Fijian Primary Pre-service Teachers: Science Teaching Outcome Expectancy

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Abstract

This paper investigates the relationship between the constructivist primary pre-service science education method course and the science teaching outcome expectancy (STOE) of Fijian primary pre-service teachers. The primary pre-service teachers (N=300) of the first year of the three years primary pre-service teacher program in a university in Fiji were selected as subjects of the study. The STOE was measured with the help of a tool known as 'Science Teaching Efficacy Beliefs Instrument-Form B (STEBI-B). The results show that there was no influence of the social constructivist science method course on the STOE component of science teaching beliefs of primary pre-service teachers. This points to a need to improve the contents and social constructivist pedagogy of the science method course with a focus to improve the STOE.

Introduction

Constructivism is being applied for curriculum development and pedagogical discourses in school education and teacher education programs in developing countries like Fiji (Westbrook et al, 2013; Ministry of Education, Fiji, 2007, 2013). Social constructivism is an important guiding principle of the two recent initiatives of the Fijian Ministry of Education: *The Fiji Islands National Curriculum Framework-2007* (NCF-2007) and *the Fiji National Curriculum Framework - 2013* (NCF-2013). The purpose of these two major initiatives is to improve the quality and relevance of school education and teacher education in Fiji.

The philosophy of education in Fiji is based on: (a) understanding of and tolerance for ethnic, cultural, and religious diversity, (b) harmonious living, (c) nation building and global co-existence, (d) environmental sustainability, (e) sustainable social and economic development, and (f) excellence in all undertakings. The guiding principles for NCF components are: (a) social constructivism, (b) Delor's four pillars of education for 21st century, and (c) cultural influences. Social constructivism is common to both editions of the framework. NCF-2013 covers additional aspects like sustainable economic and social development, excellence in all undertakings, cultural influences, etc. Science is the key learning area among the seven areas for primary and secondary education.

The Ministry of Education, Fiji (2007, 2013) has been taking steps to improve science education and teacher education in Fiji. The desired outcomes of the two initiatives (NCF-2007, 2013) depend upon many factors including positive teaching beliefs of teachers in Fijian schools and teacher education institutions.

Considerable research on the science teaching outcome expectancy (STOE) enhancement in primary teachers have been undertaken for improving science teaching and learning in primary schools (see for example, Cone, 2009; El-Deghaidy, 2006; Flores, 2015; Huinker & Madison, 1997; Jarrett, 1999; Johnston, 2003; Knaggs, & Sondergeld, 2015; and Varma, 2007: 171-3). This paper examines the relationship between the initial statistics of the STOE component of science teaching beliefs of primary pre-service teachers and the final statistics of the STOE component of science teaching beliefs as measured with Science Teaching Efficacy Beliefs Instrument-B (Enochs & Riggs 1990; Bleicher, 2004) after the transaction of science education course based on constructivist approach during a 15–week course (trimester) of primary pre-service teacher education program in Fiji. The specific research questions asked are:

1. What are the initial statistics of the STOE component of science teaching beliefs of primary pre-service teachers as measured with Science Teaching Efficacy Beliefs Instrument-B (STEBI-B) (Enochs& Riggs 1990; Bleicher, 2004) at the beginning of the 15-week course (trimester) of primary pre-service teacher education program in Fiji?
2. What are the final statistics of the STOE component of science teaching beliefs of primary pre-service teachers as measured with STEBI-B at the close of the 15-week course (trimester) of primary pre-service teacher education program in Fiji as a result of the transaction of a science education course based on a constructivist approach?
3. What is the relationship between the initial statistics of the STOE

component of science teaching beliefs of primary pre-service teachers and the final statistics of the STOE component of science teaching beliefs as measured with STEBI-B as a result of the transaction of a science education course based on constructivist approach during a 15-week course (trimester) of primary pre-service teacher education program in Fiji?

The major factor that influenced the arousal of interest of the researcher in the present study is the research finding on the personal science teaching efficacy (PSTE) component of science teaching efficacy in Fijian pre-service teachers under the university approved pilot research project on science teaching efficacy of primary teachers in Fiji (Gupta & Sharma, 2013).

