An evaluation of an elementary science methods course with respect to preservice teacher's pedagogical development

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Abstract

The science methods course is a requirement for the Bachelor of Science degree in elementary education licensure program in a mid-west state university in the U.S.A. In one semester, the author decided to evaluate the effectiveness of the science methods course in pedagogical content knowledge areas such as theory, planning and implementation. Adapting the instrument of Hudson and Ginns (2007), the author used a questionnaire to understand what preservice elementary teachers learned in the course. Results showed that topics such as classroom management, learning environment and hands-on lessons were well understood by the preservice elementary teachers as they had acquired similar knowledge in other education methods classes. Areas which needed improvement were the nature of science and the implementation of the science curriculum. Also, the findings showed that preservice elementary teachers had a strong positive attitude in science teaching and learning.

Keywords: elementary science, teacher preparation, inquiry science, evaluation, science methods course

Introduction

Teacher education is a key element in almost every education reform or innovation. One recommendation made in the report *Rising Above the Gathering Storm* (NAS, 2007) and the *No Child Left Behind Act* enforced in 2001is that more well-qualified mathematics and science teachers are needed for the U.S. Teacher preparation programs influence preservice elementary teachers' attitudes of teaching science in the classroom. Abell, Appleton and Hanuscin (2010) stated that "the science methods course is the primary vehicle through which prospective elementary teachers learn to teach science" (p. 40). Unfortunately, little research has been done on the study of the science methods curriculum for the preparation of preservice elementary teachers (Weiss, 2002; Yager, 2005). Although there have been other studies conducted on science methods courses, these studies have typically focused on only areas such as inquiry approaches to teaching (Friedrichsen, 2001; Haefner & Zembal-Saul, 2004; Howes, 2002; Kelly, 2001; Lee, Hart, Cuevas & Enders, 2004; Schwarz & Gwekwerere, 2007) and teaching the nature of science (Akerson

& Hanuscin, 2007; Bianchini & Colburn, 2000; Bianchini & Windschitl, 2006; Harold, Samuel, & Andersen, 1991; Liu & Lederman, 2007; Tsai, 2006). Less research has been done to study which curriculum components are considered valuable in science methods course. There is a lack of universally accepted goals or objectives for elementary science methods classes. Currently, each teacher-preparing institution invents its own way of educating teachers with little or no attention paid to or knowledge of what those in other institutions are doing (Smith & Gess-Newsome, 2004).

To understand further what science curriculum should be included in science methods courses, the author performed a literature review of recommendations from professional organizations dedicated to the preparation of elementary science teachers. The National Science Teachers Association (NSTA)'s 2004 Position Statement on *Science Teacher Preparation* states that teacher educators should "demonstrate advanced knowledge of science and pedagogy in their fields" (p.3). Similarly, the Association for Science Teacher Education (ASTE)'s 2004 Position Statement on *Science Teacher Preparation and Career-Long Development* states that excellent science teacher preparation should have teachers "engage in activities that promote their understanding of science concepts and the history and nature of science; develop science-specific pedagogical knowledge grounded in contemporary scholarship" (p.2). Moreover, the National Research Council's Committee on Science and Mathematics Teacher Preparation (CSMTP) recommends that teacher education in science, mathematics, and technology should allow teachers to acquire and regularly update content knowledge and pedagogical knowledge that enhances student learning and achievement (National Research Council, 2001). The *Professional Standards for the Accreditation of Teacher Preparation* (NCATE, 2008) states that teachers should "know, understand, and use fundamental concepts of physical, life, and earth/space sciences. Elementary teachers can design and implement age-appropriate inquiry lessons to teach science, to build student understanding for personal and social applications, and to convey the nature of science" (p.54). From these documents, it is obvious that science content and pedagogical knowledge should be emphasized in the preparation of science teachers, and that knowledge of the nature of science is also crucial. Hence, it is left to teacher educators to decide which science teaching elements to put in a single and relatively compressed science methods course that may last for only one semester as part of a broader preservice teachers' course in elementary instruction methods.

