JPII 5 (1) (2016) 22-30

Jurnal Pendidikan IPA Indonesia

http://journal.unnes.ac.id/index.php/jpii

THE DEVELOPMENT OF SCIENTIFIC-APPROACH-BASED LEARNING INSTRUMENTSINTEGRATED WITH RED ONION FARMING POTENCY IN BREBES INDONESIA

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DOI: 10.15294/jpii.v5i1.5785

Accepted: 4 January 2016. Approved: 25 March 2016. Published: April 2016

ABSTRACT

This study aimed to describe the eligibility category of science learning instrument based on scientific approach integrated with onion farming potency. Also, this study aimed to analyze the effectiveness of the application of the science learning instrument in terms ofscience process skills development and the cognitive learning outcomes in the student of class VII SMPN 1 Bulakamba.This study used thedevelopment research methods by adapting the 4D model that includes define, design, develop, and disseminate. The learning instruments developed in this research were the learning implementation plan (RPP) and the student worksheet (LKS). The data collection was done by using non-test technique using interview guides, product validation sheet, students' response sheet to the readability of LKS and the instructional observation sheets; as well as using theworksheet of process skills and cognitive learning outcomes. The results showed that the eligibility of the science learning instruments integrated with onion farming potency was categorized as excellent. The application of scientific-approach-based learning instruments was effective to improve the process skills and the students' cognitive learning outcomes in class VII SMPN 1 Bulakamba.

Keywords: onion farming in Brebes, science learning instruments, scientific approach.

INTRODUCTION

Red onion (*Allium cepa* var. *Ascalonicom*) is one of Indonesia's leading horticultural commodities (Wahyudin et al., 2015). The demand of red onion for consumption and its seeds has continued to increase by year (Sumarni et al., 2012). Red onion is usually used as a spice in cooking and is also often used as as a traditional medicine for wounds, stomach ulcers, colds, lowering thesugar level and loweringthe cholesterol level in blood (Princess &Watemin, 2014).

Brebes district in Central Java is the main red onion supplier in Indonesia. In 2014, the area of red onion farms in Brebes district reached 30,954 ha with a total production 375,974 tons. This production reached 72.39% of the total red onion production in Central Java. The 2014 red onion production obtained from Brebes district has increased by 71,217 tons compared to the total production in 2013 (BPS Central Java, 2015).

The farmers have succeeded to develop thered onion as the potential and main commodityas a regional identity of Brebes. They have a particular way on cultivating the red onion that can be categorized as a local genius. Their knowledge on the red onion cultivation has been maintained from generation to generation without any scientific explanation on how to grow the onions. They are taught directly by the ancestors in obtaining the onion farmin method (Khusniati, 2014).

The red onion farming has a main contribution for society towards economic function, i.e. as a source of earnings. People can work either

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as farmers, farm laborers, or onion seller. As an object of learning, the onion farms are promising to provide the alternative learning resources for science topics, such as biodiversity, and ecosystems. Nana & Salamah (2014) studied the growth mechanism process of onion plants by coconut water addition as a source of biology learning in high school students Class XII. The utilization of the onion farming potential as a learning resource is a form of the implementation of the National Education System law number 20 year 2003 article 36. It is kind of a mandatory for the school to prepare the curriculum which involves the local wisdom, biodiversity and the environment potencies. The mandate provides a great opportunity for teachers in Brebes to raise the agricultural potency of onion into learning materials.

The opportunity to raise the issue of red onion agricultural potency into science teaching is still rarely done by the science teacher in Brebes. The results of the interview with the science teacher at SMPN 1 Bulakamba Brebes revealed that some teachers have been usingthe local potencies as the learning material. However, it is still limited to a specific material and has not been raised explicitly in the lesson plandocumentsor *rencana pelaksanaan pembelajaran* (RPP). The local potency has also been utilized in the students' scientific project group or *karya ilmiah remaja* (KIR) and in the craft study subject. There were some technical problems and obstacles faced by teachers when utilizing local potencies in learning activity and it were limited to a particular study material. The technical problems were related to the lack of guidance on how to integrate theobject of local potencies into the RPP. The local potencies are limited to a particular topic of study; therefore, it could not be applied to all science learning materials.

