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The correlation of perceptions of science process skills to its extent of implementation: A study of pre-service year two teachers

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Abstract:

Correct teacher perceptions of science process skills are vital in its development and implementation in the primary science classroom. The main purpose of this study was to document the perceptions of pre-service teachers on science process skills and the extent to which these skills were implemented in their teaching during practicum experience. A sample comprised 80 pre-service teachers at a Fijian university. Participants had completed one science education course and two practicum experience. This study used questionnaire as the main data collection method which was constructed to investigate the perceptions and implementation of the science process skills for the purpose of this study. Whilst majority of pre-service teachers had little difficulty in correctly articulating their perceptions of the science process skills, the results of implementation of science process skills reflected otherwise. Pre-service teachers did not implement all the science process skills regardless of correctly articulating their perceptions. The findings have implications for teacher education at tertiary levels in the area of science education.

Key words: Science process skills, teacher education, Science education, Pre-service teachers

1. Introduction

Science education offers a lot of possibilities for experimentation and inquiry learning which can help a child to learn about and interpret the world around him or her. In practice, science is a process which involves an integration of knowledge, skills and attitudes to develop scientific understanding during investigation. Our modern world today is embedded in scientific manifestations and science is now prevailing in every sphere of human activity. Therefore it is important to focus on science education as a subject that enables to develop a scientific attitude of mind in the learner (Das, 1985), which promotes inquiry learning to take its profound effect in education.

One of the major goals of science education today is the attainment of scientific literacy, which includes deeper conceptual understanding of key scientific principles and ideas, the ability to apply scientific knowledge in real-life contexts, as well as the ability to identify problems and conduct scientific inquiry (American Association for the Advancement of Science, 1993).As science education seeks to find why things happen, while learning science, the learner develops certain faculties through reasoning and experimentation which no other subject can provide (Das, 1985). Since science education is a dynamic subject involving a process and a product, the teaching of science should involve the rudiments of the scientific method. The fundamental skills which govern the scientific method are referred to as science process skills. Process skills are fundamental to science, allowing everyone to reach conclusions in a manner which is understandable to them as investigators

2. Review of literature

The purpose of science education is to enable individuals to use skills such as observing, classifying, inferring, measuring,

communicating, predicting, hypothesizing, and experimenting. (Bass, et al, 2009). The above scientific skills are known as science process skills. In order to construct knowledge on their own in science, students need to study in a science-friendly environment that gives prominence to science process skills. Effective science instruction begins with concrete experiences and carefully scaffolds to more abstract representations such as developmentally appropriate text and graphs (Olson, 2008). The science process skills should be central to the teaching and learning of science as these are the skills which are used when doing science (Rezba, etal.2007). The science process skills are the tools that students use to investigate the world around them and to construct science concepts. Therefore, it's essential for teachers to have a good understanding of these skills to ensure investigation and construction of science concepts as a process in action in the classroom.

Science process skills are foundation for concept formulation, therefore during the school education students need to understand basics of science. The process skills are used to make sense of the world therefore these process skills should be embedded and integrated in inquiry. (Bass, et al, 2009).

Science education should be process based where learners can get concrete experience by using their mind and hands. In practice, science is a process involving an integration of knowledge, skills, and attitudes to develop scientific understanding which means that the teaching of science include the teaching of science process skills. Science process skills in science education are characterized as fundamental in facilitating teaching and learning of scientific concepts. Peacock (1986) pointed out that these skills help to stimulate the development of a curious and questioning attitude so that children can begin to understand fully their environment. Science process skills form the basis of the ability to conduct scientific research. To equip students with science process skills

in classroom environment, teachers themselves should possess and practice these skills. Science process skills involve interest, thoughts and action that motivate a learner intrinsically, to understand the scientific concept clearly and acquire the skills proficiently developing a positive approach to the learning of science education.

Process skills are scientific activities that therefore facilitate the meaningful understanding of ideas. For the purpose of this study, these science process skills were investigated as per the questionnaire, the skills of observing, classifying, measuring, communicating, inferring, predicting, interpreting data, planning investigations and hypothesizing. Therefore this study has explored year two pre-service teachers' perceptions of science process skills and the implementation of these skills during practicum experience. This study will help teacher educators to identify and modify the content and delivery of science education units for the benefit of pre-service teachers.

