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Promoting Nature of Science Understanding for Elementary School through Joyful Learning Strategy

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ABSTRACT

Most of students, teachers and preservice teachers has not understood the nature of science by. Even though the teacher's understanding of the nature of science that properly and mastery will affect students' the ability to do open mind, imagination, and creativity. The purpose of this study is to implement a learning plan that develops open mind, imagination, and creativity using Joyful Learning Strategy. The mixed methods used and the participants were 223 preservice elementary teachers (41 males and 182 females) and 32 elementary school students (10 males and 22 females). The questionnaire of NOS and joyful learning observation worksheet were validated. Data analysis used descriptive with percentage and qualitative descriptive. The results showed many preservice elementary teachers have misunderstanding about science as product, process, attitude and social interaction. Through joyful learning can develop students' students' the ability to do open mind, imagination, and creativity. Some suggestions are Joyful Learning with integrated learning will be able to generate students' the ability to do open mind, imagination, and creativity when the teacher understands the nature of science properly. The learning environment of the classroom and school facilities and non-physical interaction between teachers and students become important factors of joyful learning success.

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Introduction

The nature of science hasn't been clearly understood by students, teachers and preservice teachers' even some scientists [1-4]. Yet understanding the nature of science affects the practice of learning in the classroom [5-7]. Thus, Brickhouse found that teacher understanding of the science's nature was influential in the learning they provided in the learning process [8]. While Aslan and Tasar reported that the nature of science owned by teachers and students is informed (7).

The nature of science is the understanding of science as knowledge, processes, attitudes, and social change [9]. The fact of science as such knowledge is durable, unabsolutely or uncertainly [10]. In addition science knowledge is tentative because the subject of knowledge changes with the discovery of the latest facts [9-13].

Science as knowledge is based on the relationship or linkage between theory and law [9][15], however there is a difference between knowledge and the roles in science [16-17] or "distinct kinds of science knowledge" [15]. In addition, as knowledge, science requires the imagination and creativity of researchers [9] through the interpretation of the observed phenomenon [11][13][18].

Science is objective as well as subjective or theory-laden [10][14][16] depending on the scientific background or the field in which it was administered [13][15]. However, science is different from technology and engineering techniques but affects each other's development [16]. Science knowledge is empirically-based resulting from a series of observations and withdrawals of the conclusion of the natural phenomena [9][13] supported by the theory and Law of Science [14][18]. Science knowledge is also reliable [11], or trusted after empirically testing so that hypotheses can be a theory [19].

Science knowledge is influenced by early scientific assumptions and knowledge and theory-laden [16], using inductive approaches and hypothetico-deductive testing [17]. Then science knowledge is the subject of knowledge that undergoes a series of changes [20]. Because science is self-corrections and open to revisions due to the development of the latest facts [17][20]. Besides, science is tentativeness [15][18], the existence and uncertainty of the phenomenon/evidence [21], is replicable, making science knowledge is always growing [22].

Teacher knowledge and understanding of the nature of science is one of the key factors affecting students ' knowledge and understanding [23-24]. Yogi and Widodo report that teachers and elementary school students have an understanding of the essence of science at the same level [25]. It is in line with the research results of Chaerun et al, Hayati and Widodo, and Jumanto and Widodo [26-28].

Teacher knowledge and understanding of science is one of the main factors affecting students ' knowledge and understanding of it [29-30]. The results of the study show that both

of students and teachers who have received formal education in science have a naïve and inadequate view of the nature of s cience [24]. Therefore, one of the objectives of science education is to increase the understanding of preservice elementary school teachers about the nature of science [31].

The results showed that teachers who were able to build interest and motivation to learn science turned out to make the learning outcomes better. Making science for kids is contextual, relevant, and engaging, it can help them become science-loving. Since childhood, children are generally interested in natural phenomena, the environment, and how they work. The understanding of that attraction will make it easier for teachers to engage them in active learning, even when learning has not yet lasted [32-35].

The nature of science is closely related to the ability to do open mind, imagination, and creativity. Creative learning is a learning that invites learners to be able to empower their mind and power to create something beyond the general audience's mind. According to Liliasari, creative thinking has the characteristic that there is a sense of difficulty, the problem of information gaps, the existence of missing elements and disharmony, defining problems clearly, making allegations and alternative improvement, re-testing or even redefining problems and finally communicating the results [36].