The integration of the onion agricultural potency on science learning should have a goalto be a student learning whole achievement in accordance with the nature of science, i.e. science as a process, knowledgeproduct, the attitude development, and science application (Erina & Kuswanto, 2015; Pratiwi, et al ., 2014; Yanti, et al., 2013). The science processes are related to the problem solving procedures through scientific approaches. For example, curiosity and openended skills are included in the scientificattitude, whereas the facts, principles, theories, concepts, and law are included as the science products. Moreover, the science application is related to the application of scientific methods and concepts of science in everyday life.

Science learning as a process provides the opportunity for students to interact with the science objects and actively engage in the process skills (Abungu et al., 2014). The science process skills are the reflection of thinking skills scientific methods used by the sciencetist for building the knowledge (Sheeba, 2013; Özgelen, 2012).Science process skills are the basic of IPA problem solving in the scientific method (Wilujeng, et al., 2010). Moreover, the development of processing skilss at school could help the students to learn how to solve the problems (Abungu et al., 2014), to develop learning through experience (Rauf et al., 2013), to improve learning outcomes (Ergul et al., 2011; Wardani et al. 2009), and to improve creative thinking skills (Rahayu et al., 2011). The development of process skills also helps students to think logically, to think critically, to ask reasonable questions, and to seek answers that can solve problems in everyday life (Ergul et al., 2011).

The results of a preliminary observation on the learning process in high school students showed a fact that some process skills such as observing, measuring, predicting and communicating were not observed in the learning process. These facts indicated that science learning process skills was needed to be improved. Based on the results of interviews with the science teacher at SMPN 1 Bulakamba the aspect of knowledge (cognitive) also needed to be improved. Some teachers realized that there were who have not reached the minimum completeness of the specified criteria. The results of the midterm test (*ulangan tengah semester*) 1 in the academic year 2015/2016 in SMPN 1 Bulakamba showed that the average scores of seventh grade students in the science subjects only reached 65.8. Students who achieve the minimum criteria only reached 13.10% or 11 students out of 82 students (VII. C 42 students; VII.D 42 students).

One of efforts to develop the process skills and to increase the students' cognitive learning outcomes can be made by applying the learning activities that emphasize the student active involvement (Akinbobola & Afolabi, 2010) or the practice of scientific investigations (Ango, 2002). Moreover, an effort that can be done is to adopt a scientific approach. Scientific approach is a learning approach that emphasizes the process skills (Sujarwanta, 2012). Learning activities with a scientific approach includes activities to observe, to ask, to gather the information, to associate, and to communicate (Wijayanti, 2014). Results of Yeni et al. (2015) and Machin (2014) studies showed that the application of a scientific approach for learning showing a positive effect on the cognitive learning, affective and psychomotor.Marjan et al. (2014) reported that a scientific approach to improve learning outcomes and basic science process skills of students. Wijayanti (2014) reported that the implementation of project-based authentic assessment with effective scientific approach could improve the scientific thinking skills.

Machin (2014) mentioned that the scientific approach was the application of contextual learning. As a contextual learning, scientific approach can be integrated with contextual learning resources around the students, such as agricultural potential. Knobloch et al. (2007) stated that agriculture provided a context for discussing the relationship between nature and human needs. Çepni et al. (2011) research results showed that the use of agricultural assisted modules of student worksheets or *lembar kerja siswa* (LKS) was effective in developing a conceptual understanding of elementary school students on the concept of agriculture. Mabie & Baker (1996) reported that the participation of students in agriculture-oriented activities have positive impact on the development of science process skills of students which include observing skills, communication, compare, connect, order, and concludes. The use of the agricultural context by Balschweid (2002) on the biology learning could help students in understanding the relationship between science with agriculture.