3. Statement of the problem

The purpose of this study was to gain an insight into pre-service year two primary science teacher's perceptions of science process skills and implementation of the same during practicum. Specifically, the study sought to answer these following questions:

(i) What are year two pre-service primary science teachers' perceptions of science process skills?

(ii) What is the correlation between pre-service primary science teachers' perception of science process skills and the implementation of science process skills?

4. Focus of the study

This study was conducted on the assumption that correct perception of science process skills is reflected in the extent of

implementation of these skills during primary science lessons. The present study's instrument aimed at investigating the perception of pre-service teachers on science process skills and implementation, the purpose being to document the extent to which pre-service teachers used science process skills in their teaching. There seems to be a serious educational gap in this area, especially in bringing these science process skills into the classroom. Unless the teacher is competent in the specific science process skill, they would not be able to correctly develop or implement the same in the learners. Therefore, this study investigated the correlation of perceptions of science process skills to its implementation.

5. Methodology

5.1 Participants

This study comprised of 80 participants, of which 16% were males and 84% females. Participants had completed one of the two required science education course; science education 1, at tertiary level and had completed two rounds of practicum experience. A convenient sampling was done to aid the researcher in the administration of the questionnaire. Out of the 80 pre-service teachers that participated in this study, 35 % did science up to form 7 level, while 65% of the participants did science till form 4 only. It's therefore evident to note that pre-service teachers are enrolled with at least form 4 science knowledge. (Fig 1b).The participants were selected randomly. This number was a convenient sampling as it was easier for the researcher to administer the questionnaire.

5.2 Data collection

For the purpose of this study, one instrument was constructed by the investigator and used for the study: a science process skills perception and implementation questionnaire. The instrument was developed to suit the kind of study undertaken.

This instrument sought to answer the research questions for this particular study. At the same time it sought some demographic information about the participants. Quantitative method was employed to get collect relevant data. This research therefore used questionnaire as the main data collection method. This research was conducted in 2 phases. The first phase involved the administration of questionnaires which was largely quantitative. The second phase involved analysis and reporting of data.

6. Findings

The results of the present study is organized and presented in three sections. The first section deals with pre-service teachers' perception of science process skills. The second section deals with pre-service teacher's extent of implementation of science process skills during their practicum experience. The final section explores the correlation of perceptions of science process skills to its extent of implementation. For ease of interpretation and presentation of data, the results have been organized and presented in graphs and tables.

6.1 Pre- service teachers' perception of science process skills.

As shown in Figure 2, 1% of pre-service teachers noted that they had excellent understanding, 64 % of participants declared they had a good understanding of science process skills while 14% stated their knowledge was limited. 14% reported a need for development in the area of science process skills and 7% did not respond to this question. This result indicates that pre-service teachers tend to be fairly confident in the knowledge of science process skills.

The result was further analyzed where the pre service teachers rated themselves using the scale of excellent, good, limited knowledge and in need of development for each of these skills- observation, classification, measurement, communication, inference, predicting, interpretation of data, planning investigations and hypothesizing.

6.1.1 Observation

54% of the 80 participants rated themselves as good in observation skill, 39% as excellent and 4% noted limited understanding and 4% required development. (Fig 3, graph 1)

6.1.2 Classification

54% of the 80 participants rated themselves as good in classification skill, 21% noted limited understanding, while 16% rated as excellent and 10% required development. (Fig 3, graph 2)

6.1.3 Measurement

43.75% of the 80 participants rated themselves as good in measuring skill, 26.25% noted limited understanding, while 20% rated as excellent and 10% required development. (Fig 3, graph 3)

6.1.4 Communication

54% of the 80 participants rated themselves as good in communication skill, 33% as excellent and 11% noted limited understanding and 4% required development. (Fig 3, graph 4)

6.1.5 Inferring

43.75% of the 80 participants rated themselves as good in inferring skill, 25% noted limited understanding, and 16.25% required development while 15% rated as excellent. (Fig 3, graph 5)

