Higher-Order Thinking Skills and Scientific Attitudes Components as Predictors of Scientific Creativity Among Preservice Biology Teachers

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Abstract

The study assessed preservice biology teachers' higher-order thinking skills (HOTS), scientific attitudes, and creativity in the study area. The study also evaluated how the components of HOTS and scientific attitudes predict scientific creativity to determine which elements were strong predictors of scientific creativity. The study adopted a correlational survey research design. The population consists of all preservice Biology teachers in Southwestern Colleges of education, from which five hundred were randomly selected from five colleges of education. Three instruments, including Higher Order Thinking skills Test, Scientific Attitude questionnaire, and Scientific Creativity Test, were used to collect data for the study. The result showed that the HOTS scores of the respondents were low, with low mean scores of 2.54, 1.22, and 1.88 from a total maximum possible score of 9, 5, and 6, respectively, the cognitive (=20.00), emotional (=19.05), attitudinal components (=26.67). The mean score for fluency, flexibility, and originality were 14.00, 12.00, and 13.00. It was also seen that a correlation exists between sex and HOTS. The study finally showed that the Analysis ($t=2.597$, $p<0.05$) and evaluation ($t= 2.115$, $p<0.05$) components of HOTS predict scientific Creativity while cognitive component teachers ($t=2.373$, $p<0.05$) of Scientific attitude predicts Scientific Creativity.

Keywords: Scientific Creativity, Scientific Attitudes, Higher-Order Thinking Skills, Preservice Teachers

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INTRODUCTION

Education in the 21st century demands that learners contribute positively to society through innovative thinking and developing novel, solution-centric ideas. Learners must become intellectually responsible to themselves and other people in the community. Education and training are supposed to serve as a bridge between the lapses in the society and the desired level of development a society seeks to attain. Umeano and Adinwe (2012), in Eze and Onwe (2016), stated that education is vital for sustainable development and enhancing human potential and capabilities. They pointed out that Creativity and skills acquisition are essential foundations for national development. Developed countries today emerged due to scientific innovations and ideas generated by the people in their society. It is impossible to talk about innovations and ideas if the concepts and skills demanded in science and education have not been adequately internalized.

Science education is a vital part of education that aids societal development. It is believed that Science Education, as confirmed by the National Policy on Education (FRN, 2014) emphasizes the teaching and learning of science processes and principles for individual and national development. Science education is believed to develop scientists for all-around national development by providing knowledge and understanding of the complexity of the world and the human environment. However, reports in Nigeria and many other developing countries revealed that there had not been uncommon development in science education in the last few years.

One would expect science education to achieve its stated objectives as its contribution to national development and adaptation to rapid changes for globalization would be attained through innovative ideas that come from critical and creative thinking (Sugiyanto, Masykuri & Muzzazinah, 2018). It is believed that the teaching and learning of science will bring about the overall mental development of an individual. This cognitive development through science will determine how innovative and creative an individual will be; this is called scientific creativity. Arokoyu and Nna (2012) believed that knowledge and skills, which we know as the core components of science education, are essential for scientific creativity. Hence, the overall goal of concepts, activities, and science education assessment should be oriented toward achieving scholarship in creativity.

Building and developing creativity in students demands a high level of intellectual engagement. The core of creativity should be towards advancing intellectual skills through higher intellectual engagements. Though conceptualized in various ways, these intellectual engagements would demand higher-order cognition in the higher levels of Bloom's Taxonomy. Students, especially those in sciences, are expected to possess high other thinking skills to excel in their academic pursuit or succeed in the outside world. Donovan, Green and Mason (2014) stated that educationists in the 21st century agree that education should possess and engage intellectual skills other than primitive memorization. These engagements are encouraged through the deliberate development of the intellectual skills and cognition of the learners. Students' intellectual engagements would be appropriately developed through the development of higher-level cognition of the learners. This higher-level cognition will relate to higher-order thinking skills.

Higher-order thinking skills refer to using higher domains of Bloom's Taxonomy. Thinking skills are usually categorized into two levels. Lower-order thinking skills comprise the lower level of Bloom's taxonomy which are knowledge, comprehension, and application, and the higher-order thinking skills, which consist of Analysis, Synthesis, and Evaluation. (Montano & Crowe, 2008). It is necessary to note that there is no generalized definition of higher-order thinking skills as there could be variation in the delineation of the components of the skills. Higher-order thinking skills could broadly be described as intellectual and creative skills that allow students to provide solutions to problems without rote memorization. Pratama and Retnatwati (2018) believe that higher-order thinking skills are difficult to define but can be easily noticed, observed and recognised.

