Interdisciplinary Research in Education
Volume 11, Issue 1, 2026: 79-88
DOI: https://doi.org/10.3126/ire.v11i1.96704

Science Teaching Self-Efficacy Among Pre-Service Teachers in Nepal: An Insight from the Case Study

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Keywords

Self-efficacy, pre-service teachers, science education, STEBI-B, teacher development

Abstract

This study is carried out to investigate the self-efficacy beliefs of pre-service science teachers in Nepal and explores potential relationships with student science achievement. This study aimed to identify the self-efficacy beliefs of pre-service science teachers and to explore the relationship between professional development. The study based on quasi experimental design using a survey instrument (STEBI-B) to measure self-efficacy. Fifteen science teachers were involved in STEBI. The result showed that the STOE was insignificant indicating their poor science teaching belief while the PSTEB was significant that they were aware about their role as science teacher. The result was correlated with their high PSTEB. The finding of this study clearly indicate that teacher education programs enhance the pre-service science teachers' self-efficacy and improving student science learning outcomes.

Introduction

Science is one of the important subjects included in the school curriculum by the government of Nepal. The achievement in science is a matter of debate as we see the result of SEE and BLE (CDC, 2007; Acharya, 2018). The curriculum of science in school aims to develop a positive attitude towards scientific thought and to be able to so solve the problems of daily life scientifically. The instructional technique adopted in the teaching-learning process has not been able to fulfil the objective of the curriculum (Acharya, 2018). He also added that the outcome of science teaching is affected by the competency of the teacher. The competency of the teacher in turn is related with the self-efficacy of the teacher in teaching in elementary school (Ravi Kumar, 2013). As per Bandura's view one can have better understanding of themselves

through the process of self-reflection through their experience and thought process. He also emphasizes the way of one's action is the result of the meditation of their beliefs about their capabilities. Bandura (1977) describes self-efficacy as the belief in one's capacity to plan and carry out actions necessary to manage future scenarios. In simpler terms, self-efficacy is a person's confidence in their ability to perform required tasks. These beliefs are specific to the tasks and situations at hand and are used to refer to goals or tasks they aim to achieve. In Nepal, hiring new teachers is the responsibility of the Teacher Service Commission (TSC) and the process includes: Advertisement: Across Nepal, the TSC posts job openings for qualified teachers in different government schools. These job postings list the subjects, prerequisites, and other requirements for the roles. Application: Within the time frame specified in the advertisement, interested candidates must submit their online applications via the TSC website. Written Exam: Depending on the particular course they are applying for; shortlisted candidates are invited to a written exam. The TSC sets the syllabus and format for written exams. Interview: Following their passing score on the written exam, candidates are invited to an interview. Typically, subject matter experts and representatives from the interview committee make up the interview team. Merit List: The TSC compiles a list of qualified applicants based on the combined results of the written exam and interview. Candidates with higher marks are given priority. Appointment: Based on their standing on the merit list and the unique requirements of the schools, teachers are assigned to open positions (Shahi, 2021). The students who are studying in education campuses under the faculty of education are termed as pre-service teachers as they are not in service and are joining as teachers in the near future (Palmer, 2006). The teachers who are willing to join as a teacher must have the competency of teaching, and this in turn affects the outcome of the students (Menon and Sadler, 2016).

The teaching-learning of science at the secondary level is based on recitation and a lack of students' in-depth understanding of the concepts. Such a pervasive science teaching approach has failed the majority of our students. The method of science teaching is interrelated to science teaching self-efficacy of Nepal's science teachers. According to the report published by Education Review Office (2019) the national average achievement of science is 41%, of which the achievement of community is fairly low 33%. There are several factors that contribute to the lower achievement of the students. No, research has been carried out to explore the self-efficacy belief of science teachers of Nepal. Therefore, the present study aims to find the self-efficacy belief of future science teachers of Nepal. It also finds the role of professional development to increase self-efficacy belief of the science teacher in the future.