Purpose of the study

The purpose of this study is to evaluate a science methods course in a mid-west state university in the United States and to see whether the teaching instruction used by the author was appropriate, and how much science knowledge and pedagogy preservice elementary teachers understand. Due to the shortage of teaching time, it is almost impossible to teach all the science knowledge that an elementary teacher should know. Hence, the author must be selective in choosing appropriate teaching materials related to the goals of elementary science education. In the U.S. most of the teacher education programs are four-year degree program (Abell, Appleton & Hanuscin, 2010). Teaching pedagogies are taught not only in science methods course but also in other education classes as well. To use the time wisely and to avoid overlapping of teaching pedagogies, it is essential for the method instructors to understand what curricula are best for preservice elementary teachers. The research questions of this study are focused on:

1. What do preservice elementary teachers learn in the existing science methods course?
2. What teaching components are essential in an elementary science methods course?

Methods of the study

A survey questionnaire adapted from the instrument of Hudson & Ginns (2007), which measured preservice elementary teachers' perceptions of their development towards becoming elementary science teachers, was used. The questionnaire was administered at the beginning and at the end of the science methods course. The data were collected from a class of senior students (Year 4) who enrolled in a mid-west state university for an elementary education licensure Bachelor of Science degree program. The class was taught intensively 160 minutes per week for 14 weeks. It was an independent course not related to a practicum or field experiences. A total of 30 preservice elementary teachers were in the class. However, the analysis of the data was based on 26 questionnaires completed separately at the beginning and at the end of the semester. Four preservice elementary teachers did not complete one of the two questionnaires, hence the other questionnaires that they had completed were considered to be invalid. The demographic distribution was three males and twenty-three females, with half of the preservice teachers below the age of 22 and half of them within the ages of 22-25. All of them had experiences in elementary teaching, but only two had experience in teaching science. All participants remained anonymous. The maiden names of the preservice teachers' mothers were used to match the pre- and posttest questionnaires for paired samples t-test and all of the questionnaires were destroyed after the data analysis.

Highlights of some of the teaching pedagogies in the science methods course

The main purpose of the science methods class as listed in the syllabus (Appendix A) was to prepare preservice elementary teachers with positive attitudes and the skills needed to successfully begin teaching elementary science through the development of science pedagogical content knowledge. The syllabus covered the fundamental principles of science knowledge such as the nature of science, constructivism, inquiry, science and technology. The inquiry continuum is introduced, emphasizing that there is no one particular way of using an inquiry approach as inquiry teaching greatly depends on the ability of the students and the topics being taught. However, a 'cookbook' approach was definitely not recommended. When illustrating 'guided inquiry' and 'structured inquiry', the author used activities from the topic of 'sound' as a model. First, the preservice teachers began the investigation of the production of sound and how the pitch of sound was varied by following a structured inquiry worksheet. Then a discussion among preservice elementary teachers followed about how this activity could be modified into a guided inquiry. This 'sound' activity was purposefully planned so that preservice elementary teachers not only learned the inquiry teaching strategies but also the science content knowledge of sound.

To illustrate one of the key aspects of the nature of science that 'There is a distinction between science and technology' (Alshamrani, 2008; McComas, 2004) and to clarify preservice elementary teachers' misconceptions between science and technology, a lesson was designed on how science principles were applied in technology. Preservice elementary teachers investigated how a car moved and factors affecting its movement by playing with toy cars and running them down a ramp. Questions discussed included 'What moves a car?', 'After traveling a distance, what makes a car stop?' and 'What makes the car run down a ramp without a push?' These questions help preservice elementary teachers think about the science content knowledge of Force and Motion. During discussions preservice elementary teachers brought up terms like gravitational pull, acceleration, friction. A further in-depth discussion followed in order to understand the meaning of those terms and how they were illustrated in the activity. After the exploration of car movement, preservice elementary teachers were required to build a car using the following provided materials: life saver candies, papers, paper clips, drinking straws and tapes. The assessment criteria were how far the car could run down the ramp and across the floor with all the parts of the car still intact. Challenges for the preservice elementary teachers were how they could make their hand built car not turn when running down the ramp and how to keep the car sturdy and intact. Some preservice elementary teachers came up with the solution of fixing the shaft in position with paper clips and tape, and allowing the wheels to rotate but not turn. Through this hands-on activity, it is hoped that preservice elementary teachers would apply their knowledge of force, friction, gravity and acceleration to the technology of designing and building a car.