Based on a meta-analysis of studies on 117 empirical studies of the effects of learning intervention students ' critical thinking and disposition, suggests that educators should use a critical thinking instruction approach either by integrating critical thinking into academic content and by teaching self-thought skills [37]. The success of this learning requires professional development of teachers specifically focused on critical thinking-based learning. First, students should be given the opportunity to apply critical thinking skills in a variety of contexts and field studies. Secondly, teaching should emphasize the functions or skills of metacognitive, such as setting goals, planning, and monitoring progress toward the goal [38]. Thirdly, students must be sensitive to the problem structure deeply, because the minds of most students tend to focus on the surface structure of the problem [37-39].

Chaille, Finson and Buldu looking for the understanding an obscure world by method of test, scientisits are persistently doing likewise things that childrens doing: having bits of knowledge, posing inquiries, taking care of issues, evaluating new thoughts [39-42]. Researchers, similar to a youngsters, don't just apply precise strategies to respond the reserved inquiries. Kids, loaded up with wonder and excitement, are contantly upset, testing, and examining thoughts, much the same as scientists. The constructivist study hall that help this logical action is so normal to kids. Kids are in a situation that is encouraging their

experimentation, a domain that is purposively intended to start their interest, bolster their inquiry, and contain numerous assets to fuel their critical thinking.

Students spent most of their time in the school classroom between 6 to 18 years. This is where they develop the potential, knowledge, attitudes and skills needed for their future [43]. Given the importance of learning environment in child growth and development, it is important to understand how to influence the environment in order to obtain the maximum learning process effectiveness [38]. One alternative strategy that fits the neuro system is joyful learning [44]

Joyful Learning is a strategy, concept and learning practice that synergize meaningful learning [45-46], contextual learning [46,47], constructivism theory [39], active learning [40]. Children will be happy in learning because they know what the meaning and purpose of learning, because they learn according to their interests and hobbies [40], and because they can integrate the concepts of learning they learn with everyday life [39][43][44], even with a variety of topics that flourish in society [41].

Joyful learning is recognized as a success in making students feel a different and enjoyable learning atmosphere. It's as reported by the Hongkong Arts Development Council which implements a learning collaboration between 30 schools in Hong Kong to make learning about art and history using Joyful Learning [42]. Chopra and Chabra described the success of the school that used the Joyful Learning approach in India in a stakeholder perspective [43]. Based on research by Kirikkaya et al., joyous perception has a positive influence on student learning motivation [44]. Besides that, a number of educational games with Joyful Learning approach have been developed and based on theoretical and educational strategies/scientists [45].

Jadal describes the implementation of the Activity-Based Joyful Learning (ABJL) approach in several elementary schools in Maharastra India [48]. The ABJL approach is a strategy that maximizes student involvement in the learning process. The ABJL approach refers to the principles of learning by playing, learning by doing, learning by enjoying & learning by problem solving. Joyful Learning makes the student's learning attitude more positive [39]. This affects the mastery of concepts. Based on the research of Jadal and Ali and and Awan shows that a positive learning attitude is strongly correlated with the mastery of the science concept [44].

Method

A. Participants

First, two hundred and twenty three (41 males and 182 females) preservice elementary school teacher in one of the private universities. They took the course of the 2nd Basic Concept of Science. The high school background of the respondents include Science (17

males/80 females), non-Science (18 males/73 females), Vocational Science (4 males/4 females), Vocational non-Science (2 males/16 females) and Religion School (9 females). Second, as observed class, thirty two students (10 sons and the rest of the daughter) of 4th graders of one private elementary school.

B. Research instruments

The first research instrument was used is the NOS Questionnaire developed by Anwar et al. includes science as a product (20 items), science as a process (18 items), Science as attitudes (10 items) and science as a result of social interactions (8)[26]. The validity coefficient of a statement item is selected using the product moment with the criteria > 0.3 and the reliability coefficient of the instrument using Cronbach Alpha of 0.6. While the second instrument is the Joyful Learning observation sheet for the RPP thematic science My Ideals, with the basic competency is the relation of Sound and Matter and the relationship between natural resources and environment, technology and society. The observed indicators include pleasure in learning, give students choice, let students create things, take time to thinker, environment of freedom, comes from the experiences of success, make school spaces inviting and adventure, based on a student's abilities, read good books, and get outside.

