THE INTERRELATION BETWEEN PRE-SERVICE SCIENCE TEACHERS' CONCEPTIONS OF TEACHING AND LEARNING, LEARNING APPROACHES AND SELF-EFFICACY BELIEFS

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Abstract

The purpose of this study was to investigate the interrelation between pre-service science teachers' conceptions of teaching and learning, learning approaches and self-efficacy beliefs in Sagaing University of Education. Correlational research design was used in this study. A total of 858 pre-service science teachers from different BEd courses were randomly selected as participants. In order to collect and analyze data, four surveys were used in this study. They are *"Draw-A-Science-Teacher-Test Checklist (DASTT-C)"*, *"Teaching and Learning Conceptions Questionnaire (TLCQ)"*, *"Learning Approach Questionnaire (LAQ)"* and *"Science Teaching Efficacy Belief Instrument (STEBI-B)".* Based on the research findings of *"Draw-A-Science-Teacher-Test Checklist (DASTT-C)"*, 30% pre-service science teachers expressed that they will utilize student-centered instruction, 21.4% pre-service science teachers expressed that they will utilize teacher-centered instruction, and 48.6% pre-service science teachers expressed that they will utilize both student-centered and teacher-centered instruction when they become science teachers. It was also found that they had constructivist conceptions of teaching and learning, and they learned science subjects by meaningful learning approach. Therefore, they had both personal science teaching efficacy and science teaching outcome expectancy. Finally, it was also found that *"Constructivist Conception"* was moderately and significantly correlated with *"Meaningful Learning Approach"* (r=.375, p<0.01), positively correlated with *"Personal Science Teaching Efficacy"* (r=.346, p<0.01) and *"Science Teaching Outcome Expectancy"* (r=.229, p<0.01). On the other hand, *"Traditional Conception"* was highly related to *"Rote Learning Approach"* (r=.668, p<0.01), negatively and significantly correlated with *"Personal Science Teaching Efficacy"* (r=-.346, p<0.01) and *"Science Teaching Outcome Expectancy"* (r=-.134, p<0.01) in selected courses. Therefore, teacher educators from Sagaing University of Education should instruct their students to develop constructivist conceptions of teaching and learning and encourage them to use meaningful learning approach in their learning. Only then, they will increase their personal science teaching efficacy and science teaching outcome expectancy and they can teach science subjects effectively when they become science teachers. Further research needs to be expanded to other Universities of Education and Education Colleges in our country.

Keywords: Constructivist Conception, Traditional Conception, Meaningful Learning Approach, Rote Learning Approach

Introduction

The rapid growth in knowledge over recent times has meant that teachers have to be responsive to new and ever changing demands of society. Science is among those key areas of knowledge that has experienced overwhelming growth and thus developing scientific literacy is a priority if citizens are to participate effectively in society (Watters & Ginns, 2000).

Science education provides us an opportunity to think critically, and unify the concepts of man's natural environment and apply these concepts to the control of the environment for man's benefit. Therefore, Watters and Ginns (2000) stated that failure to develop children's interest in science will disempower a generation of children in an era when scientific knowledge is at the foundation of our culture.

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It is universally acknowledged that any attempt at the improvement in the quality of science education ultimately depends on the quality of teaching and learning in the classrooms and laboratories (Safdar, 2013). The task is to make science education meaningful and useful for children of today (Watters & Ginns, 2010; cited in Watters & Ginns, 2000). At the core of making science meaningful for children are the actions and initiatives of classroom teachers (Watters & Ginns, 2000). Therefore, Bursal (2012) stated that having science teachers with an accurate understanding of science concepts is a must-have requirement for a better science education.

Purpose of the Study

The main purpose of this study is to investigate the interrelation between pre-service science teachers' conceptions of teaching and learning, learning approaches and self-efficacy beliefs at Sagaing University of Education.

Specific purposes of this study are-

- To explore the images that pre-service teachers have of themselves as science teachers,
- To explore the teaching and learning conceptions perceived by pre-service science teachers,
- To investigate the learning approach adopted by pre-service science teachers,
- To examine the pre-service science teachers' efficacy beliefs regarding science teaching, and
- To discover the relationship between pre-service science teachers' conceptions about teaching and learning, learning approaches, and self-efficacy beliefs.

Research Questions

The following research questions guide the direction of the study.

1. What images do pre-service science teachers have of themselves as science teachers?
2. What are the teaching and learning conceptions perceived by pre-service science teachers?
3. What is the learning approach adopted by pre-service science teachers?
4. What are the pre-service science teachers' self-efficacy beliefs regarding science teaching?
5. What is the interrelationship between pre-service science teachers' teaching and learning conceptions, learning approaches and self-efficacy beliefs?

Limitation of the Study

The scope of the present study was limited to the information and data acquired from the pre-service science teachers about their conceptions of teaching and learning, learning approaches and self-efficacy beliefs. The participants of this study were the pre-service science teachers who were studying in BEd second year course, BEd third year course, BEd fourth year course and BEd fifth year course from Sagaing University of Education. The scope of this study was limited to Sagaing University of Education based on available time and resources of the researcher. The finding of this study may not be generalizable to any other University than Sagaing University of Education.

Definitions of Key Terms

The terms used throughout the current study are identified below for clarity and understanding.