Another assignment was a four-lesson unit plan. During the planning of the unit, preservice elementary teachers had to consider learner differences both for high ability and low ability students. The 5E learning cycle - engage, explore, explain, extend and evaluate (Bybee, 1997) was used as a framework for planning the lesson activities. Since a great deal of time in elementary classrooms is spent on reading and writing, interdisciplinary approaches of using story-telling as the first 'engaged stage' of the learning cycle are encouraged. Also, preservice elementary teachers had to teach one lesson to local children on the 'University Day.' This was an annual traditional event at the University during which local elementary students were invited to the university for a day visit. The preservice elementary teachers worked in groups and had to conduct a lesson to engage the elementary aged students in learning science. For some preservice elementary teachers, this might be the only science teaching experience they had in the four-year teacher preparation program.

Another feature of the course was a field trip to a local botanical garden. It was a great opportunity for preservice elementary teachers to think about what need to be done before, during and after a field trip. Laboratory safety was introduced at the same time when talking about the collection and observation of plant and animal specimens. This was a necessary component of the course because it was found that many preservice elementary teachers were unfamiliar with the handling of chemicals. For example, they thought that alcohol could be used in an elementary classroom without realizing that alcohol is flammable.

Evaluation questionnaire

To evaluate the science methods course, the author did a quantitative study by using a questionnaire (Appendix B) adapted from the instrument of Hudson & Ginns (2007). The instrument was used in examining the course outcomes and measuring preservice teachers' perceptions of their development towards becoming elementary science teachers. There were 37 items in Hudson & Ginns (2007) questionnaire which represent four course outcomes or constructs and are listed in Table 1.

Table 1. Constructs of the questionnaire used by Hudson and Ginns (2007)

	Constructs	Course outcomes
1	Theory	The preservice teachers are able to understand theoretical underpinnings used for developing a science curriculum, articulate the key components of the science syllabus, provide a rationale based on theory for designing and implementing an effective science program, describe and analyze the theoretical base of science curriculum development, articulate constructivist principles for teaching science, compare existing approaches for teaching science, articulate different viewpoints on teaching science, and talk comfortably about teaching science.
2	Children's development	The preservice teachers are able to understand the development of children's concepts, abilities, skills, and attitudes.
3	Planning	The preservice teachers are able to understand effective planning for science teaching and learning.
4	Implementation	The preservice teachers are able to understand and implement effective science teaching practices.

According to Hudson & Ginns (2007), the Cronbach's alpha that measures the internal reliability of this instrument is high, i.e., Cronbach's alpha for Theory is .92, Children's development is .89, Planning is .96 and Implementation is .97. Hair et al. (1995) state that Cronbach's alpha for an instrument if greater than .70 is considered acceptable. In this study, the author did not include the construct of children's development as this element was not emphasized in the science methods course. Instead, it had been taught in child development courses taken by preservice elementary teachers such as Introduction to Education, General Psychology, Child Development, Classroom Learning Theory and Early Childhood Education. This led to a reduction in the number of questions. The questionnaire the author used consists of 25 items with a Likert-type scale of responses, namely: 'strongly disagree,' 'disagree,' 'uncertain,' 'agree,' and 'strongly agree.' For statistical analysis, a score of '1' was assigned to 'strongly disagree,' and so on through the five response categories. As less items were used in this study (reduced from 37 to 25 questions), the Cronbach's alpha of the adapted instrument had to be recalculated and are listed in Table 2. The Cronbach's alpha for Theory was below .70, due to the fact that few items ($N = 4$) extracted. The Cronbach's alpha for Planning and Implementation were acceptable as they were above .70.