Literature Review

Teacher Beliefs

Teacher beliefs are important constructs in educational research. Teacher beliefs are the best indicators of teacher's planning, decision-making and subsequent classroom behaviour (Irez, 2007: 1). Beliefs are psychological constructs that include understandings, assumptions, images or propositions considered to be true. They have highly variable and uncertain linkages to personal, episodic and emotional experiences. Although undeniably related to knowledge, these differ from knowledge in that beliefs do not require a condition of truth (Irez, 2007: 17).

Wallace lists four components of teacher beliefs in science education: (a) core teacher beliefs create a strong impact on their enactment of the curriculum and their stance towards implementing reform–based practices, (b) novice as well as experienced teachers can make lasting changes to their practices even without changing their core beliefs, (c) there is a need for more research on the formation of teacher beliefs in early stages of teaching including the induction stage, and (d) there is a problem in the enactment in the classrooms due to educational policy under the influence of political climate (2014: 27-9).

Wallace proposes that the following assumptions about the nature of teacher beliefs are widely accepted:

(a) Beliefs are far more influential than academic knowledge in framing, analysing and solving problems and making teaching decisions.
(b) Some beliefs are more strongly held than others, resulting in 'core' and 'peripheral' beliefs. An individual's core beliefs may be more resistant to change.

(c) Beliefs do not exist independently of one another, but are arranged in an ecology, or in an 'internal architecture' of systems that have psychological importance to the individual.
(d) Individuals may have competing belief sets about the same topic.
(e) When one belief is changed, it is likely to affect other beliefs throughout the system.
(f) Some scholars posit that belief systems occur in 'nests' (Bryan, 2003) or sets of beliefs, including core and peripheral beliefs about various principles that are linked or grouped together (2014: 17 -18).

Self-efficacy: Sources of information

Bandura (1994) defined perceived self-efficacy as people's beliefs about their capabilities to produce designated levels of performance that exercise influence over events that affect their lives. Thinking, feeling, motivation and behaviour of people are linked with self-efficacy beliefs. There are four sources or ways to modify the self- beliefs (self-efficacy) of individuals (Bandura, 1994; Bautista, 2011, 2013; Palmer, 2006, January). Most influential source of self-efficacy is the mastery experiences or enactive mastery experiences as they provide authentic evidences regarding the ability of an individual to succeed in the given task.

The second source of self-efficacy is the organisation of vicarious experiences. These experiences are provided by organising situations where individuals estimate their own capabilities in comparison to others who have modelled the behaviour. Palmer (2006) reports four modes of modelling: (a) effective actual modelling (where an individual observes a person similar to oneself who performs the task successfully), (b) symbolic modelling (where individuals are exposed to effective models, television or other media) (c) self-modelling (where individuals watch their edited favourable aspects in their own videotaped performances), and (d) cognitive self- modelling (where an individual visualises oneself performing successfully at task).

The third source of self-efficacy is social persuasion of individuals. The positive verbal feedback on the capability is given to the individual. The individual is persuaded verbally that he/she possesses the capabilities to master or to attain success in the given activities.

The fourth source of self-efficacy is linked with physiological/affective states of an individual, like states of stress, fear, or anxiety.

Palmer (2006) argues further that there are additional sources of self-efficacy that apply to primary teacher education students, namely cognitive content mastery, cognitive pedagogical mastery and simulated modelling. On the basis of the investigation on the relative importance of

the various sources of self-efficacy in a primary science methods course using formal and informal surveys, he reported that cognitive pedagogical mastery was the main source of self-efficacy. A few more examples of mastery and vicarious experiences/activities are:

(a) *Mastery enactive, cognitive content, and cognitive pedagogical experiences:* these experiences can be provided to teachers to develop capability in them to integrate content on a school science concept and the relevant pedagogy through a dynamic social interaction with learners on a specific science concept. The teacher is then required to prepare a paper on it by incorporating content on the science concept and pedagogical approach on the science concept.

(b) *Mastery enactive activity:* the pre-service teacher is asked to create a constructivist lesson plan for presentation in class and reflection over the lesson and classroom practices.