- ***Traditional Teaching/Learning Conception:*** "It stresses learning by getting information from teachers and textbooks by considering teacher as transmitter of the knowledge as well as student as the recipient of the knowledge or passive learner" (Chan & Elliott, 2004; cited in Saçici, 2013).
- ***Constructivist Teaching/Learning Conception:*** "It stresses the importance of experience and active learning process that encourage critical thinking, discovery and cooperation by considering teacher as counselor as well as student as active participant" (Chan & Elliott, 2004; cited in Saçici, 2013).
- ***Meaningful Learning:*** It implies that what one has learned is intellectually linked and understood, in a non-arbitrary fashion, to what was known previously, and that this knowledge can be called upon in new situations (Ausubel, 1960; cited in Biser, 1984).
- ***Rote Learning*** is arbitrary, verbatim, and not related to experience with events or objects, and lacks affective commitment on the part of the learner to relate new and prior knowledge (Chin & Brown, 2000; cited in Kılıç & Sağlam, 2010).
- ***Personal Science Teaching Efficacy*** refers to the belief that one is capable of effective science instruction (Ngman-Wara & Edem, 2016).
- ***Science Teaching Outcome Expectancy*** refers to the teacher's beliefs about students' ability to learn science (Ngman-Wara & Edem, 2016).

Theoretical Framework

This study is based on Dewey's (1916) Constructivism Learning Theory, Ausubel's (1963) Assimilation Learning Theory and Bandura's (1977) Self-Efficacy Theory. The theoretical framework for this study is summarized in the following Figure 1.

Entrenched in learning theories advanced by Dewey (1916), Piaget (1972), Vygotsky (1978) and Bruner (1990), constructivism learning theory is defined as active construction of new knowledge based on a learner's prior experience (as cited in Koohang, Riley, & Smith, 2009). According to Dewey, active participation and self-direction by students are imperative and learner's experience and worldview are critical to problem-solving education. Dewey (1961; cited in Ültanır, 2012) insists that the "contents of the child's experience" is more important than the "subject-matter of the curriculum".

Ausubel's assimilation theory of meaningful learning was published in 1963 (Novak, 2010). First and most important was the emphasis on meaningful learning, which he defined as non-arbitrary, non-verbatim, substantive incorporation of new symbolically expressed ideas into cognitive structure. Ausubel defined rote learning as arbitrary, verbatim, non-substantive incorporation of new ideas into cognitive structure. Information does enter cognitive structure, but with no specific relevance to existing concept/propositional frameworks.

Science teaching self-efficacy is based on the work of Bandura (1977) who laid the foundation for self-efficacy. Bandura (1986; cited in Uswatte, 2013) defined self-efficacy as, "people's judgments of their capabilities to organize and execute courses of action required to attain designated types of performance". Self-efficacy beliefs determine how people feel, think,

motivate themselves and behave (Bandura, 1994). According to Bandura (1977; cited in Hunter, 2016), our beliefs about self-efficacy are informed from four main sources; enactive mastery experiences, vicarious experiences, physiological factors and verbal persuasion. Among them, the most influential source of efficacy information is enactive mastery, which provides authentic evidence of the teacher's performance in the classroom and school setting, with success leading to enhanced self-efficacy and failure to reduced self-efficacy (Bandura, 1997; cited in Oh, 2011).

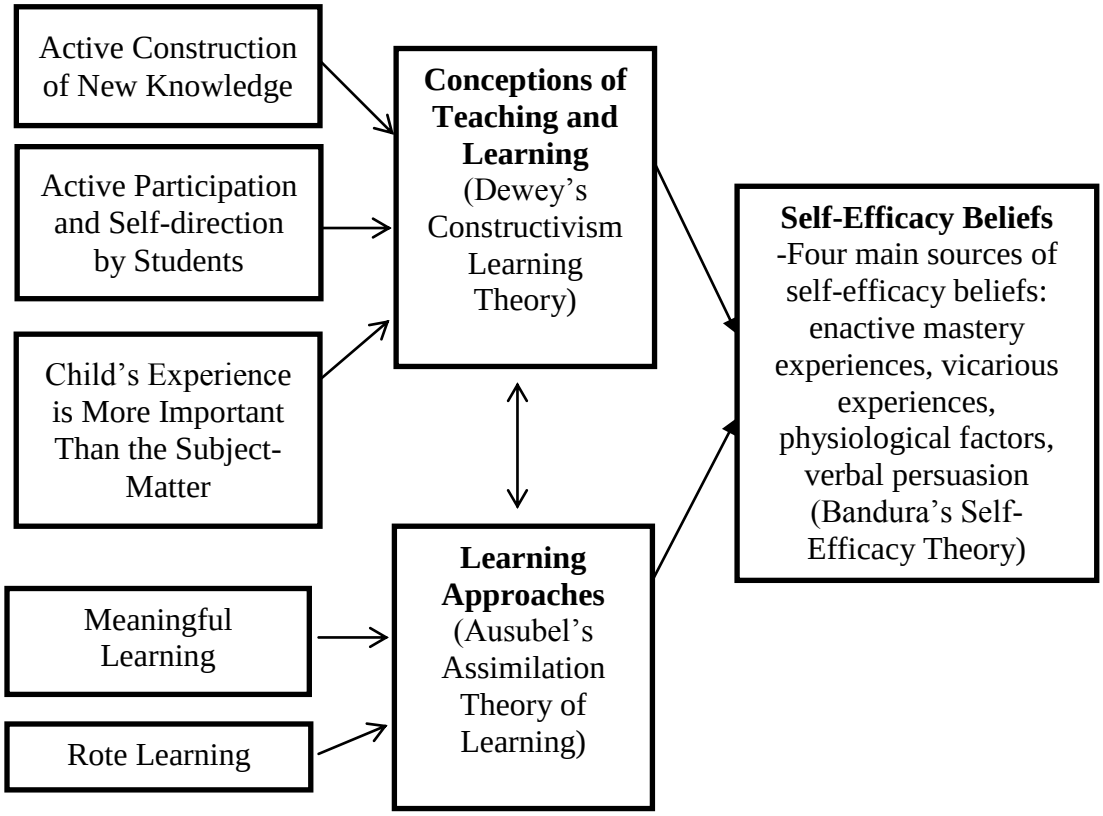


Figure 1 Theoretical Framework for the Study

Review of Related Literature

Conceptions of Teaching and Learning

What teachers do in their classrooms is oriented by their conception of teaching which are derived from their beliefs including a teacher's prior experiences, school practices, and a teacher's individual personality (Canbay & Beceren, 2012). Kember (1997, cited in Brown, Lake & Matters, 2009) concluded that "the methods of teaching adopted, the learning tasks set, the assessment demands made and the workload specified are strongly influenced by the orientation to teaching". Since behaviour can be seen as an outcome of beliefs (Ajzen, 1991), teachers' beliefs or conceptions of teaching matter to educational practices and outcomes (Pajares, 1992; Thompson, 1992; as cited in Brown *et al*., 2009). Moreover, teachers' understandings of what learning is probably influence their teaching practices and student academic performance (Brown, Lake & Matters, 2008). How teachers conceive of learning is useful in understanding classroom teaching and assessment practices (Brown *et al*., 2008).