Table 2. Cronbach's alpha of the adapted instrument

Theory	pretest	α= .66	$N = 4$
	posttest	α= .40	
Planning	pretest	α= .77	$N = 8$
	posttest	α= .73	
Implementation	pretest	α= .89	$N = 13$
	posttest	α= .88	

Results and discussions

The completed questionnaire was analyzed using *SPSS* (version 15). Descriptive statistics of each construct such as mean scores (*M*), standard deviations (*SD*), percentages of preservice elementary teachers who either 'agree' or 'strongly agree', *p* values (2-tailed) of paired samples t-test were computed.

Surprisingly, most of the preservice elementary teachers did not have much confidence in their science knowledge as 21 (81%) of them either disagreed with or were uncertain about their own strength in science. On analysis of their training in science, 20 (77 %) of them had taken three or more science courses in high schools and 24 (92%) of them had taken three or more science courses in colleges. Over

96% of the preservice elementary teachers had taken biology in high schools; and over 92% of them had taken either biology or geology in college. This showed that biology was a popular subject among preservice elementary teachers.

Learning and understanding the theory for developing a science curriculum (Construct: Theory)

Looking at the measures of preservice elementary teachers' perceptions on 'Theory,' results showed a significant change from a low percentage of 'agree' and 'strongly agree' ranging from 8-31% (below 50%) at the beginning of the semester to 65-92% (above 50%) at the end of the semester (Table 3). The three indicators 'syllabus', 'constructivist' and 'viewpoints' were well understood by the preservice elementary teachers as data showed a high percentage of 92% at the end of the semester. However, the result for "theory" was not high when compared with other items in this construct, with only 65% of preservice elementary teachers indicating that they either 'agree' or 'strongly agree.' This might be because the preservice elementary teachers did not fully realize what theories of science were, or the concepts of science theories may not have been exemplified clearly to the preservice elementary teachers in the science methods class. Even though the nature of science as illustrated by Alshamrani (2008) and McComas (2004) was introduced in the science methods course, preservice elementary teachers might not have enough science knowledge background to appreciate and comprehend the concepts of the nature of science. On the other hand, the author was pleased that the preservice elementary teachers almost fully (92%) understood the 'syllabus' as this was extremely important in their classroom teaching. In the course, two official documents related to the concept 'syllabus' were reviewed - the *National Science Education Standards* (NRC, 1996) and the state curriculum framework.

Table 3. Descriptive statistics of preservice elementary teachers' responses for the construct 'Theory'

Question item	Indicator	Pretest ($N = 26$)			Posttest ($N = 26$)			*Paired samples t-test*
		M	*SD*	%*	*M*	*SD*	%*	*p*-value# (two-tailed)
1	syllabus	2.69	0.93	19	4.23	0.59	92	<.001
6	theory	2.35	0.80	8	3.73	0.60	65	<.001
10	constructivist	3.12	1.03	31	4.15	0.54	92	<.001
17	viewpoints	2.88	0.77	23	4.08	0.48	92	<.001

*percentage of preservice elementary teachers who 'agreed' or 'strongly agreed' that they believed they understand the theory for developing a science curriculum

p-value < 0.05 means significant

Understanding effective planning for science teaching and learning (Construct: Planning)

The percentage score of item 12 - independent/collaborative and item 20 - inclusivity were both 100% at the end of the semester, which meant that all preservice elementary teachers fully understood these two areas (Table 4). However, item 4 - scope and sequence was not high when compared with other items in the construct, with only 77% of preservice elementary teachers choosing 'agree' or 'strongly agree'. When looking at question 4 (Given my current knowledge of elementary science, I believe I am able to develop a scope and sequence for teaching elementary science), the question may not be explicitly clear. Preservice elementary teachers might not contextually understand what 'scope' or 'sequence' means. If the questionnaire is to be used again for future research, the author will modify that question so there are not two different indicators occurring together in one question, and the words 'scope' and 'sequence' are explained.