The scientific approach and the utilization of agricultural contextual learning resources could be applied to overcome the problems of students' process skills and cognitive learning outcomes in class VII SMPN 1 Bulakamba using the adoption of an integrated scientific approach with the agricultural potency of onion. The use of integrated learning instruments could provide an answer for some problems in scientific learning, noting some of the constraints faced by teachers in implementing these efforts. This study aimed to describe the eligibility criteria and to analyze the effectiveness of learning instruments based on scientific approach application which integrated with the onion agricultural potency in terms of the process skills improvement process and the cognitive learning outcomes in students of class VII SMPN 1 Bulakamba.

METHODS

This research used the method ofresearch and development which adapted to the 4D model of Thiagarajan et al. (1974).The research stages included the define, design, develop, and disseminate. In this study, the products developed was in the form of science learning instruments based on scientific approach which integrated with the agricultural potential of red onion in Brebes, i.e. lesson plan documents or *rencana pelaksanaan pembelajaran* (RPP) and student worksheet or *lembar kerja siswa* (LKS). Products were developed to improve the science process skills and cognitive learning outcomes in the seventh grade of junior high school students on the topic of science object and observations.

Product trials were conducted in October to December 2015 at SMPN 1 Bulakamba Brebes. Product trials were conducted in two phases, namely the limited field trial (trial I) and the main field trial (trial II). The first trial was carried out in the non-class samples to analyze and to gain direct input in the form of responses, reactions, comments of teachers and students. The first trial was conducted on the subject amounted to 12 students of class VII.

The first trial test design used the method of pre-experiment with a one-group pretest-posttest design (Sugiyono, 2012). The second trial test used thequasi-experiment with non-equivalent control group design (Sugiyono, 2012).

The second trial test used two classes, i.e. the class that applied the learning instruments based on the scientific approach which integrated with the red onion agriculture potency (as an experimental class)and the control class without integrated learning tools. The experimental class and control class were selected with preceded by pre-test and post-test. There was a span of time between the pre-test and post-test, thus the results were not affected by the pre-test and post-test.

The subject of this study was the students of class VII SMP N 1 Bulakamba Brebes in first semester of academic year 2015/2016. The subjects to limited trial (trial I) were 12 students of class VII were selected randomly.The main subject of field trials (trial II) composed of class VII A and VII B selected from nine classes of grade VII in SMPN 1 Bulakamba. The determination of the experimental class and the control class was done randomly with the results of class VII A as an experimental class and class VII B as the control class.The data collection was done by (1) non-test techniques using interview guides, product validation sheet, students' worksheet response to the readability and instructional observation sheets; and (2) the testing techniques used a booklet about the process skills and cognitive learning outcomes sheet.

The feasibility of learning instruments and student response to the legibility of worksheets were analyzed qualitatively based on the classification of four categories, namely: (1) very good: the interval score $3.25<X\leq4.00$; (2) good: $2.50<X\leq3.25$; (3) Poor: $1.75<X\leq2.50$; and (4) very poor: $1.00\leq X\leq1.75$. The table of four categories classification was arranged according to the guidelines of Widoyoko (2012).

The implementation of science learning using scientific-approach-based learning integrated with the agricultural potential of onion were analyzed by calculating the percentage of enforceability of learning activities aspects on the observation sheet. The result of the calculation of the implementation adherence percentage with the classification of four categories, namely: (1) very good: 75% percentage interval $<X\leq100\%$; (2) either: 50% $<X\leq75\%$; (3) poor: 5% $<X\leq50\%$; and (4) very poor: 0% $\leq X\leq25$.

The improved learning outcomes were analyzed based on the normalized gain average score ($<g>$) using the following equation.

$$< g >= \frac{< \%post > - < \%pre >}{100 - < \%pre >}$$

Description:

$<g>$ = average score of normalized gain

$<\%post>$ = average percentage of post-test score gained by students

$<\%pre>$ = average percentage of pretest score gained by students (Hake, 2007).

Value ofobtained $\langle g \rangle$was consulted with three categories, namely (1) high: $\langle g \rangle \geq 0.7$; (2) medium: $0.3 \leq \langle g \rangle <0.7$; and (3) low: $\langle g \rangle <0.3$ (Hake, 1998).