Learning Approaches

Approaches to learning are understood to be learning processes which learners establish in order to deal with an academic task, and they originate from the learners' perceptions of the task and from their attributes (Entwistle and Peterson 2004; cited in López, Cerveró, Rodríguez, Félix, & Esteban, 2013). According to Biggs (1994; cited in Chiou, Liang & Tsai, 2012), students' approaches to learning refer to "the way in which students go about their academic work".

Self-Efficacy Beliefs

Bandura (1977; cited in Bahcivan & Kapucu, 2014) refered self-efficacy beliefs to perceived beliefs, judgments or capabilities of a person about performing actions at designated levels. In the context of science teaching, self-efficacy consists of personal science teaching efficacy (PSTE) and science teaching outcome expectancy (STOE) (Ngman-Wara & Edem, 2016; Cantrell *et al*., 2003; Moore & Watson, 1999; cited in Bursal, 2012). PSTE is a person's belief in his or her ability to teach science effectively and STOE is the belief that effective teaching will have a positive effect on student learning.

Methodology

Descriptive research method was used to collect the required data in this study. Questionnaire survey was used in quantitative methods. In this study, 858 pre-service science teachers who were studying at BEd second year, BEd third year, BEd fourth year and BEd fifth year courses were randomly selected as participants.

Instrumentation

In this study, four research instruments were used to collect data. To explore the pre-service science teachers' conceptions about how to teach science, *"Draw-A-Science-Teacher-Test Checklist (DASTT-C)"* developed by Thomas, Pedersen and Finson (2001), to examine the pre-service science teachers' conceptions about teaching and learning, *"Teaching and Learning Conceptions Questionnaire (TLCQ)"* developed by Chan and Elliott (2004), to explore the pre-service science teachers' learning approaches, *"Learning Approach Questionnaire (LAQ)"* developed by Cavallo (1996), and to examine the pre-service science teachers' self-efficacy beliefs about their science teaching, *"Science Teaching Efficacy Belief Instrument (STEBI-B)"* developed by Enochs and Riggs (1990) were used.

Procedure

Before field testing the instruments with a sample of pre-service science teachers, four instruments were revised by a panel of experts who have special knowledge and close relationship with this area, from Department of Educational Theory. Two Education Colleges were selected as sample colleges for the pilot testing. The preliminary instruments were tested by 200 pre-service science teachers (100 male pre-service science teachers and 100 female pre-service science teachers) representing two colleges. Questionnaires were delivered to pre-service science teachers from those colleges on 14th December, 2017 and on 20th December, 2017 and collected after one week. All of pre-service science teachers responded to those questionnaires. After calculating the collected data in items of reliability, the researcher reviewed and revised the items which had correlation coefficient less than 0.3.

In order to measure the reliability of instrument, the Pearson product-moment correlation method (Average Item Total Correlation) was used. In this study, the coefficient of correlation

for pre-service science teachers' perceptions on their conceptions of teaching and learning ranged from 0.556 to 0.844, and thus the average was 0.7. Moreover, the coefficient of correlation for pre-service science teachers' perceptions on their learning approaches ranged from 0.542 to 0.8, and thus the average was 0.671. Furthermore, the coefficient of correlation for pre-service science teachers' self-efficacy beliefs ranged from 0.834 to 0.835 and thus the average was 0.835.

After taking permission from the responsible persons, questionnaires were distributed to pre-service science teachers who were attending at second year, third year, fourth year and fifth year science classes from Sagaing University of Education on 10th January, 2018 and 11th January, 2018 and then collected them after lasting 7 days. Out of 921 pre-service science teachers, only 858 pre-service science teachers completed the questionnaires. Based on the results of responses, this study was carried out to investigate the interrelation between conceptions of teaching and learning, learning approaches and self-efficacy beliefs pre-service science teachers from Sagaing University of Education.

Research Findings

Pre-service Science Teachers' Drawings Regarding Their Conceptions about How to Teach Science Subjects

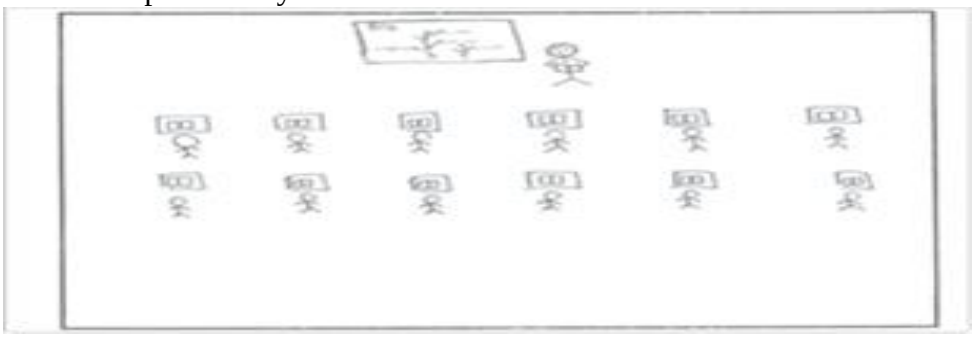
The researcher identified that the pre-service science teachers who got between 0 and 4 scores will likely to use student-centered instruction, those who got between 10 and 13 scores will likely to use teacher-centered instruction and those who got between 5 and 9 scores will likely to use both student-centered and teacher-centered instruction when they become science teachers. Examples of student-centered, teacher-centered and neither student-centered nor teacher-centered drawings of pre-service science teachers are shown in Figure 2, Figure 3 and Figure 4**.**

Participant ID: 537
Draw a picture of yourself as a science teacher at work.