Table 4. Descriptive statistics of preservice elementary teachers' responses for the construct 'Planning'

Question item	Indicator	Pretest (N = 26)			Posttest (N = 26)			*Paired samples t-test* *p*-value# (two-tailed)
		M	*SD*	%*	*M*	*SD*	%*	
3	lesson plans	2.88	0.95	31	4.20	0.96	81	<.001
4	scope & sequence	2.65	0.94	19	3.85	0.68	77	<.001
5	program	2.73	0.78	15	4.00	0.85	92	<.001
9	integrate	3.81	0.75	69	4.23	0.51	96	.019
12	independent/ collaborative	3.88	0.71	77	4.38	0.50	100	.004
13	appropriate activities	3.58	0.70	62	4.31	0.62	92	<.001
20	inclusivity	3.00	1.02	38	4.31	0.47	100	<.001
24	concept map	3.27	0.92	54	4.15	0.68	92	.001

*percentage of preservice elementary teachers who 'agreed' or 'strongly agreed' that they believed they understood effective planning for science teaching and learning
p-value < 0.05 means significant

Implementing effective science teaching practices (Construct: Implementation)

It is interesting to note that 'positive attitudes' (item 25) has a high mean score (96%) in both the pre- and posttest (Table 5). Though preservice elementary teachers did not have confidence with respect to their science knowledge, they had positive attitudes toward the teaching of science. They also understood fully that science was about 'hands-on' activities (item 21). The percentage of preservice elementary teachers who indicated 'agree' and 'strongly agree' was high (88%) at the beginning and became higher (100%) at the end of the semester.

At the beginning of the semester, the preservice elementary teachers knew little (19%) about the unit of work (item 15), but as the lessons progressed, their knowledge grew so that on the posttest, the score was 85%. Item 15 (unit of work) in Table 4 was closely related with item 3 (lesson plans) in Table 3 and the final percentage for both items were above 80%. However, the author was not totally satisfied with the submitted unit work assignment, i.e., the four-lesson unit plan.

The author felt that many preservice elementary teachers held the misconception that by doing hands-on activities, the science concepts would be illustrated. The preservice teachers rarely queried the science content knowledge behind the activities and how the activities could be conducted or modified appropriately to suit the abilities of students. They focused more on the 'fun' part of the activities than on the science concepts that the elementary students need to know.

Table 5. Descriptive statistics of preservice elementary teachers' responses for the construct 'Implementation'

Question item	Indicator	Pretest (N = 26)				Posttest (N = 26)				*Paired samples t-test* p-value# (two - tailed)
		M	*SD*	%*		*M*	*SD*	%*		
2	problem-based learning	3.15	1.01	50		4.04	0.79	88		.005
7	strategies	2.92	0.94	35		4.19	0.69	92		<.001
8	classroom management	3.92	0.80	73		4.19	0.75	81		.148
11	learning environment	3.73	0.83	65		4.12	0.65	85		.057
14	ethical issues	3.54	0.86	54		4.15	0.73	81		.007
15	unit of work	2.81	0.80	19		4.27	0.72	85		<.001
16	assessments	3.19	0.63	31		4.31	0.62	92		<.001
18	critical reflection	3.54	0.91	50		4.23	0.71	85		.005
19	questioning skills	3.31	0.88	42		4.23	0.65	88		<.001
21	hands-on lessons	4.12	0.71	88		4.69	0.47	100		.001
22	content knowledge	3.15	0.78	38		4.27	0.67	88		<.001
23	teaching confidently	2.96	0.87	31		3.96	0.53	85		<.001
25	positive attitudes	4.42	0.58	96		4.35	0.69	96		.664