C. Data Collection and Analysis

The nature of science understanding and learning disposition is acquired by non-test instruments, including: survey method with Likert scale, interviews, and observation. Participant was filling of questionnaire about nature of science (covering the segment of Science as knowledge, procedure, social, and social dimension). The validity test of the instrument use construct validity by judgement expert review and empirical validity.

Data collection nature of science understanding of preservice elementary teachers is done through the filling of the nature of science that has been validated by an expert team. Participants answered the statement provided with the form of feedback ranging from highly disagree to the very agreed. Whereas joyful learning data collection in learning is done with joyful learning observation sheets supported learning videos.

Data analysis using descriptive analysis in the form compares the percentage of the number of students who have experienced misunderstanding about the nature of science based on previous educational background. While the analysis of observation data is done in a qualitative descriptive. Whereas for looking the joyful learning indicators used observation video.

Result and Discussion

The understanding of NOS of preservice elementary teachers' is generally shown in table 1. The results indicated that the understanding of them still needs improvement. They

assumed that science is a collection of unchanging facts and theories and humans are incapable of changing it.

Table 1. Preservice Elementary Teachers' Understanding about Nature of Science

Nature of Science	Student numbers (%)	
	Science	Non Science
Science as a product	64.32	66.61
Science as process	55.62	48.62
Science as attitude	77.25	80.5
Social dimensions of science	79.3	88.75

Table 2 shows the understanding of preservice elementary school teachers about the nature of science as a product or knowledge. More than half of particSciencents argue that knowledge has not changed or remained. Whereas the results of the study stated that knowledge is durable but unabsolutely or uncertainly, and tentatively with the discovery of recent research results [9-13].

Table 2. Preservice Elementary Teachers' Understanding Science as a Product

Science as a Product	Student Numbers (%)	
	Science	Non Science
Durable and tentative	42	46.25
Natural Science and Consistency	53.75	54.75
Natural phenomena	66.67	61
Science as product of imagination and creativity	71.5	92
Objectivity	83	76.67
Technology as part of Science	69	69

Table 3 shows the understanding of preservice elementary school teachers about the nature of science as the process of gaining knowledge. Most of the participants, especially those in non-scientific backgrounds, argue that hypotheses can change according to recent research results. This is contrary to the opinion that the scientific concept is a accumulated understanding of the concept has been agreed upon by scientists based on the linkage between the theory and the law [9] [15-17].

Table 3. Preservice Elementary Teachers' Understanding Science as Process

Science as Process	Student Numbers (%)	
	Science	Non Science
Empirically-based	55	59
Way of knowing	73.5	75.5
Hypothetico-deductive testing	24	2
Scientific approach	70	58

Table 4 shows an understanding of elementary school teachers about the nature of science as attitudes. Most participants have understood that science is built on a critical and open stance on new ideas. According to the results of science research are theory-laden, self-corrections, tentativeness, and replicable so that science is always evolving and can accept new ideas [15-22].

Table 4. Preservice Elementary Teachers' Misunderstood

Science as Attitude	Studen Numbers **(%)**	
	Science	**Non Science**
Skepticism	80.5	82.5
Open to new ideas	74	79.5

Table 5 shows the understanding of elementary school teachers about the social dimension of Science. Most particSciencents have understood that science is open to revision and affects social life. Science is theory-laden, depending on the social background of the scientific [10][14][16] or the field in which it was administered [13][15]. Besides that science knowledge subject has always been developments in line with the latest findings results [17][20].

Table 5. Preservice Elementary Teachers' Understanding about Science as a Social dimensions of science

Social dimensions of science	**Student Numbers (%)**	
	Science	**Non Science**
Scientific knowledge is open to revision with the latest evidence	80.1	91
Science affects human social life	78.5	86.5

Learning the nature of science can be done implicitly or explicitly. Abd-El-Khalick and Lederman stated that learning the essence of science was done implicitly, with consideration of the nature of science being the result of learners ' engagement as students study scientifically (science-based activities) [23]. However, some research suggested that the nature of science taught explicitly is more effective to develop the concept of the essence of Science [24]. Learning the essence of science should be done explicitly because the nature of science is a framework of the concept of science that includes historical, philosophical and sociological. Nevertheless, learning explicitly has limitations because it is not contextual. So Seung et al. argued that the learning of the nature of science is done explicitly and contextually (within

science contexts) so that preservice teachers can integrate the understanding of the nature of science by teaching science.