6.1.6 Predicting

49% of the 80 participants rated themselves as good in predicting skill, 21% noted limited understanding, and 18% required development while 13% rated as excellent. (Fig 3, graph 6)

6.1.7 Interpreting data

44% of the 80 participants rated themselves as good in interpreting data skill, 24% noted limited understanding, and 21% required development while 11% rated as excellent. (Fig 3, graph 7)

6.1.8 Planning investigations

46% of the 80 participants rated themselves as good in planning investigation skill, 23% rated as excellent, 19% noted limited understanding, and 13% required development. (Fig 3, graph 8)

6.1.9 Hypothesizing

40% of the 80 participants rated themselves as good in hypothesizing skill, 26% required development, 18% noted limited understanding, while 16% rated as excellent. (Fig 3, graph 9)

6.2 Implementation of science process skills

Figure 4 shows the extent of implementation of science process skills by pre-service teachers. The response was 0% for no implementation, which therefore leads the researcher to believe that all participants had implemented some aspects of science process skills in their science lessons during practicum. 44 % of the pre-service teachers implemented science process skills in few lessons while 50% of the participants had implemented science process skills in most lessons. 5 % of participants had implemented the skills in all of their science lessons. 1 % of the participants did not disclose any information on their implementation.

Figure 5 presents the percentage of each specific science process skill as identified by the pre-service teachers which the learners/ students in primary classrooms were using during science lessons. The result also shows that the skill of observation (52.5%) was used to a greater extent in the science lesson when compared to other skills. The least used skill was inferring (26.25%).

Figure 6 highlights the extent to which pre service teachers encouraged the use of specific science process skills during science teaching and learning sessions. The results reflects that the observation skill (52.5%) was encouraged the most to be used in the science lesson while the least encouraged was inference (26.25%).

7. The correlation of perceptions of science process skills to its extent of implementation

The need for development of science process skills is necessary in any science classroom as it will enhance children's understanding of the scientific investigations. Peters., etal (2006) states using science process skills makes science learning an active and meaningful process. Scientific process skills include skills that every individual could use in each step of his/her daily life by being scientifically literate and increasing the quality and standard of life by comprehending the nature of science. Science process skills are used to make sense of a new experience, collect evidence to form an explanation and connect that explanation to previously held knowledge, conceptions and models (Llewellyn, 2002).

Furthermore, Tolman (2002) discusses that implementation of science process skills is important as these are tools of inquiry in science. Therefore, it can be agreed that science process skills is not only related to the classroom but can be also used for producing and arranging information about the world at large. The concept being that our world revolves

around science, thus learning science process skills becomes mandatory.

Deplorably, in primary schools, sometimes the teacher is the major impediment to the development and implementation of science process skills. Science lessons are merely seen as using equipment rather than as a process of discovering information. The reason simply reflects teachers' inadequacy and lack of expertise in the science process skills themselves due to inadequate training. Rezba., etal, (2007), emphasizes that in order for teachers to teach the science process skills to children, teachers need to be confident in their own skill. Unless teachers model and teach the science process skills, students will continue to take science education as a subject full of facts to memorize and reproduce in exams or assessments. And in order for teachers to teach science process skills competently in their science lessons, teachers themselves need to be fully aware and competent in the understanding and demonstration of these skills. Ostlund (1992) states that the intellectual value of mastering the science process skills is far greater than the value of the ability to repeat scientific facts or principles. Developing science process skills can promote favorable attitude towards science which could lead to enhanced understanding of scientific concepts.

Improving primary teachers' implementation of the science process skills is essential, as Chan (2002) reflects that teaching science is an important responsibility. The teacher is expected to model good science and to teach the students the skills needed to learn about science and scientific inquiry. Bhattacharyya et al., (2009) further emphasizes on this issue stating, that teachers don't teach what they don't know. This is one impeding factor in the success of science lessons as teachers focus on known science process skills and avoid unknown or difficult skills.

