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Development of Learning Tools based on Food Security to Build Scientific Attitude of Undergraduate Students

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Abstract

This study aimed to develop learning tools that are proper to use, where the learning tools developed are based on food security in a food chemistry course to increase the scientific attitude of undergraduate students of the science teacher candidates. The type of research used in this study is Research and Development. The proper learning tools are conducted by testing the validity and effectiveness of the product. This research was conducted on 23 undergraduate students at the Department of Science Education, Faculty of Teacher Training and Education, Universitas Sultan Ageng Tirtayasa, Indonesia by using students' scientific attitude questionnaire responses and the students' questionnaire responses to learning tools. The analysis results stated that food security-based learning tools which be developed were proper for using in food chemistry course because after going through the stages of validation, small groups trial, and product revision, the validity criteria of learning tools are in very valid criteria and based on the effectiveness test of learning tools are in very effective criteria. Food security-based learning tools developed can also build the scientific attitude of undergraduate students on very good criteria. Then it is concluded that learning tools developed are proper to use. The next will be implemented in the large-scale trial to get the final product of food security-based learning tools.

Keywords: Learning Tools, Food Security, Scientific Attitude

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INTRODUCTION

Learning tools are things that must be prepared by educators before carrying learning. According to Prasetyo et al (2011), learning tools are tools to conducted process that support educators and students in activities of learning. In Regulation of Mininstry of Education and Culture No. 65 of year 2013 concerning Standard Process Primary and Secondary Education states that the preparation of learning tools is part of the learning plan (Republic of Indonesia, 2013). Learning plan is designed in the form of syllabus and semester learning plan (RPS) which refers to the content standards. In addition, learning tools are everything or some preparations arranged by educators both individually and in groups so that the implementation and evaluation of learning can be done systematically and obtain the results as expected. In addition, learning plan is also carried out in preparing assessment tools, learning scenarios and learning resources.

In this study, learning tools will be developed in semester learning plan (RPS) and teaching materials based on food security in food chemistry course. Scientific attitude encourages questioning mind and a spirit of inquiry. Scientific attitude has three basic components: belief, feeling and action (Mukhopadhyay, 2014). Scientific attitude is an attitude that describes the mindset with ethics of science and the rules (Kristiani et al, 2015). Oluwatelure and Oloruntegbe (2010) stated that scientific attitude is individual's competency to feel, to react, to think based on their competency to the object, either negative or positive.

Food security definition according to Law of Indonesian Republic No. 18 of 2012, is the condition for individuals, to fulfill the availability of food sufficiently, both in quality and quantity, nutritious, safe, equitable, diverse and affordable and does not contrary to beliefs, religion, culture, and to be able to active, productive, live healthy and sustainably (Republic of Indonesia, 2012).

Food chemistry course is Science Education department's course at the Department of Science Education. This course discusses the concept of food chemistry in terms of existing food, especially local food in Banten province, Indonesia. The concepts discussed in the course of food chemistry will be linked to the four pillars in food security, namely food access, food availability, food stability and food utilization (El Bilali, 2019). Hopefully, through the development of food security-based learning tools, the students not only understand the concept of food chemistry, but can associate

scientifically with food security, especially local food in Banten. Through the development of learning tools is also expected to increase the scientific attitude of students through activities during the learning process.

Singh and Bai (2017) described that science has significant effect in promoting life quality either indirectly or directly. The qualities were embedded by the students through learning science are very valuable for a citizen to live in the society. Managing and building scientific attitude of students has become a consistent aims in education of science and is a research topic, because attitude is an aspect that reveale students' persistence in science learning in school for gaining a career in science (Osborne et al, 2003). The most important point in scientific attitude is the students do not go to school by disliking or liking science lessons (Akpinar et al, 2009). Scientific attitude is one of the education character that students must be have and the learning implementation is expected to be able to learning students' scientific attitude (Wildan et al, 2019). Revati and Meera (2017) described that scientific attitude is solving objectively without bias using thinking of logical so that a person reveales everything around their environments based on their scientific knowledge.