*percentage of preservice elementary teachers who 'agreed' or 'strongly agreed' that they believed they understood the implementation of effective science teaching practices, including successful management of the learning environment

p-value < 0.05 means significant

Limitations of the study

This study is focused on the evaluation of a science methods course to see if the curriculum used by the author helped preservice elementary teachers to develop their science teaching pedagogy. No control group was administered in the research as it was unethical to teach a class where little to be taught. The results of this study are not meant to be generalized as the number of participants is small (N=26) and this curriculum for the science methods course was implemented in only one mid-west state university. Due to the reduction of the items as compared with the original questionnaire of Hudson and Ginns (2007), the Cronbach's alpha for each of the construct was recalculated with Theory (pretest α= .66, posttest α= .40), Planning (pretest α= .77, posttest α= .73) and Implementation (pretest α= .89, posttest α= .88). This led to a low Cronbach's alpha for the construct Theory. The author accepted the low Cronbach's alpha as some of the question items in the original questionnaire were not applicable to this study. As for future research, additional items can be added to increase the Cronbach's alpha. As there is no practicum attached to the science methods course, the preservice elementary teachers may understand the concepts and the teaching pedagogy but they need to have a real classroom setting to practice what they learn.

Conclusion

In this science methods course, there was no practicum or teaching experience linked with the course. The author could not observe or give feedback to the preservice elementary teachers on how science is to be taught in a real classroom setting. Hence the course was based more on theories rather than on practices. Furthermore, much of the science knowledge learned in this course was broad but not in-depth due to the short period of time. The intention of the author was to engage the interest of the preservice elementary teachers and help them to develop a positive attitude in learning and teaching science. Hopefully, they can explore science education further when they are 'hooked' on the excitement of teaching science.

The statistical data of this study were significant and invaluable. Based on the findings, the author knew which areas of instruction or curriculum needed further improvement. The four-lesson unit plan was a good assignment for preservice elementary teachers as they could integrate all of the theories they had learned and applied in a classroom setting. At the end of the semester, the preservice elementary teachers had to do a demonstration teaching of the unit. The feedback from the preservice elementary teachers was that the peer teaching offered them an insight of how science could be taught in the classroom and that the lesson plans were good teaching resources.

As reviewed in the findings, the author realized that the scope and sequence for teaching elementary science should be made explicit to preservice teachers. The *National Science Education Standards* (NRC, 1996) and the state science curriculum framework do not provide a clear guideline of what to teach. Thus, more time is needed to spend analyzing the depth and breadth of what is to be taught with respect to the state science curriculum framework. This is important as most of the preservice elementary teachers do not have a strong science background and are uncertain of what has to be taught. In addition, the misconception that science is just hands-on activities should be clarified as this concept has been deep rooted in many preservice elementary teachers' minds. They focus too much on the 'fun' part of the activities and overlook the importance of introducing and solidifying the science concepts.

Overall, the author felt satisfied with the science methods course as there was a great increase in the percentage scores when comparing the pre- and posttest. Nevertheless, there are still certain areas that need to be improved. Moreover, the author found that the Hudson and Ginns (2007) instrument offers a good self-evaluative tool for teacher educators to reflect on their teaching pedagogy.