What is the teacher doing?
"Teacher is supervising the students' study about photosynthesis".
What are the students doing?
"Students are studying about photosyntheis outside the classroom".

Figure 2 Student-centered DASTT Picture and Pre-service Science Teacher' Explanation

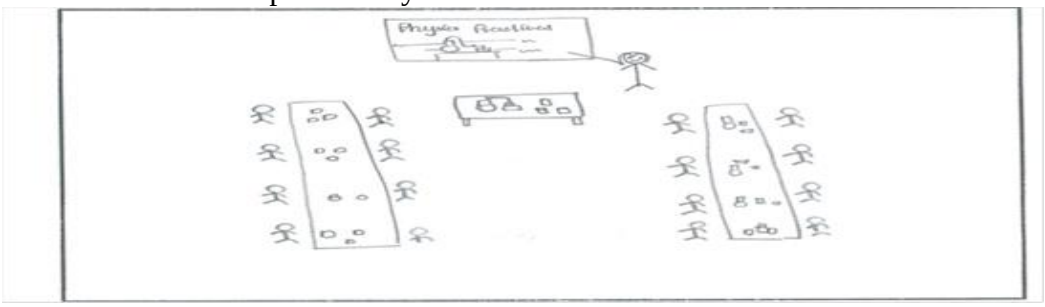
Participant ID: 462
Draw a picture of yourself as a science teacher at work.



What is the teacher doing?
"Teacher is lecturing about a topic in Biology subject".
What are the students doing?
"Students are listening".

Figure 3 Teacher-centered DASTT Picture and Pre-service Science Teachers' Explanation

Participant ID: 463
Draw a picture of yourself as a science teacher at work.



What is the teacher doing?
"Teacher is explaining the procedures to be followed by the students when doing an experiment".
What are the students doing?
"Students are listening their teacher's explanation and then they will do an experiment as groups".

Figure 4 Middle Category—Neither Teacher-centered nor Student-centered—DASTT Picture and Pre-service Science Teacher' Explanation

The results of the DASTT-C showed that 30% of pre-service science teachers will utilize student-centered instruction regarding their perspectives of science teaching conception. Similarly, 21.4% of pre-service science teachers will use teacher-centered and 48.6% of pre-service science teachers will teach by using both approaches (*i.e.,* neither student-centered nor teacher-centered instruction) (See: Figure 5).

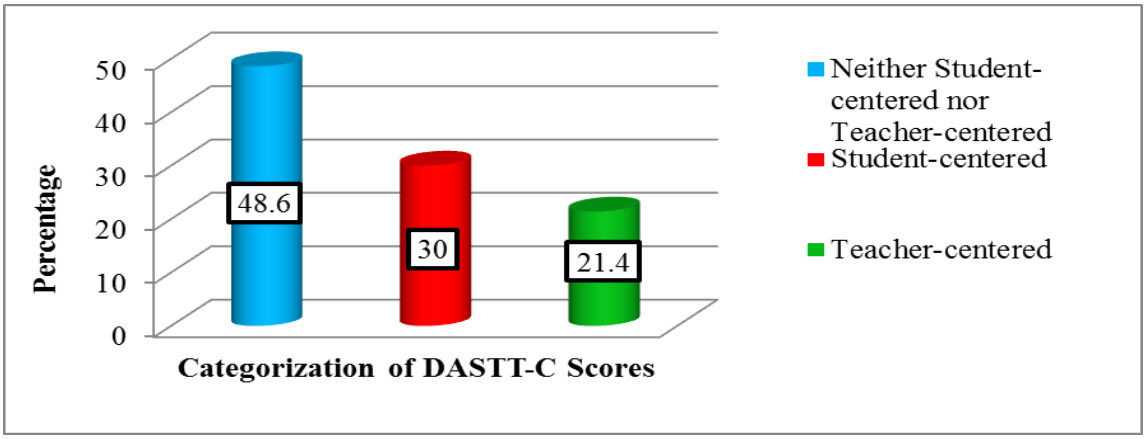


Figure 5 Results of DASTT-C Categorization in Percentage

Table 1 presents the mean values of *"Conceptions of Teaching and Learning"* perceived by pre-service science teachers at selected courses from Sagaing University of Education. According to Table 1, it was found that pre-service science teachers from all selected courses perceived constructivist conception. With respect to traditional conception, it was found that pre-service science teachers from all courses did not decide that whether they had traditional conception or not.

Table 1 Mean Values of Conceptions of Teaching and Learning Perceived by Pre- service Science Teachers from Different Courses

Course / Dimension	2nd Year (133)	3rd Year (236)	4th Year (172)	5th Year (317)	Total (N=858)
Constructivist Conception	4.07 (.532)	4.15 (.369)	4.32 (.353)	4.29 (.382)	4.22 (.410)
Traditional Conception	3.15 (.640)	2.90 (.667)	3.03 (.501)	2.87 (.656)	2.95 (.636)

1= Strongly Disagree 2=Disagree 3=Undecided 4=Agree 5=Strongly Agree

Table 2 presents the mean values of learning approaches adopted by pre-service science teachers at selected courses from Sagaing University of Education. According to this Table, it was found that pre-service science teachers from all selected courses were learning by meaningful learning approach. However, it was found that they did not decide that whether they were learning by rote learning approach or not.