HOTS focuses on developing students' abilities to analyze effectively and evaluate by drawing inferences from existing information and synthesizing the available information. Since the essence of education is to remold or reshape individuals' mindset and thinking capacity, this can only be achieved through the individual's deep intellectual thoughts and ability. Thus, for education to be quality, higher-order thinking is required. The lower level of cognition seeks to allow students only to remember and provide information on concepts learned, which might not necessarily allow for practicability. In the case of higher-order thinking, learners can engage in in-depth interaction with what was learnt in the classroom. It can potentially enable students to improve or achieve better learning outcomes and better understand information to enhance scientific literacy. The analysis component of the higher-order thinking skills explain how students can expand on concepts and give critical reflections by breaking down components into different parts so that their organizational structure can be understood to explain life phenomena. Synthesis relates to how they can combine various knowledge components to provide a viable explanation of concepts. At the same time, evaluation would explain how valid judgments are made from concepts learnt and the practicability of knowledge and skills to different situations. These could serve as scaffolds for creative development.

Students must use higher-order thinking skills, especially at higher levels. This is because students in higher education are expected to be faced with situations in the outside world that would demand that they think independently and spontaneously (Eryaman, 2007). As related to this study, preservice teachers are expected to use these skills to carry out practicals for secondary school students in the laboratory and encourage students to learn the use of these skills as well as set questions that will demand that students use higher-order thinking skills. It is important to note that higher Order thinking skills go beyond their importance as they relate to academic performance; they are also critical in helping students carry out tasks effectively in the labour market.

Another vital factor that has been proven to support teaching and learning is the attitude towards learning (Riedler & Eryaman, 2016). This attitude is specific to science as it entails scientific attitude. Meenakshi and Vasimalairaia (2016) that Scientific attitude is essential for critical thinking and reasoning. It deals with how skills and knowledge and skills are acquired into known behaviour. According to Gokul and Malliga (2015), scientific attitudes are the most important outcomes of learning science. They viewed the dimensionality of scientific attitudes to include rationality, open-mindedness, curiosity, aversion to suspicion, the objectivity of intellectual belief, and suspended judgments. Other aspects include self-reliance, flexibility, perseverance, adaptability, proactiveness, honesty, respect, humility, and initiative. (Okunnuga. 2017). Genc (2015), distinguished attitude to be of three essential components. These, he said, included central and emotional components (feelings), cognitive components (beliefs), and attitudinal components(actions/behaviours). The emotional component refers to verbal knowledge about a concept; the cognitive component deals with observable verbal response to an attitudinal matter, and the behavioral component identifies all observable behaviours towards an attitudinal matter. Scientific attitude relates to and helps build methods and skills used by scientists, which is synonymous with scientific practices. The plethora of different scientific attitudes develops from the actions and activities of scientists. Some attitudes, such as honesty, would be expected in any human endeavor, but other attitudes, such as tolerance of uncertainty, are more characteristics of the scientists.

The scientific attitude being learners' disposition could serve as a trigger to help students think creatively. It could help them open their minds toward learning and thinking about new ways of carrying out different activities. Each of the components of scientific creativity could assist learners in different ways. It then becomes essential that factors that will help learners develop scientific creativity are given utmost attention. Hunashal (2013) explained that scientific creativity, scientific attitude, and scientific interests can improve students' academic performance in secondary schools. A positive way to make this possible is by improving these scientific skills in teachers to help improve students' academic performance when the preservice teachers become in-service teachers; teaching students in secondary education. Hunashal (2013) suggested that science educators promote the development of scientific creativity and scientific attitude among secondary school students as this will assist in accomplishing and achieving definite success in science education.

Creativity can be defined as the awareness or the development of an individual's original idea. It is an essential problem-solving strategy where there are no easy answers to problems for which popular or conventional responses do not work. Thus, it employs novel and valuable ideas to solve societal issues.