(c) *Vicarious cognitive self-modeling experiences:* pre-service teachers create inquiry–based lesson and present before other pre-service teacher colleagues;

(d) *Vicarious symbolic modeling:* video lessons of experienced teachers are presented and reflections are carried over classroom practices.

(e) *Vicarious simulated modeling:* presentation of model inquiry lessons are done by the teachers with provision of participatory experiences to pre-service teachers in inquiry-based hands-on activities

(f) *Vicarious cognitive self-modeling:* provision of experiences based on preparation of inquiry-based lesson plans by pre-service teachers and presentation of the same to their peers (Bautista, 2011, 2013).

Constructivism

There are a number of merits of using constructivism in education. It is conducive to learning. It provides situations for an active participation of learners. It creates democratic and collaborative learning environment. It provides situations for metacognitive reflection and development of attitude of respect for multiple point of view (McPhail, 2016).The meanings and history of constructivism are still emerging (Mahoney, 2003: 211). There are varied views on constructivism (Kumar & Gupta, 2009; Mahoney, 2003; Phillips, 1995: 5–6). Phillip (1995: 8) concluded that humans are the creators of two forms of knowledge: (a) individual psychology and (b) socio-political construction of knowledge. Individual psychology deals with creation of knowledge by individuals. The views of Jean Piaget and Vygotsky are concerned with individual psychology. The individual learner constructs knowledge in his or her own cognitive

apparatus. Piaget placed stress on biological/psychological mechanisms linked with the learner while Vygotsky argued on the influence of social factors on the construction of knowledge of an individual. Socio-political construction of knowledge deals with disciplinary bodies of knowledge. Constructivists, for example, feminist epistemologists, focus on construction of knowledge in general. There are a number of constructivist, for example, Ernst Von Glasersfeld, Immanuel Kant, Karl Popper, who are interested in individual psychology and bodies of knowledge constructed by human communities.

McPhail (2016) argues constructivism on the basis of epistemological and learning perspectives. Epistemological perspective of constructivism deals with the nature of human knowledge, collective formation of bodies of knowledge over time, legitimation of collectively formed knowledge and influence of these bodies of knowledge on the world. This branch of constructivism is termed as social constructivism. The approach that can be derived from social constructivism may be termed as epistemological constructivism (from the epistemological point of view).

Knowledge is considered as a human construct and hence knowledge is more relative as compared to absolute. Knowledge is not the objective reflection of an external world. Students are makers and co–constructors of knowledge. Social constructivism has implications for curriculum content.

Constructivism is also used in context of learning theory that deal with a set of ideas about learning processes in individuals. It has generated influential ideas about pedagogy. This branch of constructivism is often termed 'psychological constructivism'. This branch of constructivism deals with internal learning process of the learner. The views of Ernst von Glasersfeld, Jean Piaget and Lev Vygotsky are concerned with learning and meaning-making processes of the individual. The focus is on the intrinsic characteristics, mental processes, state of consciousness and cultural identity of the learner. Psychological constructivism has implications in education from the point of view of learning. The approach of pedagogical constructivism is derived from psychological constructivism on the basis of pedagogical perspective. In this view, knowledge is the procedural process of construction. Constructivists prefer to use the verb ‘knowing’ rather than ‘knowledge’.

Samuel & Ogankola (2013) highlight that instructional decisions of elementary school teachers regarding use of traditional approaches or constructivist approaches in science are influenced by a variety of their educational beliefs; these are (a) epistemological beliefs, (b) science teaching and learning beliefs (pedagogical beliefs) , (c) science teaching

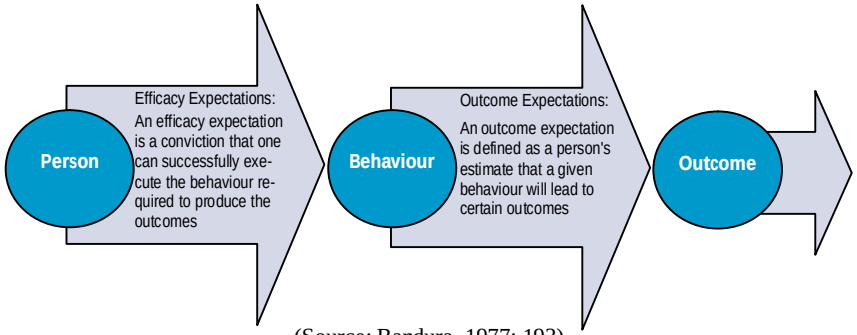
efficacy beliefs and (d) the situation specific construct applicability beliefs which depend upon factors like social, psychological and environmental factors affecting the attempts of the teacher at inquiry based science instruction.