Table 2 Mean Values of Learning Approaches Adopted by Pre-service Science Teachers from Different Courses

Course / Dimension	2nd Year (133)	3rd Year (236)	4th Year (172)	5th Year (317)	Total (N=858)
Meaningful Learning Approach	3.74 (.445)	3.85 (.440)	3.82 (.376)	3.80 (.412)	3.81 (.419)
Rote Learning Approach	2.94 (.627)	2.73 (.609)	2.82 (.448)	2.76 (.610)	2.79 (.587)

1= Strongly Disagree 2=Disagree 3=Undecided 4=Agree 5=Strongly Agree

Table 3 presents the mean values of self-efficacy beliefs perceived by pre-service science teachers at selected courses from Sagaing University of Education. This Table showed that the pre-service science teachers from BEd third year, fourth year and BEd fifth year courses had high level in *"Personal Science Teaching Efficacy"* and those from BEd second year course had moderate level in it. With respect to *"Science Teaching Outcome Expectancy"*, it was found that the pre-service science teachers from all selected courses had moderate level.

Table 3 Mean Values of Self-Efficacy Beliefs Perceived by Pre-service Science Teachers from Different Courses

Course / Dimension	2nd Year (133)	3rd Year (236)	4th Year (172)	5th Year (317)	Total (N=858)
Personal Science Teaching Efficacy	3.57	3.72	3.76	3.81	3.74
Science Teaching Outcome Expectancy	3.54	3.52	3.53	3.58	3.55
Overall Self-Efficacy	3.55	3.62	3.64	3.69	3.64

1.00-2.33=Low 2.34-3.67=Moderate 3.68-5.00=High

According to table 4, there was a moderate positive correlation between *"Constructivist Conception"* and *"Meaningful Learning Approach"* (r=.375, p<0.01) in selected courses. However, it was found that there was a low positive correlation between *"Constructivist Conception"* and *"Personal Science Teaching Efficacy"* (r=.346, p<0.01). Similarly, it was also found that there was a low positive correlation between *"Constructivist Conception"* and *"Science Teaching Outcome Expectancy"* (r=.229, p<0.01).

In addition, it was found that there was a high positive correlation between *"Traditional Conception"* and *"Rote Learning Approach"* (r=.668, p<0.01) in selected courses. However, it was found that there was a low negative correlation between *"Traditional Conception"* and *"Personal Science Teaching Efficacy"* (r=-.346, p<0.01). Similarly, it was also found that there was a low negative correlation between *"Traditional Conception"* and *"Science Teaching Outcome Expectancy"* (r=-.134, p<0.01).

Table 4 Interrelation between Dimensions of Conceptions of Teaching and Learning, Learning Approaches and Self-Efficacy Beliefs of Pre-service Science Teachers from Sagaing University of Education

	1	2	3	4	5	6
1.Constructivist Conception	1					
2.Traditional Conception	.024	1				
3.Meaningful Learning Approach	**.375****	.004	1			
4.Rote Learning Approach	-.006	**.668****	**-.071***	1		
5.Personal Science Teaching Efficacy	**.346****	**-.346****	**.382****	**-.428****	1	
6.Science Teaching Outcome Expectancy	**.229****	**-.134****	**.385****	**-.231****	**.393****	1

**Correlation is significant at the 0.01 level (2-tailed).

*Correlation is significant at the 0.05 level (2-tailed).

According to the above Table, it was also found that there was a low negative correlation between *"Meaningful Learning Approach"* and *"Rote Learning Approach"* (r=-.071, p<0.05) in selected courses. However, it was found that *"Meaningful Learning Approach"* was moderately and positively correlated to *"Personal Science Teaching Efficacy"* (r=.382, p<0.01). Moreover, it was also found that *"Meaningful Learning Approach"* was moderately and positively correlated to *"Science Teaching Outcome Expectancy"* (r=.385, p<0.01).

Additionally, it was found that there was a moderate negative correlation between *"Rote Learning Approach"* and *"Personal Science Teaching Efficacy"* (r=-.428, p<0.01) in selected courses. Moreover, it was found that there was a low negative correlation between *"Rote Learning Approach"* and *"Science Teaching Outcome Expectancy"* (r=-.231, p<0.01). Finally, it was found that *"Personal Science Teaching Efficacy"* and *"Science Teaching Outcome Expectancy"* were moderately and positively correlated (r=.393, p<0.01).

Conclusion, Discussion and Recommendation

The results of research findings for selected courses were as follows:

1. When exploring the pre-service science teachers' drawings regarding their conceptions about how to teach science subjects, 30% pre-service science teachers expressed that they will utilize student-centered instruction, 21.4% pre-service science teachers expressed that they will utilize teacher-centered instruction, and 48.6% pre-service science teachers expressed that they will utilize both student-centered and teacher-centered instruction when they become science teachers.
2. When exploring the conceptions of teaching and learning perceived by pre-service science teachers from selected BEd courses, it was found that the pre-service science teachers from selected BEd courses perceived *"Constructivist Conception".* However, they did not decide that whether they had *"Traditional Conception"* or not.
3. In addition, when investigating the learning approaches adopted by pre-service teachers from selected BEd courses, it was found that pre-service science teachers from all selected courses were learning by *"Meaningful Learning Approach"*. However, they did not decide that whether they were learning by *"Rote Learning Approach"* or not.
4. When examining the pre-service science teachers' self-efficacy beliefs regarding science teaching from selected BEd courses, it was found that pre-service science teachers from all selected courses had both "*Personal Science Teaching Efficacy*" and "*Science Teaching Outcome Expectancy"*. Among the selected BEd courses, the pre-service science teachers from BEd third year, BEd fourth year and BEd fifth year courses had high level in *"Personal Science Teaching Efficacy"* and those from BEd second year course had moderate level in it. With respect to *"Science Teaching Outcome Expectancy"*, it was found that the pre-service science teachers from all selected courses had moderate level.
5. When exploring the interrelation between conceptions of teaching and learning, learning approaches and self-efficacy beliefs of pre-service science teachers from selected BEd courses, it was found that there was a moderate positive correlation between *"Constructivist Conception"* and *"Meaningful Learning Approach"* (r=.375, p<0.01) in selected BEd courses. However, it was found that there was a low positive correlation between *"Constructivist Conception"* and *"Personal Science Teaching Efficacy"*

