experience of teaching science is supposed to be arranged for PETs. PETs have the opportunity to observe and cooperate with experienced science teachers as well as get along with students, thus constructing their teaching knowledge, skill and attitude.

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