Combining the learning essence of science explicitly and the implist gave encouraging results. The understanding of the science nature of 70 high school teachers in the U.S. increased significantly and substantially after attending science teacher training for 2 semesters. In addition, 4 science teachers for special needs children have increased understanding of the scientific essence and can use both approaches in enhancing the understanding of the nature of their students. Most of the science teachers in Palestine were surveyed have an 'unsophisticated' about the relationship between scientific methods, theory-laden and the meaning of theory and law in science. Science studies provided by teachers are still using ' traditional teaching practices ', as science in the curriculum is understood as a series of theories and laws, and is influenced by educational, cultural and religious background. So teachers must always improve the understanding of their scientific nature through training and education [24].

The training of science's nature is proven effective in helping teachers build the concept of the scientific essence ' informed '. Such understanding can last long in their minds and be applied in the learning process. Through a strategy of learning the right essence of science proved to be able to improve the understanding of the science nature of elementary school teachers [14], and partly able to apply the understanding in the learning process they did then [15]. Through learning the essence of science is explicitly-reflective, it is proven to improve the understanding of the science of teachers and reduce their misconceptions. The increasing understanding of the science's essence is significant in empirical science, creative-imaginative and social – cultural embeddedness. However, such changes are not significant in the aspects of science and the relationship between the law and scientific theory.

The nature of science that informed will lead students to understand that science is not merely a collection of facts, principles and laws that must be memorized. The element of science that is relevant to science education is tentative, empirical, theory-laden, imaginative and creative, influenced by socio-cultural value. The modern science curriculum also contains the relationship and functions of science theory and law, the difference between observation and inference, the use of scientific methods in building knowledge.

In the learning process using Joyful Learning strategy, teachers apply learning activities using the principles of learning by playing, learning by doing, learning by enjoying and learning by problem solving [48][54]. Students conduct synergies of making tools and role-playing such as making telephone and erosion. At other times students make musical instruments of bottles filled with water in a certain amount and make the tone of the songs they choose themselves. See Fig. 1 to Fig. 4.



Fig. 1-4. Some Activities on Joyful Learning Strategy

The teacher's role in the activity was as a facilitator and judge. Students look enthusiastic in applying these activities, seen from their willingness to bring their own equipment from home and strong desire to be able to make props and apply them. It is in accordance with the opinions about pleasure in learning and as parts of science as process [5-8] .

Joyful learning improves students ' critical and creative thinking skills. Students ' creativity is seen when they use plastic bottles to make soil containers on the erosion theme, the student uses several ways to be able to trim the bottles according to the shape used. Then when you attach the balloon to seal the water funnel to create a stethoscope, some groups cut the air in horizontally. The others cut vertically. This fits one of the joyful learning indicators of Give Students Choice and these are parts of science as knowledge that need imagination and creativity [9][11][13[18]. In the view of constructivism, every child has a conception of everything around them, with or without the help of teachers. Piaget believes that learning can happen if students are actively building knowledge, supported by the opportunity to choose them to study themselves. Through active learning activities, teachers and students build a classroom atmosphere that can explore and understand more concepts or materials.

The time of the exception, the teacher conveys the concept of using interesting media, such as puzzle games and science comics. Then, during core activities, teacher and student

interactions are intensively intertwined through interactive discussions and playing together. In addition, by taking advantage of classrooms and school pages in lessons, make students more enthusiastic. The group's learning and experimentation activities are more enjoyable and refreshing. Learning feels more playful, so the activity of thinking and acting can be done simultaneously and fun [48][53-54]. While in closing activities, evaluation is conducted through competition activities. Each group presents the results of the discussion through posters, while others give judgment. They are enthusiastic about making and showcasing their best, so they can be a winner.

Vygotsky believes that all aspects of development can be optimised through learning with playing activities [85]. Through play, all aspects of child development can be improved. By playing freely the child can express and explore to reinforce things that are already known and discover new things. Through the game, children can also develop all their potential optimally, both physical and mental, intellectual and spritual. Therefore, playing for children is a bridge for physical and psychic development [35]. This view is in line with the zone Proximal development concept developed by Vygotsky.