(r=.346, p<0.01) and also *"Science Teaching Outcome Expectancy"* (r=.229, p<0.01). In addition, it was found that there was a high positive correlation between *"Traditional Conception"* and *"Rote Learning Approach"* (r=.668, p<0.01) in selected courses. However, it was found that there was a low negative correlation between *"Traditional Conception"* and *"Personal Science Teaching Efficacy"* (r=-.346, p<0.01) and also *"Science Teaching Outcome Expectancy"* (r=-.134, p<0.01). Furthermore, it was also found that there was a low negative correlation between *"Meaningful Learning Approach"* and *"Rote Learning Approach"* (r=-.071, p<0.05) in selected courses. However, it was found that *"Meaningful Learning Approach"* was moderately and positively correlated to *"Personal Science Teaching Efficacy"* (r=.382, p<0.01) and also to *"Science Teaching Outcome Expectancy"* (r=.385, p<0.01). Additionally, it was found that there was a moderate negative correlation between *"Rote Learning Approach"* and *"Personal Science Teaching Efficacy"* (r=-.428, p<0.01) in selected courses. Moreover, it was found that there was a low negative correlation between *"Rote Learning Approach"* and *"Science Teaching Outcome Expectancy"* (r=-.231, p<0.01). Finally, it was found that *"Personal Science Teaching Efficacy"* and *"Science Teaching Outcome Expectancy"* were moderately and positively correlated (r=.393, p<0.01).

Analyses of quantitative data collected from the study attempted to answer five research questions. **Research question one** assessed the pre-service science teachers' drawings regarding their conceptions about how to teach science subjects. According to their drawings, it can be interpreted that the pre-service science teachers from selected courses will most utilize both teacher-centered and student-centered teaching approaches, will less utilize student-centered and will least utilize teacher-centered teaching approaches when they become science teachers. Therefore, this study is in line with the previous study of Uner, Akkusa and Turana (2012).

Research question two explored the conceptions of teaching and learning perceived by pre-service science teachers at selected BEd courses from Sagaing University of Education. When studying their rating, it was found that all (N=858) pre-service science teachers at selected BEd courses perceived *"Constructivist Conception"*. It can be concluded that the pre-service science teachers at selected BEd courses accepted the conception of teaching that the focus of teaching was to help students construct knowledge from their learning experience instead of knowledge communication. Moreover, they perceived that learning meant providing students ample opportunities to explore, discuss and express their ideas. This study was also in line with the previous study of Yılmaz and Şahin (2011) in which they found that the pre- service teachers were more homogeneous in believing conceptions of constructivist teaching than traditional ones.

Research question three examined the learning approaches adopted by pre-service science teachers at selected BEd courses from Sagaing University of Education. According to their rating, it was found that all (N=858) pre-service science teachers at selected BEd courses were learning by using *"Meaningful Learning Approach"*. It can be interpreted that all pre-service science teachers at selected BEd courses were learning by relating the knowledge they learned in a subject to what they have learned in another subjects and repeating the important matter until they fully understand when they were learning. This study was also in line with the previous study of Özkal (2007) in which the students used more meaningful learning approach than rote learning approach.

Research question four explored the pre-service science teachers' self-efficacy beliefs regarding science teaching at selected BEd courses. It was found that pre-service science teachers at selected BEd courses had both *"Personal Science Teaching Efficacy"* and *"Science Teaching Outcome Expectancy"*. It can be said that pre-service science teachers at selected BEd courses will be able to teach science subjects effectively. Moreover, it can be concluded that they understood science concepts well enough to be effective in teaching science subjects; they believed in their ability in helping students understand the science concepts better; and they accepted that students' achievement in science subjects was directly related to their teacher's effectiveness in science teaching. Therefore, this study was in line with the previous study of Saçici (2013) in which the pre-service science teachers were confident in their ability to teach science subjects and generally convinced about the efficacy of their teaching on students' learning.

Finally, **research question five** explored the interrelation between conceptions of teaching and learning, learning approaches and self-efficacy beliefs of pre-service science teachers at selected BEd courses from Sagaing University of Education. Based on the research findings, the correlation (r=.375, p<0.01) depicted that there was a moderate positive correlation between *"Constructivist Conception"* and *"Meaningful Learning Approach"* at selected BEd courses. It pointed out that the more constructivist conception pre-service science teachers perceive, the more meaningful learning approach they adopt when they were learning. In other words, pre-service science teachers who perceived that good teachers always encourage students to think for answers themselves were learning by solving puzzles and problems. The correlation (r=.346, p<0.01) indicated that there was a low positive correlation between *"Constructivist Conception"* and *"Personal Science Teaching Efficacy"* at selected BEd courses. It depicted that the more constructivist conception pre-service science teachers perceive, the more personal science teaching efficacy they have. In other words, pre-service science teachers who perceived that learning meant students have ample opportunities to explore, discuss and express their ideas would usually welcome student questions when they teach science subjects. Similarly, the correlation (r=.229, p<0.01) stated that there was a low positive correlation between *"Constructivist Conception"* and *"Science Teaching Outcome Expectancy"* at selected BEd courses. It described that the more constructivist conception pre-service science teachers perceive, the more science teaching outcome expectancy they have. In other words, pre-service science teachers who perceived that the focus of teaching was to help students construct knowledge from their learning experience instead of knowledge communication would take responsibility for the achievement of students in science subjects. It can be concluded that the more *"Constructivist Conception"* pre-service science teachers perceive, the more *"Meaningful Learning Approach"* they adopt, the more *"Personal Science Teaching Efficacy"* and *"Science Teaching Outcome Expectancy"* they have.