The importance of creativity in science is towards the end that learning will to improve learning outcomes alone but so that they will be able to create learners that will contribute positively to society. The education system has been criticized for focusing solely on academic performance and neglecting the core of science, promoting innovation and innovative skills, which is a concept best learnt by developing creativity. This study then seeks to provide concrete information and overview on creativity of preservice teachers and explore the predictive capacity of scientific attitudes, which affects interests and development of skills; and higher-order thinking skills on scientific creativity of learners. Investigating the predictive ability of higher-order thinking skills also becomes essential because learning outcomes, through academic achievements and classroom tests are assessed primarily based on Bloom's Taxonomy of cognitive domains. Exploring and seeking information about the higher levels of Bloom's taxonomy and its influence on creativity could help to encourage teachers to test on these higher domains to help build learners' scientific creativity

In the past several years, scientific creativity has become well-known in educational circles. Teaching science creativity has always been one of education's latest and most successful words. It is used in the present educational sector as a phrase. In principle, science creativity is a human marvel. This artificial cycle supports him throughout his life with achievement of nobility and importance. It is essential that, in a society that begins to merge the gap and perceived difference between Male and Female gender, there is a pronounced encouragement towards improving this scientific creativity based on gender as every individual must have equal access to education and contribution to the society. The extension of the universe and the principal work of man on this planet are indistinguishable from scientific creativity. Furthermore, scientific creativity skills integrate life and public access. Consequently, its findings and development should therefore be deemed essential in these present times.

Purpose of the Study

1. Determine higher order thinking skills, scientific attitudes, and scientific creativity of preservice Biology teachers;

2. Does sex relate to HOTS, SA, and SC of preservice Biology teachers; and

3. Assess how higher-order thinking skills and scientific attitude components predict scientific Creativity of preservice Biology teachers

Research questions

1. What are preservice teachers' higher-order thinking skills, scientific attitudes, and Creativity in Biology?

2. Does sex relate to HOTS, SA and SC of preservice Biology teachers

3. How do the components of higher order thinking skills and scientific attitudes predict preservice teachers' scientific Creativity?

Contribution to Knowledge

The study added to the body of knowledge by providing information related to the level of higher-order thinking, scientific attitudes and creativity of preservice Biology teachers. It also informed on how higher order thinking and scientific attitude components predicted the scientific creativity of preservice teachers to expand the scope of knowledge on the relationships among these variables. This will help to know how to help learners and preservice teachers improve components of thinking and attitudes to improve their creativity. Improved scientific creativity will make them better citizens in their society.

METHODOLOGY

The study adopted a survey research design with the population comprising all Biology Pre-service teachers in Southwestern Nigeria. A simple random sampling technique was used to select five colleges of education. From each of the institutions, one hundred participants were randomly selected. Three research instruments were used for the study. Higher-order thinking skills tests containing items on the higher domains of Bloom Taxonomy: Analysis, Synthesis, and Evaluation. The other instrument was the Scientific attitude questionnaire, which will elicit information about scientific attitude's cognitive, affective, and psychomotor components. In contrast, scientific creativity test provided information on the scientific Creativity of the respondents based on fluency, flexibility, and originality. Data were analysed using descriptive statistics of mean, standard deviation, skewness, and kurtosis and inferential statistics using discriminate functional Analysis.

Higher-Order Skills Test (HOST)

This test contained 20 items that had questions from the three higher levels of the cognitive domain according to Bloom's Taxonomy, that is, Analysis, synthesis and evaluation. The Analysis contained nine questions while the synthesis and evaluation domains contained five and six questions respectively. Five particular areas of Biology were selected for this study based on the courses the students have taken in their first and second years. These branches are Taxonomy/Classification, Ecology; which deals with organism and their relationship with their environment, Anatomy; which deals with organs and their structure, Physiology, which deals with functions and Cell Biology. The questions were self-developed multiple-choice questions. Each correct response scored 1 mark and the wrong answer was 0. Doring and Bortz (2016) explained that the difficulty index (P) and discrimination index (D) should be considered such that items whose difficulty index was $0.25 \leq P \leq 0.75$ and the discrimination index (D) was $0.4 \leq D \leq 0.6$ should be retained. The selected items for the study were within the difficulty and discrimination indices. Kuder Richardson-21 score of 0.82 was gotten for the instrument.