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Appendix

Appendix A. Syllabus of the science methods course

Week	Topics	Assignments Due
1	**The Science Education Imperative** Goals of Elementary Science Education Overview: Content, Process, Nature of Science	
2	**Visit a local science teaching center**	Print Science Curriculum Frameworks
3	**Science Education Today** Content: Standards & Frameworks The Processes of Science--Basic Skills	

4	**The Processes of Science** The Processes of Science--Integrated Skills Nature of Science	Teach Process Skill Activity
5	**The Nature of Science**	
6	**UNIVERSITY DAYS**	
7	**Graphic Organizers** Concept Mapping	
8	**Constructivism in Elementary Science Education** K-W-L-H Charts 5E Learning Cycle	Nature of Science Assignment
9	**Inquiry** Essential elements of inquiry Inquiry continuum	
	Spring Break—No Class	
10	**The Elementary Science Classroom** **Field Trips** **Safety** **Respect for living things**	Safety Quiz
11	**Field Trip**	
12	**Learner Differences** Differentiated instruction **Assessment**	Journal article critique
13	**Reading, Writing and Interdisciplinary Approaches**	
14	**Technology in Elementary Science Education** Science-Technology-Society	• Webquest (in class) • Mini-Unit
15	**Peer Teaching**	Resource Folder

Appendix B. Questionnaire

Curriculum and Pedagogies: Elementary Science
Section 1:
This section aims to find out some information about you. To preserve your anonymity, write your mother's maiden name on this survey. Please **circle** the answers that apply to you.

Mother's maiden name: ___________________

a. What is your gender? Male Female

b. What is your age? <22 22-25 26-29 >30

c. List all the science courses you have completed in Years 9-12 at high school?

d. List all the courses you have completed at college level?

e. How many block practicum (field experiences) have you now completed during your college teacher education?
0 1 2 3 4
5 or more

f. How many elementary science lessons have you taught so far?
0 1 2 3 4
5 or more

g. Science is one of my strongest subjects?
Strongly disagree Disagree Uncertain Agree Strongly agree

Section 2:

Please indicate the degree to which you disagree or agree with each statement below by circling only **one** response.
Key: SD = Strongly disagree D = Disagree U =Uncertain A = Agree SA = Strongly Agree
Given my current knowledge of elementary science, I believe I am able to:

1.	articulate the key components of the elementary science syllabus.	SD	D	U	A	SA
2.	provide a problem-based learning environment for teaching primary science.	SD	D	U	A	SA
3.	devise clear lesson structures for teaching elementary science.	SD	D	U	A	SA
4.	develop a scope and sequence for teaching elementary science.	SD	D	U	A	SA

5.	articulate the components of an effective elementary science program.	SD	D	U	A	SA
6.	describe and analyze the theoretical base of science curriculum development.	SD	D	U	A	SA
7.	implement appropriate elementary science teaching strategies.	SD	D	U	A	SA
8.	model effective classroom management when teaching science.	SD	D	U	A	SA
9.	integrate elementary science education with other key learning areas.	SD	D	U	A	SA
10.	articulate constructivist principles for teaching elementary science.	SD	D	U	A	SA
11.	manage the elementary science learning environment effectively.	SD	D	U	A	SA
12.	demonstrate a social capability to participate and work both independently and collaboratively in science education.	SD	D	U	A	SA
13.	select appropriate activities and resources for teaching elementary science.	SD	D	U	A	SA
14.	address ethical and attitudinal issues related for implementing an elementary science lesson.	SD	D	U	A	SA
15.	design an elementary science teaching unit.	SD	D	U	A	SA
16.	assess the preservice teachers' learning of elementary science.	SD	D	U	A	SA
17.	articulate different viewpoints on teaching elementary science.	SD	D	U	A	SA
18.	critically reflect on becoming a more effective teacher of elementary science.	SD	D	U	A	SA
19.	use effective questioning skills for teaching elementary science.	SD	D	U	A	SA
20.	provide elementary science lessons that cater to all students, regardless of ability (i.e. inclusive education).	SD	D	U	A	SA
21.	use hands-on materials for teaching elementary science.	SD	D	U	A	SA
22.	teach elementary science with competent content knowledge.	SD	D	U	A	SA
23.	teach elementary science confidently.	SD	D	U	A	SA
24.	use concept maps for planning an elementary science unit.	SD	D	U	A	SA
25.	demonstrate positive attitudes towards teaching elementary science.	SD	D	U	A	SA

**** THANK YOU****