Efficacy Expectation and Outcome Expectancy

Bandura's 1977 paper on self-efficacy is regarded as a landmark paper for its application to teaching and learning. The core of Bandura's view is provided in Figure 1. Bandura differentiated between an efficacy expectation and an outcome expectation: 'An outcome expectancy is defined as a person's estimate that a given behaviour will lead to certain outcomes. An efficacy expectation is the conviction that one can successfully execute the behaviour required to produce the outcomes' (1977: 193).

Efficacy expectation and outcome expectancy are illustrated in the following figure.

Figure 1: An Efficacy Expectation and an Outcome Expectation



(Source: Bandura, 1977: 193)

On the basis of Bandura's theory of self-efficacy, Enochs & Riggs (1990) argued that the willingness of elementary teachers to devote more time and energy to curriculum is a must for the purpose of improvement of elementary science education. They proposed that increased personal science teaching efficacy (PSTE) and science teaching outcome expectancy (STOE) are the predicted antecedents to behavior change. They proposed that teachers 'who believe student learning can be influenced by

effective teaching (outcome expectancy beliefs) and who also have confidence in their own teaching abilities (self-efficacy beliefs) … persist longer, provide a greater academic focus in the classroom, and exhibit different types of feedback than teachers who have lower expectations concerning their ability to influence student leaning' (1990: 6).[1]

The STOE and the PSTE are two separate expectations (Bandura, 1977: 193-4; Chong, Wong, & Lang, 2005; Evans, Luft, & Pea, 2014; Gupta & Sharma, 2013; Hassan & Tairab, 2012; Irez, 2007; Joseph, 2010; Maddux, 1980; Samuel & Ogankola, 2013; Varma, 2007). Bandura argues self-efficacy as mechanism of operation of personal self-efficacy (1977: 193). Self-efficacy as mechanism of operation means that self efficacy assists an individual in two ways: first, efficacy expectations assist an individual in the initiation and persistence of coping with behaviour; and second, efficacy expectations act as major determinants of individual's selection of activities. Psychological procedures, whatever their form, serve as a means of creating and strengthening expectations of personal self-efficacy.

The STOE enhancement

A number of studies indicate the enhancement of the STOE component of self-efficacy beliefs through the transaction of constructivist science education methods courses (Cone, 2009; El-Deghaidy, 2006; Flores, 2015; Huinker& Madison, 1997; Jarrett, 1999; Johnston, 2003; Knaggs, & Sondergeld, 2015; Varma, 2007: 171-3). Knaggs, & Sondergeld (2015) analysed preservice elementary teachers engaged in a semester-long science content course, using Bandura's concept of self-efficacy as a conceptual framework. Quantitative data indicated a significant increase in science self-efficacy on both subscales (personal efficacy and outcome expectancy). The qualitative data showed that students communicated an increased sense of confidence with regard to the discipline of science.

Flores (2015) conducted a study of thirty preservice teachers enrolled in a field-based science methods course. The teachers were placed at a public elementary school for teaching practice with elementary stu-

[1] Enochs & Riggs (1990) present specific reference to designing of a valid and reliable measure of the teacher self- efficacy of pre-service elementary science teachers. In order to do this, they modified the Science Teaching Efficacy Belief Instrument (STEBI-Form A) and presented the two-sub scales of Science Teaching Efficacy beliefs Instrument (STEBI-Form B), based upon Bandura's social learning theory, to measure PSTE and STOE with regard to science teaching and learning.

dents. Teaching practice with fifth-grade students at the host elementary school occurred over a five-week period towards the end of the course. Teachers were asked to focus on building conceptual understanding of science content and pedagogical methods through innovative curriculum development and other course assignments during the first ten weeks. A pre-test - post-test administration of the Science Teaching Efficacy Beliefs Instrument-B (STEBI-B) was done. Results indicated that general efficacy and the PSTE increased significantly. The STOE increased, but to a lesser degree.