The effectiveness of the application of the learning instruments in the first trial was analyzed based on the normalized gain average score gain and Wilcoxon tests. The effectiveness of second trial was analyzed based on the normalized gain average score and multivariate Hotelling's Trace test to normalized gain score of each student. The normalized gain score for each student (g) obtained by the following equation.

$$g = \frac{postscore\% - prescore\%}{100 - \%pretest}$$

Description:

g = normalized gain score

% postscore = percentage of students' post-test scores

% prescore = percentage of students' pre-test scores

(Coletta et al., 2007)

RESULTS AND DISCUSSION

The result of this study was an end product; a scientific-approach-based learning instrument integrated with red onion agriculture potency in Brebes, Central Java Indonesia. The implemented activities of scientific approach were observation, formulate questions, data collection, data association, and communicating the results. The developed learning instruments were the lesson plan documents (RPP) and student worksheet (LKS) on the subject of science object and its observation in class VII first semester.

RPP was designed with reference to the format of the Regulation of the Minister of Education and Culture (Permendikbud) No. 103 year 2014 on Education in Primary and Secondary Education. RPP components include 1) the identity of the school/ madrasah, subjects, and grade/semester; 2) time allocation; 3) KI, KD, and indicators of achievement of competencies; 4) learning materials; 5) learning activities; 6) assessment; and 7) media/instruments, materials, and learning resources.

Learning activities in RPP was designed for five meetings with the allocation of 12 hours of lessons (JP). The learning activities were designed with the strategy of indoor and outdoor learning. The indoor learning strategy was designed at the meeting of the 1st, 3rd, and 4th. While outdoor learning strategy was designed at the 2nd meeting. The first meeting was designed to study the science objects sub topics and process skills a 2-hour lesson or *jam pelajaran* (JP). The second meeting was completed to study the unit and measurements sub topics with time allocation of 3 JP. The third meeting was conducted to study the sub-topic of the principal scales with 2 JP time allocations. The 4th meeting was used to study the derivative scales sub topics 3 JP time allocations. Lastly, the 5th meeting was designed for the implementation of the review tests and the with 2 JP time allocations.

LKS was developed to support the learning activities that have been designed on the RPP. LKS components include title, introduction, objectives, tools and materials, work step, observation data, a list of questions and conclusions. LKS is designed with five activities as follows.

LKS 01 Red onion observation

LKS 01 was designed to be used in the first meeting to guide the students to observe the onion as a science object and to introduce some of the science process skills such as observing, estimating, classifying, measuring, inferring, and communicating.

LKS 02 Measuring the science object in red onion fields

LKS 02 was designed to be used in the second meeting to guide students in doing the measurement of science objects in the red onion fields.

LKS 03 Measure the principal scales of red onions

LKS 03 was designed to be used in the third meeting to guide the students to perform the measurements on the principal measurement of onion.

LKS 04 Measurement of the derivative scales in onion

LKS 04 was designed to be used in all four meetings to guide the students to perform the derivative scales measurement of quantities in onion.

LKS 05 Measuring the growth rate of red onion

LKS 05 was designed to guide students in determining the rate of growth of the onion. LKS 05 was part of the 4th meeting of the activities carried out outside regular instructional hours. Information in LKS 05 activities were presented at the 1st meeting.

The results of the feasibility assessment of RPP by eight validators are presented in Table 1. Table 1 notes that RPP developed included in the excellent category with an average score reached 3.86. The results of the assessment of the validator showed that the developed RPP was eligible for use in the learning process after being revised in accordance with the advice and input from the validator.

The results of the worksheets feasibility assessment are presented in Table 2. Table 2 note that the worksheets that were developed included in the excellent category with an average score reached 3.76. The results of the assessment indicated that the developed LKS developed was eligible for use in the learning process after being revised in accordance with the advice and input of the validator.

The worksheet eligibility is strengthened by the results of student questionnaire responses on the worksheet legibility in the aspects of the views presented in Table 3. According to Table 3 it can be seen that the presentation of the image and the performance was categorized as an excellent; such as the layout of images, tables, and statements; also the display name, description, instructions, pictures, tables, and questions were very well categorized; and the use of language was very good. In general, all aspects of the worksheets were excellent according to the students' opinion.