The development of many attitudes in the process of learning is not possible but blending some scientific attitudes in the science study is the real step (Kustijono et al, 2018). Attitudes such as, rationality, critical thinking, willingness to maintain judgment, open mindedness, curiosity, honesty, objectivity, and humility are scientific attitudes that manage behavior directed to an object or situations group of object (Pitafi & Farooq, 2012). Jancirani et al (2012) described that people who have scientific attitudes will be experiment oriented, systematic in their approach and open minded. Those students will be an intellectuals who honest, have a love of knowledge, use their verified knowledge and have a scientific passion. Scientific attitudes involve students' affective behavior; such as preferences, acceptance, awards, and commitments (Hacieminoglu, 2016). Baruch et al (2016) described that curiosity to study science, to get positive attitude towards science, and to consider science are all factors that affect achievement in the short term and long term as also involvement of scientific.

Denessen et al (2015) described that there is the movement of labeling an attitude toward science assessment from “negative”, "positive," or "ambivalent" to a more complex labeling, a series of non-linearis correlation qualitative that

may exist in different sides. Many previous studies on students' attitude toward technology and science showed negative attitude towards science increasingly when the students get older (Denessen et al 2015). Fulmer et al (2019) states that if we do test to the students is not only on experienced instruction level, but how it can be variative from the side of students preference. Therefore, when we support teachers in teaching and learning strategies, the preference of students like can increase the positive feelings of students in learning class so that it support their attitudes towards science development.

The previous study by Anwer and Iqbal (2012) found that the student's gender has a influence significantly on their attitudes to science. Many researches all over the world have shown an important problem in that condition which there is the percentage of students who are not interested in science increasingly. Many women students have negative feelings towards science, its condition make them more difficult from continuing investigations scientifically (Hacieminoglu, 2016). The student's attitude in science also have significant correlation statistically with the achievement of students in mastery of content knowledge (Bybee & McCrae, 2011; Newel et al, 2015).

Gartaula (2017) described that there is a vital component in development of human that must be maintained by individuals, society, and state. In addition, Mokonnen and Gerber (2017) also described that food security as a complex concept and its definition continues to grow. Food security was a situation where at all times people have an economic assets, safe, sufficient to nutritious food for fulfiling their needs in food and their preferences in food for active and healthy living (Payne et al, 2019).

Drimie and McLachlan (2013) also explained that food security will be exists when everyone has an access to manage a healthy and productive life, enough food, malnutrition is absent, food comes from an effective, efficient, low cost, and fair food system that are compatible for using of natural resources sustainably. In addition, Karltun (2017) described that food security exists when all the time people have social economic access, physical, safe, sufficient to nutritious food for fulfilling their needs on dietary and preferences of food for healthy and active life. This definition implies a 4 pillars model that discusses food access, food availability, stability of food sources and food utilization. FAO defines food security as a perspective of global by emphasizing

everyone all the time (Taylor et al, 2019).

El Bilali (2019) explained that there are four pillars in food security such as food access, food availability, food stability and food utilization. Barret (2010) described that nutrition, for example food quality such as deficiencies of micronutrient, safety of food, and the ability to metabolize and absorb essential nutrients, it's called the concept of utilization.

Ansah (2019) described that food security is just not as an indicator of shocks and resilience are separated from pillars that take a role to resilience capacity. This challenge for arranging general ways and models is described by the complexity of food security concepts, which describes their relationships and dimensions with many biological, social, economic factors and nutritional (Ville et al, 2019). Bonatti et al (2018) showed a case study on innovative educational tools in methodological development, which make the contribution to understand which pedagogical tools based on Freire and Boal concepts, where it can be blended to involve the community role in the development of local solutions in food security projects and how this method application can be used to increase the understanding in situation of local food insecurity.

Hendriks (2015) described that many manifestations in food insecurity. Many causes of individual behavior, food availability, social norms, food quality, and stages in the human life cycle, cause the problem that needs a comprehensive solution. Candel (2014) and Coates (2013) stated that the way we understand and define food security determine the way we measure it. Many researchs on food security tend to take a look on population of rurals. However, the challenges for achieving food security are showing (Mutisya et al, 2016).

To support this, the researchers consider that lecturers need to develop learning tools based on food security that will be associated with food chemistry concepts. Learning tools in food security course were applied since the beginning of the lecture with the hope that it could improve the competence of lecturers who have an impact on the quality of learning and teaching and can improve scientific attitude of students. Scientific attitudes in learning are really needed by students because it can motivate their learning activities. In a scientific attitude, there is a description of how students should behave in learning, responding to a problem, carrying out a task, and developing themselves. This certainly greatly affects the outcome of student

learning activities in a positive direction. Through the planting of scientific attitude in learning, students have the possibility to be able to learn, to understand and to discover. Lang & Evans (2006) stated that scientific attitude will emerge in students if they are continuously strengthened. For example, when lecturers regularly use the scientific method, even though using simple tools and materials, it will increase students' positive attitude towards science.