Moreover, the correlation (r=.668, p<0.01) indicated that there was a high positive correlation between *"Traditional Conception"* and *"Rote Learning Approach"* at selected BEd courses. It meant that the more traditional conception pre-service science teachers perceive, the more rote learning approach they adopt when they were learning. In other words, pre-service science teachers who perceived that learning occurred primarily through drill and practice, they were learning the subjects by memorizing. However, the correlation (r=-.346, p<0.01) mentioned that there was a low negative correlation between *"Traditional Conception"* and *"Personal Science Teaching Efficacy"* at selected BEd courses. It pointed out that the more traditional

conception pre-service science teachers perceive, the less personal science teaching efficacy they have. In other words, pre-service science teachers who perceived that teaching was simply telling, presenting or explaining the subject matter would usually be at a loss as to how to help the student understand a science concept better when a student had difficulty understanding it. Similarly, the correlation (r=-.134, p<0.01) indicated that there was a low negative correlation between *"Traditional Conception"* and *"Science Teaching Outcome Expectancy"* at selected BEd courses. It implied that the more traditional conception pre-service science teachers perceive, the less science teaching outcome expectancy they have. In other words, pre-service science teachers who perceived that the major role of a teacher was to transmit knowledge to students accepted that the low science achievement of some students could not generally be blamed on their teachers. Therefore, it can be concluded that the more *"Traditional Conception"* pre-service science teachers perceive, the more *"Rote Learning Approach"* they adopt, the less *"Personal Science Teaching Efficacy"* and *"Science Teaching Outcome Expectancy"* they have. The first part of this finding was consistent with the finding of Saçici (2013) in which the pre-service science teachers who had high sense of personal science teaching efficacy, high sense of science teaching outcome expectancy and adopted more meaningful learning approach and less rote learning approach were likely to prefer more constructivist conception and less traditional conception. Although Saçici's (2013) study found that pre-service science teachers who had high sense of science teaching outcome expectancy and adopted more rote learning approach were likely to prefer traditional conception, this study found that the more traditional conceptions pre-service science teachers perceived, the more rote learning approach they adopted, the less *"Personal Science Teaching Efficacy"* and *"Science Teaching Outcome Expectancy"* they had.

These findings make the pre-service science teachers know the requirements in order to have confidence in their ability to teach science subjects and the efficacy of their teaching on their students' learning when they become science teachers in the future. Moreover, these findings informed the teacher educators from Sagaing University of Education that there are some pre-service science teachers who cannot decide whether they have traditional teaching/learning conception or not and learn by rote learning approach or not and do not have high level in both "Personal Science Teaching Efficacy" and "Science Teaching Outcome Expectancy". Therefore, teacher educators should cultivate them to absolutely develop constructivist conceptions of teaching and learning and encourage them to always use meaningful learning approach in order to believe in their capability to teach science subjects and the efficacy of their teaching on their students' learning like other pre-service science teachers when they become science teachers in the future.

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References

Bahcivan, E., & Kapucu, S. (2014). Turkish Pre-service Elementary Science Teachers' Conceptions of Learning Science and Science Teaching Efficacy Beliefs: Is There a Relationship? *International Journal of Environmental & Science Education, 2014, 9 (4), 429-442*. Retrieved January 3, 2018 from http://files.eric.ed.gov/ fulltext/EJ1048084.pdf

Bandura, A. (1994). Self-Efficacy. In V. S. Ramachaudran (Ed.), *Encyclopedia of Human Behavior, Vol. 4, 71-81*, New York. Academic Press. (Reprinted in H. Friedman [Ed.], *Encyclopedia of Mental Health*. San Diego: Academic Press, 1998). Retrieved February 22, 2018 from https://www.uky.edu./~eushe2/Bandura/ Bandura1994EHB.pdf

Biser, E. (1984). Application of Ausubel's Theory of Meaningful Verbal Learning to Curriculum, Teaching and Learning of Deaf Students. *Working Paper presented at the International Symposium on Cognition, Education, and Deafness Gallaudet College, Washington, DC.* Retrieved February 2, 2018 from https://files.eric. ed.gov/fulltext/ED247712.pdf

Brown, G. T. L., Lake, R., & Matters, G (2009). Assessment Policy and Practice Effects on New Zealand and Queensland Teachers' Conceptions of Teaching. *Journal of Education for Teaching, 35 (1).* Retrieved December 12, 2017 from http://www. academia.edu/download/46323872/ Assessment policyand practice_effects_o20160607-25493-wb4p6a.pdf

Brown, G. T. L., Lake, R., & Matters, G (2008). New Zealand and Queensland Teachers' Conceptions of Learning: Transforming More Than Reproducing. *Australian Journal of Educational & Developmental Psychology, Vol 8, 1-14*. Retrieved January 15, 2018 from https://www.newcastle.edu.au/data/ assets/pdffile/ 0011/ 100325/v8-brown-et-al.pdf

Bursal, M. (2012). Changes in American Pre-service Elementary Teachers' Efficacy Beliefs and Anxieties during A Science Methods Course. *Science Education International, 23 (1), 40-55*. Retrieved November 10, 2017 from http://www. icaseonline.net/sei/march2012/p3.pdf

Canbay, O., & Beceren, S. (2012). Conceptions of Teaching Held by the Instructors in English Language Teaching Departments. *Turkish Online Journal of Quality Inquiry, 3 (3).* Retrieved December 24, 2017 from http://eric.edo.gov/?id= ED537775