Literature Review

Bandura's social learning theory described the "self-efficacy as a judgment of one's capability of what one can do with whatever skills they possess" (Bandura, 1986, p. 91). In social learning theory, he mentioned two dimensions: personal self-efficacy and outcome expectancy. Personal self-efficacy is defined as "a judgment of one's ability to organize and execute given types of performances" (Bandura, 1997, p. 21). Outcome expectancy on the other hand, relates to an individual's "judgment of the likely consequences such performances will produce" (p. 21). Both of these dimensions have a powerful influence on behavior. Hence, it can be said that higher self-efficacy leads to "greater effort, persistence, and

flexibility" during challenging events (1996, p. 544). Bandura stated his beliefs about self-efficacy in (1995) as how people feel, think, behave, and motivate them. When it comes to behaviors, self-efficacy can influence people's choice of activities. Self-efficacy levels can increase or hamper motivation. People with high self-efficacy approach difficult tasks as challenges and do not try to avoid them. "People's self-efficacy beliefs determine their level of motivation, as reflected in how much effort they will exert in an endeavor and how long they will persevere in the face of obstacles"

A study carried out by Cinici (2016) explored that the science teaching self-efficacy beliefs of pre-service teachers was enhanced by collaborative microteaching. The author used mixed method approach with questionnaires (STEBI-B) being administered to thirty-six pre-service teachers and structured interview was carried out with six PSTs. The cognitive, affective and psychomotor skills were enhanced through microteaching. I think the way to increase the self-efficacy belief of pre-service teacher is the collaborative action during the teaching learning process which is a part of professional development. Likewise, the factors responsible for increasing in science self-efficacy in school environment were studied by Williams (2017) with mixed method approach. The result showed that both boys and girls had similar type of level of performance in science. The focus group, interview and survey were conducted with 182 children aged between 10 and 12 to identify the science self-efficacy and it revealed that the girls underestimated their capacities. The author also found that the positive feedback from the teacher provided pivotal role in increasing the level of performance in science. This finding is also crucial in the countries like Nepal for the betterment of science education.

Similarly, the study carried out by Ernst and Wara (2012) revealed that that pre-service science teachers' self-efficacy was higher in males than females but the personal belief towards science teaching was higher in female than male. They conducted cross-sectional study among 210 pre-service secondary science teachers and the instrument administered was STEBI-B. From this study, it is known that the self-efficacy is also related to the gender. In the same way, Menon and Sadler (2016) used mixed method study to investigate changes in pre-service teachers' self-efficacy beliefs and science content knowledge ad their relationship using STEBI-B and the result suggested that there was positive change in the science self-efficacy belief. Semi-structured interview of 18 participants indicated positive shift in their science teacher self-image and the experience in the course provided them new level of confidence in teaching science. Here both content and pedagogy are crucial for the self-efficacy belief. Moreover, Hanson (2011) surveyed 5th and 8th grade science teachers in order to find the science teaching efficacy belief using correlational research and identified that personal science teaching efficacy belief was related to a number of variables such as undergraduate science methods course taken, level of teacher education, number of year as classroom teacher, number of years as a science teacher, teachers belief regarding instructional strategies and students engagement in the science classroom. Result showed that all the variables have significant effect on science teaching. While preparing pre-service science teachers for teaching science we have to think on all the variables that pay significant role in self-efficacy belief.