Cone (2009) conducted a pilot study on the effect of community-based service learning on the beliefs of pre-service teachers. Equitable science teaching and learning using the Self-Efficacy Beliefs about Equitable Science Teaching (SEBEST) instrument was used. Pre- and post-test data from 32 preservice elementary teachers who were enrolled in two different science methods courses were analysed. Findings suggested that community-based service learning significantly influenced preservice elementary teachers' outcome expectancy toward equitable science teaching and learning.

Varma investigated the influence of transaction of a science methods course developed on constructivist pedagogical approach (inquiry–based lessons and field activities) on the changes in science teaching confidence of elementary pre-service teachers at the University of Missouri Columbia (2007: 171-3). The STEBI-B was administered to measure two dimensions of science teaching confidence - the PSTE and the STOE. The PSTE dimension revealed that 75.5% of preservice teachers were positive regarding their personal science teaching efficacy, indicating confidence to teach science. The STOE dimension of science teaching confidence indicated that 60.7% of the preservice teachers were positive regarding their ability as science teachers in influencing learning of science on the part of primary school learners.

El-Deghaidy (2006) investigated the impact of constructivist science education method course on pre-service teachers enrolled in the 4-year teacher education programme in Egypt. The STEBI- B was used as a measuring tool for recording data on the STOE. Participants were 36 pre-service teachers (31 females and 5 males). These teachers were grouped on the basis of subjects of specialisation - primary science (N=9), chemistry and physics (N=5), and biology (N=22). All the three groups had significant gains in the STOE. The initial mean value (31.33) of the STOE increased to 41.33 in case of primary group.

Johnston (2003) similarly reported changes in the STOE using the STEBI-B in pre-service primary teachers by involving teachers actively.

The pre- and post- test data on the STEBI-B on participants (N=69) revealed significant increase in the STOE in most of the items of the STEBI-B. Johnston (2003) examined the relationship between a constructivist/hands–on elementary methods course for P-8 teachers and values of the STOE, the PSTE and attitudes in teachers. The STEBI-B was administered at the beginning and the end of the course. Results indicated that preservice teachers' attitudes were more positive at the end of the course. Preservice teachers seemed to enter the class with high outcome expectancies.

Jarrett (1999) reported the enhancement of the confidence in teaching science in pre-service teachers with the help of inquiry-based science methods course. The subjects taken in the study were the three groups of students in a Master's program. Huinker& Madison (1997) investigated the impact of enriched experiences of methods courses in science and mathematics on efficacy beliefs in pre-service teachers. They reported that the science and mathematics methods courses had a positive influence on the elementary pre-service teachers' beliefs in their ability to teach science and mathematics.

The STOE: Studies reporting no enhancement

Certain studies report no change in values of the STOE as a result of the use of constructivist science education method courses (Hechter, 2011; Mulholland, Dorman. & Odgers, 2004; Savasci-Acikalin, 2014). Savasci-Acikalin (2014) investigated the effects of the teaching science laboratory course on pre-service teachers' self- efficacy beliefs about science teaching. Participants (N=72) were from Turkey enrolled in elementary education and gifted education. The Turkish version of the STEBI-B was administered twice to the participants (at the beginning of the course and at the end of the course). Although pre-service teachers' personal teaching efficacy beliefs significantly increased, their outcome expectancy beliefs did not change.

Hechter (2011) investigated the influence of science methods course on changing the PSTE and the STOE. Findings revealed that the number of postsecondary science courses completed had a significant effect on the PSTE component but not on the STOE.

Mulholland, Dorman. & Odgers (2004) conducted a study on the assessment of science teaching efficacy in primary preservice teachers in an Australian university. Participants were 314 primary preservice teachers. The STEBI-B was used to assess two teaching efficacy dimensions: the PSTE and the STOE. Results revealed that the completion of two science

teaching subjects within the preservice program had a significant effect on the PSTE, but not on the STOE.