In order for the teaching and learning of science to be of considerable value, the students must be able to apply scientific

concepts, content, attitudes and science process skills to their wider life. A limited understanding of science process skills equals implementation with very limited value. The value of learning science is greatly enhanced when the students are led into an extensive understanding and a practical conception of how scientific concepts and process skills apply to themselves personally, to their families, their communities and their nation. Regardless of their academic standing, all students should have access to a rich and challenging science curriculum that will promote scientific literacy, while inspiring and supporting advanced study and science-related careers. Teachers need to develop students who will be confident and capable lifelong learners, equipped with the skills needed to access, understand, evaluate and apply scientific information in various contexts. Primary teacher education students undertake science education courses at tertiary levels which offer a foundation in scientific literacy that exposes pre-service teachers to the world of science education. Science education educators should take teaching science process skills to pre-service teachers as a personal responsibility as without the development of science process skills, science teaching will be in vain both at the university level which will be reflected at the later years in the primary system.

It is evident to note that pre-service teachers' perceptions of science process skills give a clear reflection of the extent of its implementation in the actual lesson. The results confirmed the researcher's view that pre-service teachers implement those science process skills of which they have a clear understanding and avoid the implementation of the rest. The way pre-service teachers perceive a particular science process skill, influences the way it will be implemented during a science lesson. If the perception is correct, the implementation done would reflect essence of the science process skills. However, if the perception is not stable, then the implementation staggers, to the extent of either being

implemented to a certain limit or totally ignored during the lesson.

The skill of observation was implemented to a greater extent (52.5%) when compared to the other process skills. In contrast to that, inferring was the least implemented (26.25%). This reflects that pre-service teachers find inferring skill difficult to teach therefore it is not implemented to the extent observation skill is implemented. Therefore, the correlation of the pre service teacher's perception and implementation of science process skills is directly proportional. The better the perception, the higher the extent of implementation. In contrast to that, limited perception and understanding reflect limited implementation.

8. Conclusion

Teaching science process skills has a special importance in the science curriculum. Science process skills are the tools that students use to investigate the world around them and to construct science concepts, so it's essential for teachers to have a good understanding of these skills. Recognizing the importance of developing science process skills in primary school is essential for developing a generation of divergent and alert students. A proper understanding of science process skills develops scientific inquiry and reinforces science teaching and learning. Teachers need to master science process skills in order to be able to implement the same in the primary science classroom. Therefore it is essential that pre-service teachers are fully aware of the importance of science process skills and are competent enough to implement the same. Only then science process skills could be effectively implemented to enhance the status of science education in Fijian primary schools.

If the primary science educators overlook this aspect of developing correct perceptions of science process skills in pre-service teachers, then young graduates who are inadequately

prepared in science education would be sent in the primary classroom. Teacher education courses should explicitly focus on developing a correct percept of science process skills due to the single fact that majority of pre-service teachers bring science knowledge up to form four level only. Science process skills are very fundamental to science and exploring the perceptions of pre-service teachers is vital in order to curb the educational gap of bringing the skills into the classroom for proper science teaching and learning to take place. It can be, therefore, concluded from this study that teachers' perception of science process skills is an important factor in the implementation of the science process skill. Lack of teacher acquisition of science process skill will lead to lack of ability to develop or implement science process skills.

9. Recommendations for further study

Based on the above findings of the present study, the following recommendations are made:

1. This study involved pre-service teachers at one university; therefore, additional studies should be conducted to investigate whether the results from other universities in other regions report statistically similar results.
2. Teachers should present the science process skills by teaching the use of basic skills like observation then gradually moving to complex skills like hypothesizing in order for students to understand the worth of each science process skill and proper acquisition of each skill.
3. Learners should be encouraged to use science process skills in the science lessons to enhance understanding of scientific concepts and also make learning science enjoyable and meaningful.
4. A major stumbling block in teaching science process skills is teaching science skills in isolation from their real world

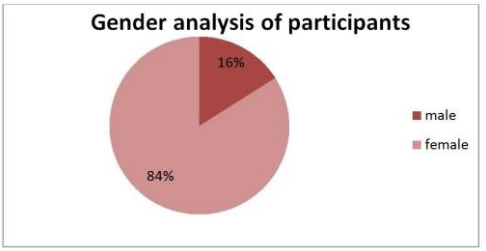
applications. Scientific readers should be developed for primary school levels to aid teaching of science process skills and develop scientific literacy. This would also enhance the notion that science is not limited to a subject only, it is very much part of our daily lives and that, science process skills are not only confined to the science classroom but are useful in all works of life.