Velthius et al (2013) revealed that science teaching self-efficacy of pre-service teachers improved during the 1 and 2 year and not

during 3 and 4 years of university course. The authors applied cross-sectional sample form two universities with 292 pre-service primary teachers across four different years of the study in the training program. From this research to enhance the science teaching self-efficacy belief professional development plays significant role. Universities are the sites that provide platform the professional development of pre-service teacher. Similarly, Kaya et al (2021) designed an explanatory sequential mixed method in order to understand secondary science teachers' self-efficacy belief and implementation of inquiry to provide information for the implantation of science education in a Midwestern U.S state. The participants were 39 secondary science teachers of which 13 were selected for semi-structured interview. The result revealed that there exists connection between teachers' self-efficacy beliefs and implementation of all five essential fundamentals of inquiry. In addition to this the teachers' background (content knowledge, pedagogical knowledge and experience) determined teachers' self-efficacy belief and implementation of inquiry during teaching science. I think we have to think on the variables that paly significant role in the self-efficacy of pre-service science teachers.

Likewise, the study conducted by Palmer (2006) found that the main source of self-efficacy was cognitive pedagogical mastery followed by cognitive self-modeling. The author used both quantitative and qualitative method including formal and informal surveys with 124, 174 and 163 in first, second and third surveys respectively, STEBI-B was administered during formal surveys. Informal surveys were designed to explore the sources of self-efficacy and relative importance of each of them. Similarly, Brígido et.al (2013) used questionnaire to study perspective primary teachers' self-efficacy and emotions using questionnaires administered to 188 pre-service teachers and their study resulted positive emotions towards natural science (biology and geology) and negative towards hard science (physics and chemistry). It also showed that self-efficacy belief was significantly related to their emotions about future teaching of hard sciences. The result of this study can be a measure to understand the emotions of future science teachers.

McCall (2016) explored the impact of science content course on pre-service teachers' science teaching self-efficacy and attitude towards science and science teaching using STEBI-B and questionnaire to 13 participants showed that on completion of the course in university science teaching effectiveness improved. It also improved confidence in teaching science and attitude towards science as a body of knowledge. The courses designed also play important role in influencing the science teaching self-efficacy belief. Likewise, Mulholland et al (2004) assessed the science teaching efficacy with a sample of 314 elementary pre-service teachers using STEBI in order to know the relationship between PSTEB and STOE. The result revealed that science teaching subject had significant effect on PSTEB but not the STOE. The number of high school science subject studied also had significant effect on PSTEB, but not STOE.

Morever, Kivit and Mji (2003) investigated sex-differences in self-efficacy beliefs of elementary science teachers of South Africa using the STEBI which was provided to 88 men and 112 elementary women and the result showed that female teachers need more support to change their belief about self-efficacy regarding science teaching. Similarly, the study conducted by Morrell and Caroll (2003) found that the science content course student teaching seminar

had no significant change in the personal science teaching efficacy at the time of enrollment but the significant gain increased during science method course. For this the authors used STEBI-B, pre/post design with 172 respondents were used although it was administered to 399 undergraduate elementary students. The method courses provided in the university has positive impact on the improvement of self-efficacy belief.

McKinnon and Lambert (2013) revealed that the self-efficacy belief of pre-service primary school teachers can be increased through informal science education like science centre and museum. For this study the authors used cohort study of 8 final year pre-service teachers and 13 in service teachers over the period of 18 months. Four hours of professional development workshop provided a source of motivation for them increasing both confidence and motivation. From this study, we can conclude that informal sector does have positive influence over self-efficacy belief. Likewise, Aydin and Boz (2013) analyzed the science teaching self-efficacy belief and their sources using STEBI-B and semi-structured interview of 492 pre-service elementary science teachers. The result showed that self-efficacy belief of pre-service teachers was high for both PSTE and STOE in the final year of the university. The courses and pedagogy the students encountered in the university is the source of self-efficacy belief. Therefore, university is the factor of self-efficacy belief.