The feasibility of the developed learning instruments were also supported by the ease of teachers in implementing the learning instruments. Results of the trial I indicated that the category of the implementation of learning aspects were observed on-one meetings to include both categories (73.33%), whereas the second meeting was in good category (70%), the third meeting was good (73.33%), and lastly, the fourth meeting was excellent (76.67%). The percentage of the

Table 1. Results of the feasibility assessment of RPP

Aspects	Average Score	Category
Formulation of RPP	3.88	Very good
Time allocation	3.88	Very good
Formulation of core competencies (KI), basic competencies(KD), and competency achievement indicators	3.75	Very good
Selection of learning materials	3.88	Very good
Formulation of learning activity	3.88	Very good
Formulation of assessment, remedial learning and enrichment	3.97	Very good
Selection of media/tools, materials and learning resources	3.81	Very good
Average	3.86	Very good

Table 2. Results of the worksheets feasibility assessment

Aspects	Average score	Category
Material presentations	3.80	Very good
Activity planning aspect	3.98	Very good
Performance	3.50	Very good
Average	3.76	Very good

Table 3. Results of student response on theworksheet (LKS) Readability

Aspects	Average score	Category
Image presentation and performance	3.67	Very good
Images, tables, and questions layout	3.17	Good
Presentation of title, description, instructions, pictures, tables, and questions	3.58	Very good
Language usage	3.67	Very good
Average score	**3.52**	**Very good**

implementation aspects were observed increased in major field trials (trial II), namely to 83.33% at the first meeting, 86.67% at the second meeting, 85.00% in third meeting, and 86.67% in the 4th meeting (Figure 1).

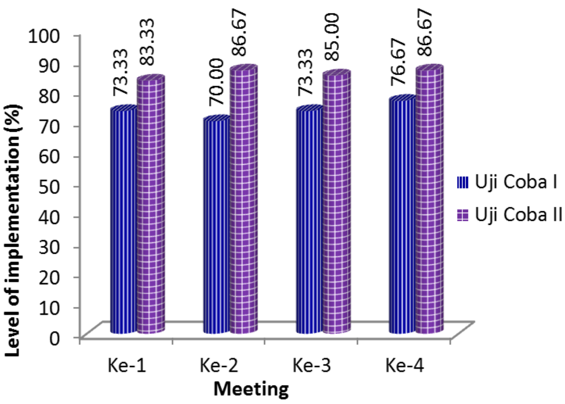

Figure 1. Learning implementation level in trial I and II

The effectiveness of the application of scientific-approach-based learning instruments integrated with the agricultural potential of red onion known through limited field trial and the main field trials. Based on limited testing, it showed that the application of the developed learning tools could increase the skills and the cognitive learning process. The results of the analysis of the average score of normalized gain (<g>) showed the improvement of science process skills and cognitive learning outcomes in a medium category (Table 4).

Table 4. Gain category on the field limited trial test

Response variable	<g>	Category
Science process skills	0.38	Medium
Cognitive learning outcomes	0.54	Medium

The improvement of skills in every aspect of the science process skills as measured on a field trial test can be seen from a comparison of the percentage of the acquisition of science process skills scores obtained by all students at the post-test and pre-test which presented in Figure 2.

Based on Figure 2 it can be seen that the post-test score was higher than the pre-test score. This result suggested that the skills of the students has increased after treatment.Test result data was paired with the value of pre-test and post-test with the Wilcoxon test to find out whether any changes on the process skills and the cognitive learning results after following the science learning by applying the learning instruments or not. Wilcoxon test that had been selected for sampling in limited trial did not meet the assumptions of normality and homogeneity.

Results of the Wilcoxon test for the skills acquired of Z value at -2.941 with Asymp. Sig 0.003; whereas the cognitive learning Z value was at -3.069 with Asymp value.Sig 0.002. All values Asymp. Sig. obtained were <0.05, which meant that there were the significant differences between the average value of pre-test and post-test of process skills, the cognitive learning, and environmental consideration attitude. Thus, based on limited trial, the application of the learning instruments was effective to improving the process skills and the cognitive learning.