There are six indicators of scientific attitude that are adapted from science for all Americans, namely: 1) cultivating curiosity, 2) prioritizing evidence, 3) accepting the differences, 4) being able to work together, 5) Being positive towards failure and 6) sensitizing to the environment. This research used all indicators of scientific attitude that are adapted from science for all Americans (Carin & Sund, 1997).

Therefore, it is necessary to intended local wisdom is viewed from local food in Banten, which is followed by 4 pillars of food security, namely food utilization, food access, food stability and food availability in Banten. This study is conducted by developing food security based-learning tools in food chemistry course to improve the scientific attitude of undergraduate students. This research is directed to improve student's scientific attitude through learning tools development based on food security.

METHOD

This study use research and development. The research objective is to produce the products that are proper to use, by testing the validity and effectiveness of these products. To be able to produce certain products, so that this research used the research in form of need analysis research and to test the validity and effectiveness of these learning tools in order to function in the society, this study is needed to examine the validity and effectiveness of these products (Sugiyono, 2008). In this research, the products are developed in the form of of semester learning plan (RPS) and teaching materials based on food security that will be used in food chemistry course to improve the scientific attitude of undergraduate students. The research took place at the Department of Science Education, Faculty of Teacher Training and Education, Universitas Sultan Ageng Tirtayasa, Indonesia.

Gall et al, (1996) outlined the general steps in research and development are as follows: Needs analysis, Planning, Initial product format development, Validation of initial product, Initial product revison, Trial of small groups, Revision of product, Field

trials, Final product revision, Dissemination and implementation.

In this research, the stage of developing food security-based learning tools in food chemistry course is only in a trial of small group. Collection and data analysis in this study were in the form of validity and effectiveness test of the developed learning tools. To obtain validity data from semester learning plan (RPS), and the developed teaching materials, then the validators are given the assessment sheet along with learning tools that have been developed to assess aspect of format, aspect of content, and aspect of language. The assessment results then analyzed to determine the level of validity which used the criteria which can be found in Table 1. Data on the effectiveness of semester learning plan (RPS) and teaching materials that have been developed were obtained through data on students' response regarding learning carried out by using semester learning plan (RPS) and teaching materials developed and the data of scientific attitude of students in student activities obtained through questionnaire sheets before and after the learning process.

Table 1. Criteria of Validity Level

Score	Criteria
$3.5 < \text{score} \leq 4$	Very valid
$2.5 < \text{score} \leq 3.5$	Valid
$1.5 < \text{score} < 2.5$	Enough valid
$\text{Score} \leq 1.5$	Invalid

Data analysis of student responses to the learning implementation conducted by counting the number of students who gave positive responses in accordance with the aspects were asked in the student response sheet. The statements on the student response sheet included attractiveness, easiness, helpfulness, and problem solving. The learning effectiveness criteria can be seen in Table 2.

Table 2. Criteria of Learning Effectiveness

Range	Criteria
3.4 to 4	Very effective
2.6 to 3.3	Effective
1.7 to 2.5	Less effective
1 to 1.6	Ineffective

To test the effectiveness of the learning tools also used data on scientific attitude of students which be analyzed by using the scoring guidelines in Table 3.

Table 3. Guidelines of Scientific Attitude Scores

(+) statement	score	(-) statement	Score
Strongly Agree	4	Strongly Agree	1
Agree	3	Agree	2
Disagree	2	Disagree	3
Very Disagree	1	Very Disagree	4

To avoid statements with a score of 0, researchers ensure that students answer all scientific attitude statements After analyzing the data using the guidelines for students' scientific attitude scores, the scores are then made in

percentages and stated in the Table 4 (Arikunto, 2015) :

Table 4. Criteria of Scientific Attitude Percentages

Rating scores	Criteria
86% - 100%	Very good
71% - 85%	Good
56% - 70%	Good enough
41% - 55%	Not good enough
> 40%	Not good