Biology Scientific Attitude Questionnaire (BSSAQ)

The test contained items relating to each scientific attitude. This included curiosity, intellectual honesty, rationality, open-mindedness, willingness to suspend judgment, proactive, objectivity, aversion to superstition, perseverance, self-reliance and humility. These attitudes were divided into the cognitive, attitudinal and affective components. Each stated scientific attitude contained questions the researcher constructed to make a total of 26 items. The instrument yielded a reliability score of 0.76 using Cronbach alpha coefficient

Biology Scientific Creativity Test

This contained questions demanding that students respond to unfamiliar situations based on individual reasoning, thinking, and opinion. It contained ten items that tested students' level of creative thinking. The creativity questions were specific to Biology. Zeng, Proctor & Salvendy (2011) posited that creativity questions specific for a particular field are more suitable than general creativity. The open-ended questions were developed after careful observations on the structure and format of different Science Creativity Tests like Hu and Adey (2002) and Torrance (1969). Each question tested students' fluency, originality, and flexibility, which are the widely accepted domains of scientific creativity. The number of logically scientific responses gave the fluency score, the number of categories gave the flexibility scores, and the frequency of accepted responses gave the originality score. Scoring was done by the researcher and a Biology science expert who has knowledge about the scale and domains of creativity. These domains were scored according to DeHaan (2011) where fluency was scored as a number of relevant points; 0-3 points, flexibility which refers to the number of different categories of responses and originality which will be the degree of novelty among the respondents (0-3 points). The highest possible score was 90 (which was 9 points per item). inter rater reliability was used to assess the reliability of the respondents' ratings by giving the responses to two assessors (the researcher and a research assistant) to score. Pearson product moment correlation (PPMC) was thereafter used to ascertain the reliability of scores. (Cohen, 1992) The results of the Analysis revealed that there was a significant correlation ($p<0.05$) between the scores of the assessors. The reliability score for Fluency ($r= 0.626$), flexibility ($r= 0.699$), Originality ($r= 0.913$). The overall reliability score for the Scientific creativity test revealed a reliability score of 0.75.

RESULTS

What are preservice teachers' higher order thinking skills, scientific attitudes and creativity in Biology?

Table 1: Descriptive Statistics of HOTS, SA and SC

Traits	N	Max. Obtainable	Min	Max.	Mean	Adjusted Mean	Std. Dev.	Skewness
Analysis	499	9	.00	7.00	2.5411	5.64	1.48750	.308
Synthesis	499	5	.00	4.00	1.2265	4.96	.95418	.564
Evaluation	499	6	.00	5.00	1.8798	6.26	1.28068	.232
HOTS	499	20	.00	12.00	5.6473		2.46009	.041
CognitiveSA	499	28	10.00	28.00	20.0200	75.79	3.09417	-.222
EmotionalSA	499	28	9.00	28.00	19.0521	72.00	3.29190	.277
AttitudinalSA	490	48	12.00	48.00	36.6673	80.98	5.52902	-1.126
SA	490	104	47.00	100.00	75.7531		8.14052	-.218
Fluency	499	30	.00	14.00	1.2645	3.81	2.22936	2.673
Flexibility	499	30	.00	12.00	.9719	2.91	1.80895	2.639
Originality	499	30	.00	13.00	.8978	2.70	1.87018	2.991
Scientific creativity	499	90	.00	39.00	3.1242		5.77807	2.740

Table 1 shows the respondents' higher-order thinking skills, scientific attitude, and scientific creativity components. It was shown that the mean score for Analysis, synthesis and evaluation of the respondents in the study were 2.54, 1.22, and 1.88 from a total maximum possible score of 9, 5, and 6, respectively. The mean score showed that the respondents' analysis, synthesis and evaluation components of higher order thinking skills in the study area were low. The respondents' total higher order thinking skills showed a mean HOTS score of 5.64 from a maximum obtainable score of 20. This shows the study's low higher order thinking skill proficiency. The HOTS was judged low as the mean scores were below mid-point. The adjusted mean also showed that evaluation component ranked highest while the synthesis ranked least in the components of Creativity of the respondents in the study area

On scientific attitudes, the result of the study showed mean scores of 20.00(from a maximum obtainable score of 28) for the cognitive components, 19.05(from a maximum obtainable score of 28) for the emotional components and 36.67 from a maximum obtainable score of 28) for the cognitive components. This shows a high level of scientific attitude components as the mean scores were close to the maximum obtainable scores. The adjusted mean revealed that the affective components of scientific attitude were the highest while the emotional component was the least component of scientific attitude.