Moreover, d'Alessio (2018) designed a science content course in order to identify the self-efficacy belief of future science teachers with pre/posttest and used STEBI-B to identify the level of self-efficacy belief. The author used qualitative analysis in order to get insight. The study was administered to 830 future teachers and found that microteaching played important role to gain science content mastery and refection from peers also contributed in increasing their belief. Similarly, Kanggs and Sondergeld (2015) studied the learner- teacher and found that self-efficacy belief of pre-service teachers increased in a semester long science content course. They used mixed method including STEBI-B and two-open ended questions in order to measure science self-efficacy of elementary pre-service teachers. The result showed that the sense of confidence increased with science discipline. Gunning and Mensha (2011) designed case study design of pre-service elementary teachers' development of self-efficacy and confidence to teach science and found that self-efficacy increased as a result of participation in childhood education. The type of experiences offered during semester long science course were valuable for the pre-service science teachers increasing their self-efficacy.

Methodology

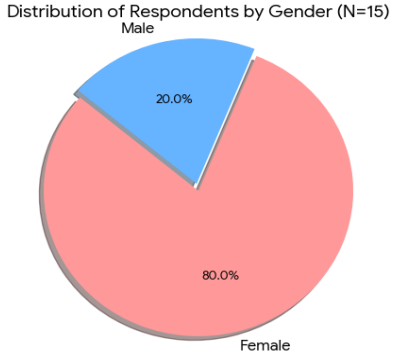
The study is based on a quantitative method. A quasi-experimental design was used in this study (Creswell, 2008). The bachelor students and campuses (B. Ed science), were the population of the study as the case of Sanothimi Campus. Fifteen students (3 males and 12 females) were selected for the sample through the purposive sampling technique (Nworgu, 2006). The STEBI-B was used as instrument for the purpose of data collection developed by Enoch and Riggs (1990) for quantitative data. STEBI-B has 23 items which are rated using a 5-point Likert type scale to measure pre-service teachers' personal science teaching efficacy (PSTE) and science teaching outcome expectancy (STOE). The tools were validated as per Settlage (2000) by calculating the reliability of the tool (STEBI-B). Stone (2016) analyzed

the STEBI-B to predict the science teaching self-efficacy beliefs of pre-service elementary teachers and found that tool is better suited for long term experience of pre-service teacher. The data obtained from STEBI-B was analyzed by the Wilcoxon Signed Rank Test. It is a widely used non-parametric test for comparing matched or paired data to evaluate whether their populations mean ranks differ. This test assesses the differences between two sets of paired data to determine statistical significance between the distributions.

Result and Discussion

The respondents who participated in the study were 15. Out of 15 respondents, females were 80% while males were 20%. Figure 2 indicates that female students were in the majority.

Figure 1. *Number of respondents regarding gender*



Wilcoxon Signed-Rank Test

The data was acquired through the administration STEBI-B that has a five-point Likert scale. The tool was used twice one before teaching practice and after teaching practice. The STEBI-B has two subunits, personal science teaching efficacy belief and science teaching outcome expectancy. The result of the STEBI-B was tabulated below. Both pre-test and post-test of STOE and PSTEB was tabulated in the given tables. The collected data was analyzed by Wilcoxon Signed-Rank Test as the test was a non-parametric test. The interval between the items was insignificant.

Table 1

The Analysis Regarding STOE in the pretest

Variables	Value
W-value	27
Mean Difference	-0.16
Sum of positive ranks	27
Sum of negative ranks	93
Z-value	-1.8743
Mean (W)	60
Standard Deviation (W)	17.61
Sample Size (N)	15
Result -Z value	p=0.6148

Table 1 shows the Wilcoxon signed-ranks test has a result W = 27, for n = 15, the mean difference was -0.16, meaning that, on average, there was a very slight reduction, since the sum of ranks for negative differences (93) was far greater than the sum of positive ranks (27), it meant more participants had had a very slight reduction than increases. The W value of -1.8743 was compared to the expected values distribution (mean W = 60, SD= 17.61), although thep-value is 0.6148 and p>.05 meaning this result has no significance and no difference between the two paired sets of measurements, and so accept the hypothesis

Table 2

The Analysis Regarding STOE in the Post-test

Variables	Value
W-value	27
Mean Difference	-0.16
Sum of positive ranks	27
Sum of negative ranks	93
Z-value	-1.8743

Mean (W)	60
Standard Deviation (W)	17.61
Sample Size (N)	15
Result -Z value	p=0.6148

Table 2 presents the Wilcoxon signed-rank test for 15 paired observations to study the difference between the two values measured (pre and post values). This produced W=27, with a mean difference of -0.16. This demonstrates that there has been a very slight decrease between the post-values compared to the pre-values.