5. There is a need to increase the focus on the development of science process skills of pre-service teachers so they are better able to develop and implement the use of science process skills while teaching science.

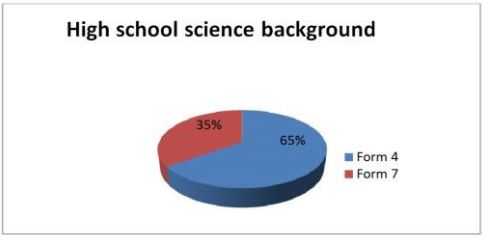
10. Limitations

This study was limited to one tertiary institution.

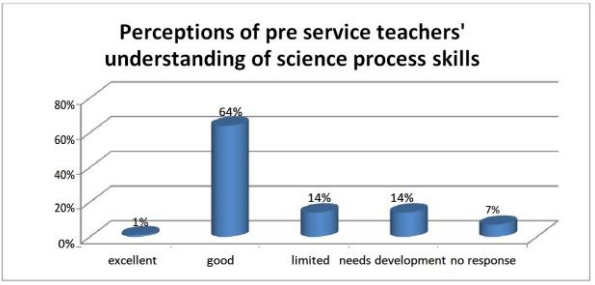
11. Figure 1a: Participants' Gender Analysis (n=80)



12. Figure 1b: Participants' Level of Science Education High School Background (n =80)



13. Figure 2: Pre Service Teachers Self-Rated Perceptions of Science Process Skills (n =80)



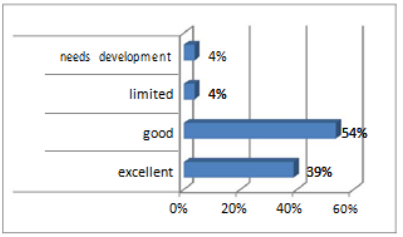
14. Table 1: Pre service teachers' rating of their perception of specific science process skills

Science process skill	**Rating**	**Percentage**
observe	excellent	39%
	good	54%
	limited	4%
	needs development	4%
classify	excellent	16%
	good	54%
	limited	21%
	needs development	10%
measure	excellent	20%
	good	43.75%
	limited	26%
	needs development	10%
communicate	excellent	33%

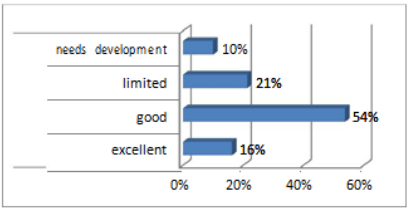
	good	54%
	limited	11%
	needs development	4%
infer	excellent	15%
	good	44%
	limited	25%
	needs development	16.%
predict	excellent	13%
	good	49%
	limited	21%
	needs development	18%
interpret data	excellent	11%
	good	44%
	limited	24%
	needs development	21%
plan investigations	excellent	23%
	good	46%
	limited	19%
	needs development	13%
hypothesize	excellent	16%
	good	40%
	limited	18%
	needs development	26%

15. Figure 3: Graphs for specific science process skills:

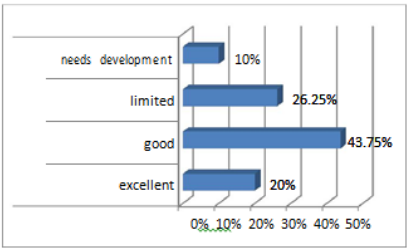
Graph 1: science process skill –observation



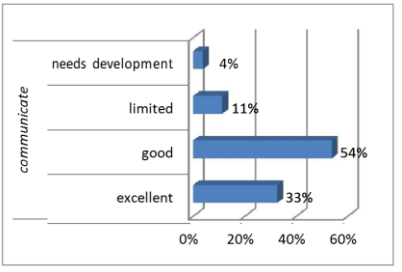
Graph 2: science process skill- classify