Literature review on the STOE component reveals major differences in research outcomes. This notwithstanding, there is no report on the STOE component in relation to primary pre-service teacher education programs in Fiji. The present study is an effort to investigate the relationship between a constructivist science education course in the pre-service teacher education programs in Fiji and the STOE component of science teaching beliefs.

Methodology

Pre-post survey research design

The survey was conducted at the Education Campus of the Fiji National University. All the 300 hundred pre-service teachers (age group 18-20) admitted in the first year, trimester-2, Session 2011, B Ed (Primary) program of the School of Education of the University were taken as the sample in the study. Pre and post survey research design was followed (Burns, 1997). The STOE scores of the pre-service teachers were measured with the help of STEBI-B, the instrument initially developed by Enochs & Riggs (1990) as modified by Bleicher (2004).

There were 23 statements (13 of the PSTE and 10 of the STOE) in the STEBI-B. Five point Likert scale (5=strongly agree; 4=agree; 3=uncertain; 2=disagree; 1=strongly disagree) was applied to record the point of agreement to a specific statement by the primary pre-service teachers. The statements at serial numbers 1, 4, 7, 9, 10, 11, 13, 14, 15, 16 (range of scores 10-50) were then linked with measurement of the STOE component taken in the research questions. The statements at serial numbers 10 and 13 were the reverse scored statements.

The statements related to the STOE are listed below:

1. When a student does better than usual in science, it is often because the teacher exerted a little extra effort
4. When science grades of students improve, it is often due to their teacher having found a more effective teaching approach.
7. If students are under-achieving in science, it is most likely due to ineffective science teaching.
9. The inadequacy of a student's science background can be overcome by good teaching.
10. The low science achievement of students cannot generally be blamed on their teachers.

11. When a low-achieving child progresses in science, it is usually due to extra attention given by the teacher.
13. Increased effort in science teaching produces little change in students' science achievement.
14. The teacher is generally responsible for the achievement of students in science.
15. Students' achievement in science is directly related to their teacher's effectiveness in science teaching.
16. If parents comment that their child is showing more interest in science, it is probably due to the child's teacher

The PSTE statements are at serial numbers 2, 3, 5, 6, 8, 12, 17, 18, 19, 20, 21, 22, 23 (range of scores 13-65) . The PSTE statements at serial numbers 3, 6, 8, 17, 19, 20, 21, 23 are the reverse score statements.

The PSTE statements are listed below:

2. I will continually find better ways to teach science.
3. Even if I try very hard, I will not teach science as well as I will other subjects.
5. I know the steps necessary to teach science concepts effectively.
6. I will not be very effective in monitoring science experiments.
8. I will generally teach science ineffectively.
12. I understand science concepts well enough to be effective in teaching elementary science.
17. I will find it difficult to explain to students why science experiments work.
18. I will typically be able to answer students' science questions.
19. I wonder if I will have the necessary skills to teach science.
20. Given a choice, I will not invite the principal to evaluate my science teaching.
21. When a student has difficulty understanding a science concept, I will usually be at a loss as to how to help the student understand.
22. When teaching science, I will usually welcome student questions.
23. I do not know what to do to turn students on to science.

The STEBI-B was administered at the beginning (initial) and the closing (final) of Trimester 2, first year, Session 2011. The filled up STEBI-B questionnaires relating to two phases of the present study were examined. It was found that 118 out of 300 primary pre-service teachers filled up the questionnaire at both the phases of the survey, that is, at the

beginning (initial) and at the close (final) of Trimester 2. Statistical Package in Social Science (SPSS), IBM Version-20 was used to analyze the data.