Cavallo, A. M. L. (1996). Meaningful Learning, Reasoning Ability and Students' Understanding and Problem Solving of Topics in Genetics. *Journal of Research in Science Teaching, 33 (6), 625-656.* Retrieved January 23, 2018 from http://www.academia.edu/download/44074284/ Meaningful Learning Ability an2016024-172 04-wo4rgq.pdf

Chiou, G., Liang, J., & Tsai, C. (2012). Undergraduate Students' Conceptions of and Approaches to Learning in Biology: A Study of Their Structural Models and Gender Differences. *International Journal of Science Education, 34 (2), 167-195.* Retrieved March 9, 2018 from https://ir.nctu.edu.tw/bitstream/ 11536/15737/1/ 000300301900002. pdf

Enochs, L. G., & Riggs, I. M. (1990). *Further Development of an Elementary Science Teaching Efficacy Belief Instrument: A Pre-service Elementary Scale.* Retrieved February 23, 2018 from https://files.eric.ed.gov/fulltext/ED319601.pdf

Hunter, F. E. (2016). *Investigating Pre-service Teachers' Self-Efficacy and Practicum Experiences.* Retrieved March 9, 2018 from https://ir.lib.uwo.ca/cgi/viewcontent. cgi?article=6010&context=etd

Kılıç, D., & Sağlam, N. (2010). *Investigating the Effects of Gender and School Type on Students' Learning Orientations.* Retrieved December 3, 2017 from https://www. uv.es/gargallo/Learning%20styles.pdf

Koohang, A., Riley, L., & Smith, T. (2009). E-Learning and Constructivism: From Theory to Application. *Interdisciplinary Journal of E-Learning and Learning Objects Vol. 5.* Retrieved February 23, 2018 from https://www.learntechlib.org/ p/44824/article_44824.pdf

López, B. G., Cerveró, G. A., Rodríguez, J. M. S., Félix, E. G., & Esteban, P. R. G. (2013). Learning Styles and Approaches to Learning in Excellent and Average First-Year University Students. *European Journal of Psychology of Education, 28 (4), 1361-1379.* Retrieved February 17, 2018 from https://www.uv.es/~ gargallo/Learning20%styles.pdf

Ngman-Wara, E. I., & Edem, D. I. (2016). Pre-service Basic Science Teachers' Self-Efficacy Beliefs and Attitudes towards Science Teaching. *International Journal for Innovation Education and Research, 4 (8).* Retrieved December 24, 2017 from http://www.ijier/issue/view/5

Novak, J. D. (2010). Learning, Creating, and Using Knowledge: Concept Maps as Facilitative Tools in Schools and Corporations. *Journal of e-Learning and Knowledge Society, 6 (3), 21-30.* Retrieved February 21, 2018 from http://rodall rich.com/advphysiolo/ausubel.pdf

Oh, S. (2011). Pre-service Teachers' Sense of Efficacy and Its Sources. *Psychology, 2 (3), 235-240.* Retrieved February 11, 2018 from https://file.scirp.org/pdf/PSYCH 20110300018_19732233.pdf

Özkal, K. (2007). *Scientific Epistemological Beliefs, Perceptions of Constructivist Learning Environment and Attitude towards Science as Determinants of Students Approaches to Learning*. Retrieved January 9, 2018 from http://citeseerx.ist.psu.edu/viewdoc/download?doi=10.1.1.461.1746 &rep=rep1&type=pdf

Saçici, S. (2013). *The Interrelation between Pre-service Science Teachers' Conceptions of Teaching and Learning, Learning Approaches and Self-Efficacy Beliefs.* Retrieved October 21, 2017 from http://citeseerx.ist.psu.edu/viewdoc/download% 3Fdoi%3D10.1.1.633.7161%26rep% 3Drep1%26type%3Dpdf&ved=0ahUKEwjVgtGC8snXAhUZSY8KHYB8AHsQFggfMAA&usg=AOvVaw2DGO5erQPIbMcfkdO_VspA

Safdar, M. (2013). Meaningful Learning and Rote Learning in Physics: A Comparative Study in City Jhelum (Pakistan). *Middle Eastern & African Journal of Educational Research, Issue 6.* Retrieved November 12, 2017 from http://majersite.org/issue6/5 safdar.pdf

Ültanır, E. (2012). An Epistemological Glance at the Constructivist Approach: Constructivist Learning in Dewey, Piaget, and Montessori. *International Journal of Instruction, 5 (2).* Retrieved February 21, 2018 from https://files.eric.ed.gov/ fulltext/ED5 33786.pdf

Uner,S., Akkusa, H., & Turana, N. (2012). Image Yourself as a Chemistry Teacher. *Procedia - Social and Behavioral Sciences, Vol. 47, 417-421*. Retrieved January 28, 2018 from http://www.ejmste.com/pdf-75311-12108?filename=Developing %2 0a%20Tool%20to.pdf

Uswatte, D. (2013). *A Quantitative Study of Mathematics Teaching Self- Efficacy and Principal Instructional Leadership in Alabama Elementary Schools.* Retrieved November 5, 2017 from http://www.mhsl.uab.edu/dt/2013/Uswatte_uab_0005D_ 11204.pdf

Watters, J. J., & Ginns, I. S. (2000). Developing Motivation to Teach Elementary Science: Effect of Collaborative and Authentic Learning Practices in Pre-service Education. *Journal of Science Teacher Education, 11 (4), 277-313.* Retrieved January 8, 2018 from https://eprints.qut.edu.au/1763/1/1763 2.pdf

Yilmaz, H., & Sahin, S. (2011). Pre-service Teachers' Epistemological Beleifs and Conceptions of Teaching. *Australian Journal of Teacher Education, 36 (1).* Retrieved December 10, 2017 from http://citeseerx.ist.psu.edu/viewdoc/download? doi=10.1.1.888.2159&rep=rep1&type=pdf