On scientific creativity components, the result of the study showed a mean score of 14.00, 12.00 and 13.00 for fluency, flexibility and originality scores of scientific attitudes. Compared to the maximum obtainable scores, these mean scores were low, showing the level of creativity component scores by respondents in the study area. adjusted mean also revealed that the fluency score was the highest of the three components while originality was the least but the creativity levels were generally poor.

Research Question Two: Does sex relates to HOTS, SA and SC of preservice Biology teachers?

Point Biserial correlation was used to ascertain the relationship between sex and Higher-order thinking skills, Scientific attitude of the respondents in the study area. The result is presented in table 2

Table 2: Point Biseral Correlation on Relationship between SEX, HOTS, SA and SC of Respondents in the Study Area.

Correlations		sex	HOTS	Scientific attitude	scientific creativity
Sex	Pearson Correlation	1	-.129**	.018	-.010
	Sig. (2-tailed)		.004	.691	.828
	N	499	499	490	499
HOTS	Pearson Correlation	-.129**	1	-.029	.185**
	Sig. (2-tailed)	.004		.525	.000
	N	499	499	490	499
Scientific Attitude	Pearson Correlation	.018	-.029	1	-.003
	Sig. (2-tailed)	.691	.525		.939
	N	490	490	490	490
scientific creativity	Pearson Correlation	-.010	.185**	-.003	1
	Sig. (2-tailed)	.828	.000	.939	
	N	499	499	490	499

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

The correlation result showed a significant relationship between sex and higher-order thinking skills of the preservice teachers as this correlation was weak and negative ($r= -0.129$, $p<0.05$). The result also showed no significant relationship between sex and the scientific attitude of respondents in the study area ($r= 0.018$, $p>0.05$). It was also revealed that no significant relationship exists between sex and scientific Creativity of the respondents ($r= -0.01$, $p>0.05$). This shows that sex does not relate to the scientific attitude and creativity of the preservice Biology teachers but relates to the Higher Order Thinking Skills of Preservice Biology Teachers in the study area.

Further Analysis of the results showed that no significant relationship exists between HOTS and SA($r=-0.029$, $p>0.05$), but a significant relationship exists between HOTS and SC($r= 0.185$, $p<0.05$).

Research Question Three: How does the components of higher-order thinking skills (HOTS) and scientific attitudes (SA) predict the Scientific Creativity (SC) of preservice teachers?

Multiple regression analysis was used to determine how HOTS and SA components predicts Scientific Creativity of preservice Biology teachers. The multiple regression table shows how Analysis, Synthesis and Evaluation components of HOTS and Cognitive, Emotional and Attitudinal Components of Scientific attitude predicts scientific Creativity.

Table 3: Multiple Regression Analysis of HOTS and SA as predictors of SC

R2= 0.048 Adj. R2=0.036 F= 4.064		Unstandardized Coefficients B	Std. Error	Standardized Coefficients Beta	t	Sig.
1	(Constant)	1.868	2.548		.733	.464
	Analysis	.462	.178	.118	2.597	.010
	Synthesis	.296	.274	.049	1.079	.281
	Evaluation	.441	.208	.097	2.115	.035
	Cognitive SA	.205	.087	-.109	2.373	.018
	Emotional SA	.018	.081	.010	.222	.824
	Attitudinal SA	.074	.048	.070	1.539	.124

Table 3 showed that the r squared value of 0.048 revealed that the independent variables which are the components of HOTS and SA explain a 4.8% variation in the dependent variable (Scientific Creativity). This shows that the variability of scientific Creativity is accounted for by just 4.8% of the independent variables. The F value of 4.064, p>0.05, also explained that the independent variables which are components of HOTS and SA do not statistically significantly predict the SC of the respondents in the study area.

The result of the study as shown in table 3 also revealed that the Analysis component of the HOTS statistically predicts the scientific creativity of the respondents as (t=2.597, p<0.05). It was shown that a unit increase in the analysis score of the respondent will yield a 0.462 increase in Creativity. It was also shown that the synthesis component of HOTS does not statistically predict SC (t=1.079, p>0.05). Evaluation components statistically predict SC (t= 2.115, p<0.05) as a unit increase in Evaluation yields a 0.441 increase in scientific Creativity of the respondents.