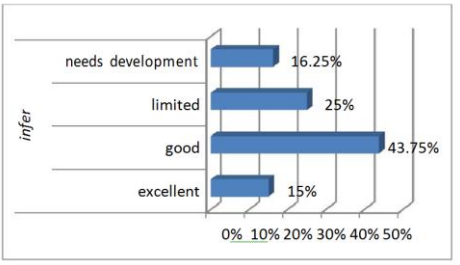
Graph 3: science process skill- measure



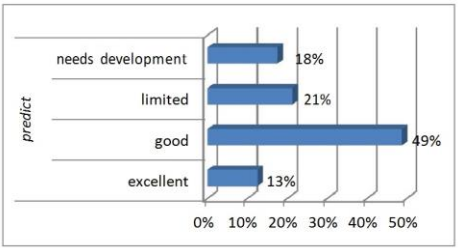
Graph 4: science process skill- communicate



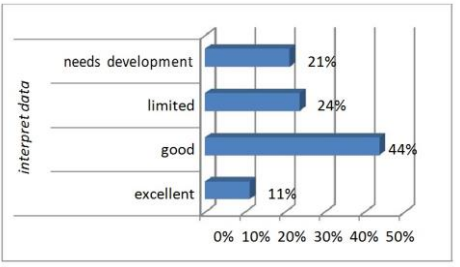
Graph 5: science process skill- infer



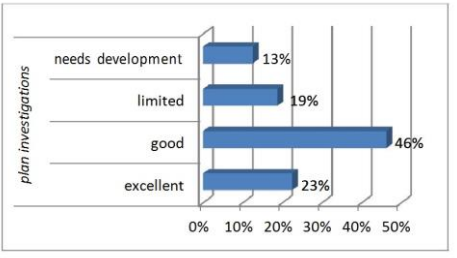
Graph 6: science process skill- predict



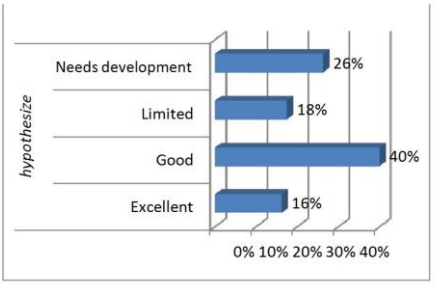
Graph 7: science process skill- interpret data



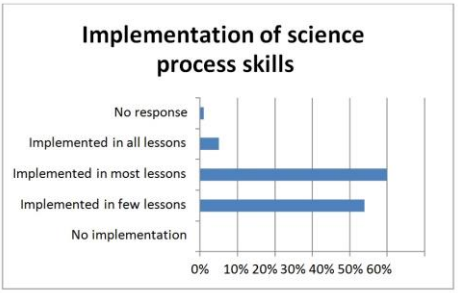
Graph 8: science process skill- plan investigations



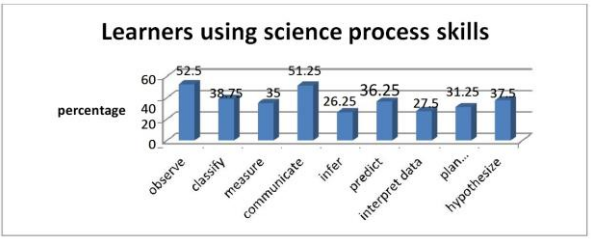
Graph 9: science process skill- hypothesize



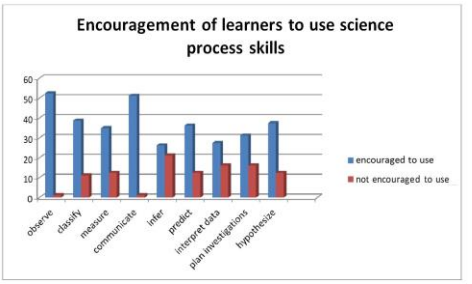
16. Figure 4: Implementation of science process skills



17. Figure 5: Learners using science process skills



18. Figure 6: Pre Service Teachers' Extent of Encouragement towards Using Science Process Skills by learners



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