Joyful Learning is a learning strategy that makes teachers and students feel comfortable through each stage so that the results will be maximal [38][48]. The learning atmosphere is fun, not tense, safe, engaging and does not make students hesitate to apply something even though it is wrong, making students achieve the learning objectives. The ability to understand the subject matter and the relevant method, the involvement of all senses and left and right brain activities, challenging activities of thinking and action, encourages students to explore the materials learned. Through these activities, make students retain enthusiasm during the joyful learning process. According to Anggoro et al., if students gain positive cognitive experience through a fun learning strategy, supported by an affective experience through interesting subject matter, interesting and enjoyable learning methods, and media and enthusiasm and pleasure, make students have a positive desire or a tendency to learn science (a conative experience).

Joyful Learning is done in accordance with the features expressed by Ref. [40]. There is a relaxed, pleasant, untense, safe, attractive environment that does not make students hesitate to apply something even if it is wrong to achieve high success. The availability of relevant subjects and methods, the involvement of all of the senses and activities of the left and right brain, challenging learning situations (challenging) for students to explore the materials being studied, as well as the positive learning environment when the students learn together, making the learning atmosphere more enjoyable. The joyful discovery atmosphere makes students retain enthusiasm through the learning process with joy.

Through hands-on exercises and role playing activities, students ' critical and creative thinking skills of the sound concept become naturally occurring. In addition, Anggoro et al. argues that through the activities, most of the elementary school teachers experienced the conceptual change from misconception to lack of knowledge even scientific conception, on the concept of free falling object motion. This is in accordance with Wei and Hung's opinion that the Joyful Learning Classroom Learning System (JCLS) approach can help students understand the concept of learning materials, improve learning motivation and joyful perception during the learning process.

The results showed that Joyful Learning approaches through learning activities using a series of role-playing activities, implementing experiments, group discussions, conducted inside and outside the classroom provided an increase in learning attitudes, the mastery of concepts and reconstruction of science conception. This is in accordance with the results of a Jadal study that concluded that the activity-based joyful Learning (ABJL) approach provides better learning outcomes than using conventional learning methods [38][55].

A change in the original learning approach using memorization and teacher-centered, then transformed into a more contextual and meaningful learning and student-centered, an increase in learning attitudes and conceptual change. Teachers enthusiastically try to lead the class optimally in the most interesting way, while the participants enthusiastically and compete actively take part in each activity. Teachers and students feel the pleasant atmosphere while at school. This is consistent with the descriptions of Chopra and Chabra and Purohit and Kamal about the school model using Joyful Learning approach [54].

Conclusion

Learning the nature of science can be done implicitly and/or explicitly. Abd-El-Khalick and Lederman stated that learning the essence of science was done implicitly, with consideration of the nature of science being the result of learners ' engagement as students study scientifically[23]. However, some research suggested that the nature of science taught explicitly is more effective to develop the concept of the essence of Science [24] [61-62]. So Seung et al. argued that the learning of the nature of science is done both explicitly and contextually (within science contexts) so that preservice teachers can integrate the understanding of the nature of science by teaching science.

The nature of science is closely related to the ability to do open mind, imagination, and creativity. Creative learning is a learning that invites learners to be able to empower their mind and power to create something beyond the common-mind[45-47]. There are similarities between the thinking of scientists and kids. Both of them having bits of knowledge, posing inquiries, taking care of issues, and evaluating new thoughts. Kids, loaded up with amazement

and interest, are contantly bewildering, testing, and examining thoughts, much the same as scientists. They are in a situation that is encouraging their experimentation, a domain that is purposively intended to start their interest, bolster their inquiry, and contain numerous assets to fuel their critical thinking[36][45].

In the Joyful Learning strategy, teachers apply learning activities using the principles of learning by playing, learning by doing, learning by enjoying and learning by problem solving with open mind, imagination, and creativity. Students look enthusiastic in applying the activities. It is in accordance with the opinions about pleasure in learning [77-82] and there parts of science as process as critical and creative thinking [5-8]. This inline of the joyful learning indicators of Give Students Choice [77-82] and these are parts of science as knowledge that need imagination and creativity

Conflict of Interest

We declare that there is no conflict of interest.

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