Because of this difference, the number of negative ranks (93) was larger than the number of positive ranks (27), which suggests that a slightly higher percentage of students had negative differences, as opposed to positive differences. However, the produced p-value was greater than 0.05 (p=0.6148), indicating that these results would not be statistically significant to assume that the change in both values was not the result of random chance and that H1 could be rejected or H0 supported.

Table 3

The analysis regarding PSTEB in the pre-test

Variables	Value
W-value	0
Mean Difference	-0.36
Sum of positive ranks	0
Sum of negative ranks	120
Z-value	-3.41
Mean (W)	60
Standard Deviation (W)	17.61
Sample Size (N)	15
Result -Z value	p=0.0064
Observed W-value	27
Critical value of W (p<0.05, N=15)	25

Table 3 indicates that the differences in paired observation data of the fifteen participants who partook in the experiment, a Wilcoxon signed rank test was carried out. It resulted in a W=0 value, a mean difference of -0.36, a sum of negative ranks of 120, and a sum of positive ranks of 0, demonstrating that all individuals achieved lower scores in the second observation when contrasted to the initial measurement. P <0.05 produced by the test for Z value of -3.41 (p value = 0.0064) demonstrates a statistically significant difference between paired observation data. Hence, the null hypothesis will be rejected with regards to significance change between observations and the resulting negative ranks display this alteration occurred uniformly between observations.

Table 4

The analysis regarding PSTEB in the Post -test

Variables	Value
W-value	0
Mean Difference	-0.36
Sum of positive ranks	0
Sum of negative ranks	120
Z-value	-3.41
Mean (W)	60
Standard Deviation (W)	17.61
Sample Size (N)	15
Result -Z value	p=0.0064
Observed W-value	27
Critical value of W (p<0.05, N=15)	25

Table 4 presents the Wilcoxon Signed Rank test, which was performed to determine the difference between paired measures in a sample of fifteen participants. The test resulted in a mean difference of 0.36 and a W statistic of 0, which implies that the

ranks for all differenced scores were in a negative direction, as is apparent in the sum of negative ranks (120) and lack of positive ranks (0). A Z-score of 3.41 was achieved from the test with a corresponding p-value of 0.0064 ($p < 0.05$). As this p value is less than 0.05, the difference in the two observations was significant. Additionally, the W value of 27 was larger than the critical W value of 25 which indicates the existence of a statistically significant difference in the two measurements and hence the null hypothesis can be rejected.

Conclusion

The present research focused on the exploration of science teaching belief or pre-service science teacher as a case study and the result showed that the pre-service science teachers were aware about their role as science teacher. Their view was that if they work hard they will be responsible for the improvement of science achievement of the school students. The effort applied by the teacher would be directly correlated with the achievement of students. The result of the research indicated that the science teaching belief was not significant among the respondents before and after the treatment that is teaching practice in the campus at the final year. The personal belief was significant in the both pre-test and the post-test marking their familiarities with the subject matter for achievements. The smaller number of participants was a significant limitation for the research. The insignificant STOE might be due to deploying STEBI-B in English medium that could have caused language problem during the survey. The significant result of subclass PSTE revealed that the pre-service science teachers were aware about their role as science teacher. Their effort could raise the standard of the students on science. Use a larger and more diverse sample to ensure the results are generalizable. Additionally, consider longitudinal studies to assess the long-term impact of the intervention on both PSTE and STOE.

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