RESULTS AND DISCUSSION

In this study, learning tools developed were the teaching materials and semester learning plan (RPS). The learning tools development procedure in this research modifies the steps in the research and development of Gall et al, (1996), including, 1) needs analysis, 2) planning, 3) initial product format development, 4) validation of initial product, 5) revision of initial product, 6) trial of small groups, and 7) revision of product. In detail, the steps in the research and development are described as follows:

1) Needs analysis

In this research, needs analysis is also conducted on the applicable curriculum. It is known that the curriculum in Science Education Department contains food security course which are compulsory course from Universitas Sultan Ageng Tirtayasa, Indonesia. With this course, it is demanded that course can support food security course in the Science Education Department is food chemistry course. In the course of food chemistry, learning tools are developed based on food security so that the University's compulsory courses can be integrated with existing courses in Science Education Department. In needs analysis step, researchers developed the width of the written interview as supporting the data needed. The written interview sheet consists of indicators of food security state in the requirement and environment of science teacher candidates in food chemistry course.

2) Planning

In the planning step, researchers conducted an analysis of the macro content of food chemistry and food security, Science Education Department Learning Outcomes (CPPS) and Courses Learning Outcomes (CPMK) which can be seen in Table 5.

Table 5. Macro Content of Food Chemistry and Food Security

Aspect	Macro content
Food Chemistry	Protein
	Carbohydrate
	Vitamin
	Fat
	Mineral
	Water
Food security	Food additives
	Food availability
	Access to food
	Food stability
	Utilization of food

3) Development of initial product format

The step of product development is carried out by preparing a draft of textbooks and semester learning plan (RPS) based on food security which is expected to increase the scientific attitude of students on food chemistry course. Teaching materials are developed based on macro content of food chemistry and food security, while semester learning plan (RPS) is arranged based on the reference to learning outcomes of Science Education Department and course learning outcomes.

4) Validation of initial product

This activity is carried out to review the initial product that has been developed and provide feedback for improvement. This validation process is called expert judgment. Expert judgment was carried out by 2 experts in their fields who are undergraduate lecturers of Science Education Department and the results can be seen in Table 6. Those lecturers if viewed from their educational and occupational background at this time are very suitable with the expertise needed to become the validators.

Table 6. Expert Validation Results

Tools	Average	Criteria
Teaching materials	3.8	very valid
Semester learning plan (RPS)	3.9	very valid
Assesment Instrument of Scientific Attitude	3.8	very valid
Assesment Instrument of Student Response	3.9	very valid

If the learning tools which has been arranged fulfill construct validity and content validity, then the learning tools is said to be valid (Akker et al, 1999).

5) Revision of initial product

Revision of learning tools is in the form of teaching materials and semester learning plan (RPS), and assessment instruments in the form of questionnaire on scientific attitude and students' response to learning tools based on the results of the assessment in the form of feedback and suggestions from the validators. If the product developed has been revised and declared valid, then the product is ready to be tested.

6) Trial of small group

After learning tools are validated and according to the results of the assessment declared valid, then learning tools is ready to be trialed in the classroom learning. Its trial is conducted on small groups by involving students of science education department. The aim of this test is to collect information in

the form of the effectiveness of learning tools that can be used as material to improve products in the next revision analysis. Information collected in the test is in the form of students' scientific attitude questionnaire responses and the students' questionnaire responses to learning tools. Percentage recapitulation of initial and final scores of scientific attitude of students can be shown in Table 7.

Table 7. Scientific Attitude of Students

	Scientific attitude			
	Min.	Max.	Ave-rage	Cate-gory
Initial	58.7	76.9	68.2	Good eno-ugh
Final	80.8	92.3	86.5	Very good

Table 7 shows the category of scientific attitude at the beginning before using food security-based learning tools are in good enough category, while the final scientific attitude after learning to use food security-based learning tools are in very good category. This was caused by the learning process arranged in semester learning plan (RPS) and teaching materials provided supported the development of students' scientific attitude. Figure 1 shows the state of students' scientific attitude in every indicator such as cultivating curiosity, prioritizing evidence, accepting the differences, being able to work together, being positive towards failure, and sensitizing to the environment.