On the components of scientific attitude, the study showed that only Cognitive components of Scientfic attitude statistically predict scientific Creativity of preservice Biology teachers (t=2.373, p<0.05). a unit increase in Cognitive SA will yield a corresponding 0.205 increase in scientific Creativity. The emotional component (t=0.222, p>0.05) and the attitudinal components (t=1.539, p>0.05) do not statistically predict the scientific Creativity of preservice Biology teachers.

It can be concluded that the Analysis & Evaluation components of HOTS and the Cognitive components of SA statistically predict Scientific Creativity as Analysis was the most significant predictor of scientific creativity.

DISCUSSION OF FINDINGS

The study showed that the components of HOTS and SC were low and possessed a high level of Scientific Attitude. The low level of higher order thinking skills and scientific creativity shows a low level of utilization of these components. These traits are related to the cognitive abilities and potentials of the respondents. Literature reveals a high demand for innovation and creativity, which are best developed by effective acquisition of HOTS. The implication is that preservice Biology teachers would not be adequately equipped to improve same traits in learners as they dpo not possess it themselves. It would stall innovation, productivity and effective acquisition of 21st century skills that will be important for innovation and improvement. This agreed with the work of Yusuf, Sadia, Suastra and Suharsono (2018) where teachers have a low level of HOTS. This will invariably affect teaching and learning as well as implementation strategies in the classroom thereby stalling learners development of HOTS. It is important that teachers her trained using activity-based strategies that would improve their thinking skills so that they will be able to engage in thinking skills that are of the higher domains hence improving creativity. Classroom assessments should be such that they contribute effectively to learners' thinking so that they can make meaningful contributions that involve thinking. Ansori (2020) explained that the use of HOTS in assessment questions is still low and will stall the improvement of HOTS in teachers.

The result was also following the results of Mustika, et. al (2019) whose work revealed a low level of creativity. One of the reasons cited by the researcher was the inability of scores to expose students to learning experiences that will solve real-world problems. The findings of the study was in concordance with that of Malik, Suhandi and Permanasari (2018) where it was seen that students possessed more fluent skills than flexibility and originality. Sugiyanto et. al. (2018) in their study also revealed that Biology students possess a low level of scientific creativity. Yang, Hong, Lee and Lin (2019) explained that a creative learning environment, science achievement and scientific inquiry has a significant effect on students' scientific creativity. This could be due to inadequate creative teaching among respondents in the study area as Hamdallah, Ozovehe and Dyaji (2014) emphasized the importance of teaching creatively to achieve better academic achievement and creative and critical thinking skills amongst students. Sugiyanto et. al. (2018) believed that training teachers can improve creativity, and providing conducive learning environment and appropriate materials for teaching and learning. This emphasized the need to train teachers in creativity and provide a better learning environment to improve creativity.

The study also revealed that Analysis & Evaluation components of HOTS and cognitive components of SA statistically predicts Scientific Creativity as Analysis was the biggest predictor of scientific Creativity. This signifies the importance of learners' cognitive development in improving scientific Creativity. The ability to analyze events by breaking them down into parts will allow them to develop options and various possible solutions to problems. The evaluation component of HOTS that deals with making valid judgments would also help to improve creativity as learners. Learners will be able to make judgments from problems, selecting the best possible solutions to problems based on judgments made, hence improving scientific creativity. Malik, Suhandi, and Permanasari (2018) stated that Higher Order Thinking Laboratory had a significant influence on student creativity and critical thinking abilities. The cognitive aspect of the scientific attitude, also called beliefs, includes rationality, intellectual belief and aversion to suspicion predicting scientific creativity, showing the importance of cognitions in improving scientific Creativity.

CONCLUSION

Scientific Creativity can hence be improved by improving learners' analysis and evaluation components of scientific attitudes and this can be done by activity-based learning, testing learners with a focus on the higher order of thinking than the lower order of thinking. Cognitive aspect of scientific attitudes can also be improved by asking questions and training preservice teachers to be rational in thinking, improve their levels of intellectual beliefs and aversion to suspicion by focusing on the development of science oriented concepts. The result of the improvement and training in components of scientific attitude is that they will not only end up as teachers with pedagogical skills but would help to train learners that will be equipped to contribute positively to society via intellectual thinking and provision of innovative ideas. Science teachers, like Biology teachers, need to be creative to diversify teaching aids based on the latest technology. Pedagogical practice should include higher-order thinking development.

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