Science education course

The science education method course (EDU505) was taught in line with social constructivist approach as mentioned in *The Fiji Islands Curriculum Framework*-2007. Inquiry lessons were designed on social constructivist approach. Five steps were followed in the development of inquiry lessons (Bybee et al., 2006). The first step of the lesson (1-E Engage) was engagement of the pre-service teachers in a problematic inquiry situation after assessing their existing ideas on the science concepts for the inquiry lesson. The second step (2-E Explore) of the lesson was exploration on the problem in small groups. Members of each group worked independently to given scientific inquiry. The third step (3-E Explain) required each group to explain the findings on the given scientific inquiry and connect these facts and understanding with their original understanding at the start of inquiry. The fourth step (4-Elaborate) was elaboration on the inquiry to go deep in to the concept and extend the understanding to new problems. The fifth step (5-Evaluate) was evaluation, where pre-service teachers made judgments about their inquiry for action. This simplified version of lesson planning is called 5 E model of lesson planning (1-E Engage; 2-E Explore; 3-E Explain; 4- E Elaborate; and 5-E Evaluate).

Results

The descriptive statistics of the STOE given in Table 1 show that the initial and final mean values of the STOE are the same (37.58). The difference is between the initial mean values of standard deviation (4.009) and the final mean value of standard deviation (3.857). The present finding with no change in the mean value of the STOE after transaction of the science method course is in line with certain findings elsewhere (Hechter, 2011; Mulholland, Dorman. & Odgers, 2004; and Savasci-Acikalin, 2014) but is not in line with reports that show positive relationship of the use of constructivist approach with the STOE component (Cone, 2009; El-Deghaidy, 2006; Flores, 2015; Huinker& Madison, 1997; Jarrett, 1999; Johnston, 2003; Knaggs & Sondergeld, 2015; Varma, 2007: 171-3).

Table 1: Statistics of the STOE Component of Science Teaching Confidence

The STOE	N	Mean value of the STOE	Standard Deviation	Variance
STOE 1	118	37.58	4.009	16.075
STOE 2	118	37.58	3.857	14.879

Discussion

The results can be interpreted with specific reference to three points: (1) Difference in the initial and final values of standard deviation; (2) Views of Bandura on the definition of an outcome expectation (Bandura, 1977:193); and (3) Views of Enochs & Riggs (1990) on outcome expectancy for primary pre-service teachers.

The reduction in the final mean value of standard deviation of the STOE is an indication of the positive influence of the transaction of the science course (EDU505) on the STOE component of science teaching beliefs. The standard deviation is the quantification of variation or dispersion of various STOE values at the initial and final stages of the investigation. A specific standard deviation value that is close to zero indicates that data tend to be close to a mean. A specific standard deviation value comparatively away from zero indicates that the data have a tendency to spread out over a wide range of values.

Results (Table 1) show that the final mean value (3.857) of standard deviation after the transaction of the methods course is closer to the mean value (37.58) of the STOE as compared to the initial mean value of standard deviation of the STOE (4.009). In terms of the meaning of standard deviation, the results indicate that the science methods course has caused changes at the standard deviation level but these changes are not sufficient enough to influence the mean value of the STOE (37.58) of the participants.

The results may be interpreted in terms of Bandura's definition of an outcome expectation as an individual's estimate that a given behaviour will lead to certain outcomes (1977: 193). The course, possibly, has not influenced the estimates of primary pre-service teachers about their own teaching behaviours that may lead them to desired learning outcomes.

The results can also be interpreted in terms of views of Enochs & Riggs (1990: 6). They predict that primary pre-service teachers who believe that student learning can be influenced by effective teaching (out-

come expectancy beliefs), can provide a greater academic focus in the classroom. The constructivist science education course in the present study has no influence on the STOE component of primary pre-service teachers. This means that teachers will not be able to teach effectively in their respective classrooms.

Conclusion

The results reveal that there is no relationship between the two variables selected in the present study: (a) the constructivist science education course in a Fijian primary pre-service teacher program, and (b) the STOE component of science teaching beliefs of Fijian primary pre-service teachers. There are reports that are in support and against the present finding. The three different arguments on the results provide ideas for future research, for example, studies on the outcome expectancy beliefs of primary pre-service teacher educators in relations to social constructivist approach and constructivist pedagogical approach. The efforts are required to improve primary science method courses in primary teacher education institutions to fulfill the expectations of *The Fiji National Curriculum Framework-2013*.

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