Many factors affect a person's attitude, one of them is a scientific attitude which have been stated by Baruch et al (2016) that several factors are very influential in the formation of this attitude include personal experience, others who are considered important, emotional factors in themselves, and culture in neighborhood environment. Ataha and Ogumogu (2013) said that there is a requirements for science educators to teaching science to the students, so they would be aware that characteristics of personal play roles in scientific knowledge acquisition. To be consistent, attitude must survive in individuals for a long time. This is consistent with the opinion of Lang & Evans (2006), that scientific attitude will emerge in students if they are continuously strengthened. So, to develop scientific attitude of students optimally, it takes a long and consistent time. Jiang and Mc. Comas (2015) described that inquiry method in science teaching and learning has been supported by the Standard of National Science Education, but most of the empirical evidence was revealed in study settings than in environments of normal school.

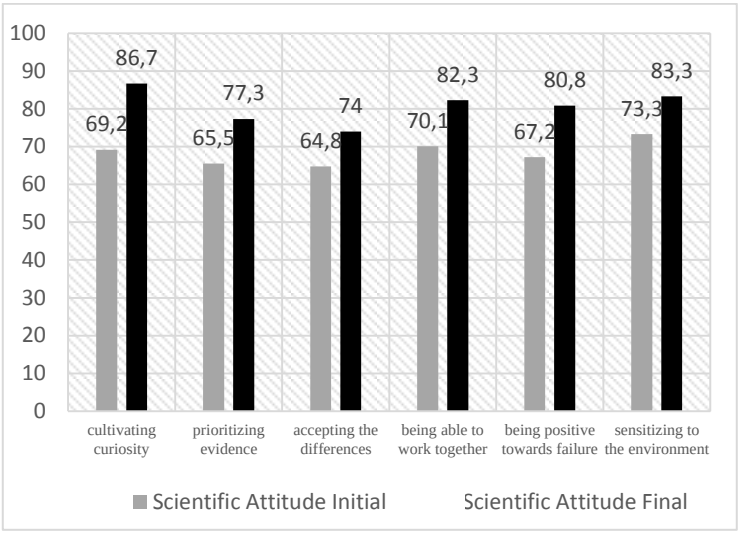

Figure 1. Graph of Students' Scientific Attitude

In Olasehinde and Olatoye (2014) revealed that attitude to science and scientific attitude do not estimate achievement of science significantly. Attitude to science and scientific attitude has positive trend but in science achievement, it is not significant.

Furthermore, in the small group trial step also obtained data on the effectiveness of learning tools developed through responses given by students at the end of process learning. The response to questionnaires in this study is in a Likert scale with 4 assesment categories, namely: strongly agree (score 4), agree (score 3), disagree (score 2), strongly disagree (score 1). The choice of the four scales response is chosen so that there is no opportunity for the respondents to be neutral, so the students' attitude towards the statement given can be more objective. Response questionnaire sheets were developed based on the aspects of attractiveness, easiness, helpfulness, and problem solving. The data analyzed were determined by the criteria based on Table 8.

Table 8. Criteria of Learning Effectiveness

Range	Criteria
3.4 – 4	Very effective
2.6 - 3.3	Effective
1.7 - 2.5	Less effective
1 - 1.6	Ineffective

(Rajabi et al, 2015)

Recapitulation of the analysis results of student responses data is shown in Table 9.

Table 9. Recapitulation Results of Student Response Analysis

Assesment aspects	Ave-rage	Criteria
Attrac-tiveness	3.85	Very effective
Easiness	3.77	Very effective
Helpfulness	3.8	Very effective
Problem solving	3.78	Very effective

The students' responses to learning tools based on food security for every aspect of the criteria are in very effective category. Based on analysis results from four components of the effectiveness of learning tools developed are in very effective category. The number of students who reached the category of very effective more than 80%, so it can be concluded that learning tools designated fulfilled the effectiveness category.

7) Revision of product

Revision of product after small groups trial is carried out if during the small groups trial process, there is a lack of both teaching materials and semester learning plan (RPS). This revision will determine the sustainability of the product trial steps to a larger scale.

CONCLUSION

Food security-based learning tools developed are proper for using in food chemistry course because after going through the stages of validation, small groups trial, and product revision, the validity criteria of learning tools are in very valid criteria and based on the effectiveness test of learning tools are in very effective criteria. Food security-based learning tools developed can also build scientific attitude of undergraduate students on very good criteria. The next, will be implemented in the large-scale trial to get the final product of Food security-based learning tools.

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