The effectiveness of the learning instruments which developed based on scientific approach integrated with the onion agriculture potency on improving the process skills and cognitive learning was measured by comparing the average gain scores between the experimental class and control class. The results of the analysis of the normalized gain average score (<g>) on each class of test samples are presented in Table 5.

Based on Table 5, the improvement of science process skills in the experimental class and in the control class were categorized as medium. Based on the value of <g> the science process skills in the treatment class was (<g> = 0.54) greater than the control class (<g> = 43). The improvement in the cognitive learning achie-

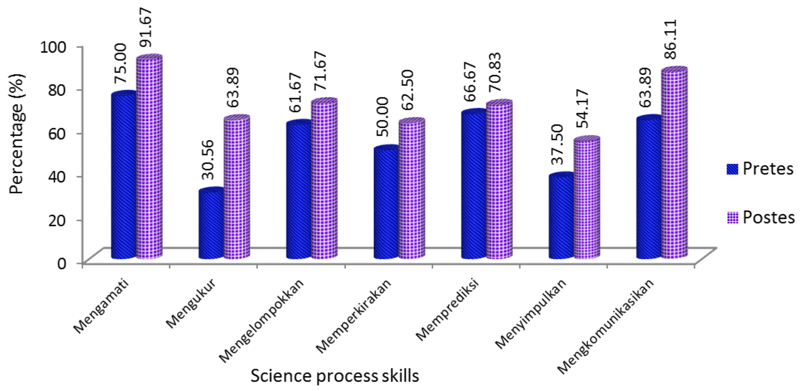

Figure 2. Percentage graph of gained scores in every aspect of science process skills of all students in the limited trial test

Table 5. Category of the improvement in the main field trial test

Response variables	Experimental class		Control class	
	<g>	Category	<g>	Category
Science process skills	0.54	Medium	0.43	Medium
Cognitive learning outcomes	0.50	Medium	0.47	Medium

vement of students in the experimental class and control class were categorized as medium. Based on the value of <g> the increase in cognitive learning outcomes in the experimental class (<g> = 0.50) was greater than in the control class (<g> = 0.47).

The comparison of process skills improvement based on the normalized gain average score in every aspect of skills was measured on each sample are presented in Figure 3. Based on Figure 3 it can be seen that the increase in every aspect of students' science process skills in the experimental class was higher than in the control class. The results of different test groups with Hotelling's Trace test obtained significance value of 0.036 (Sig. <0.05), which means that H0 was rejected. Thus there was a difference in the average score of science process skills and cognitive learning outcomes among students in the experimental class and the control class. This means that the application of the learning instruments was more effective to improve the process skills and cognitive learning outcomes of students in class VII SMPN 1 Bulakamba compared with the implementation of a learning tool used by teachers.

The results of limited and main trial tests showed that that the application of the integrated learning instruments was effectively improve the skills and cognitive learning outcomes of students. The results were consistent with the results of research of Marjan et al. (2014) which showed that the application of scientific approach can improve the skills of process and biology student learning outcomes. The results of this study were also consistent with the results of research Yeni et al. (2015) and Machin (2014) which showed that the application of scientific approach gave the positive effect on improvement of cognitive learning outcomes. The application of scientific-approach-based learning could improve the skills of the operational process because the scientific approach was emphasized on process skills (Sujarwanta, 2012). The main activity of the scientific approach, such as observing, asking, gathering the information/data, associating the information, and communicating skills was the implementation of the process itself. Learning that emphasizes process skills can help students to improve student learning outcomes (Ergul et al., 2011; Wardani et al., 2009).

The effectiveness of the learning instruments in this study was in accordance to the results of Mabie & Baker (1996) study which suggested that the participation of students in agriculture-oriented activities had shown the positive impact on the development of science process skills of students. The results of this study were also consistent with the results of research Balschweid (2002) which showed that the use of agricultural contexts could help students to understand the relationship of science to agriculture. The integration of the agricultural potential of onion in learning instruments was in line with the basic theory that asserts the importance of experiential learning activities in the learning ex-

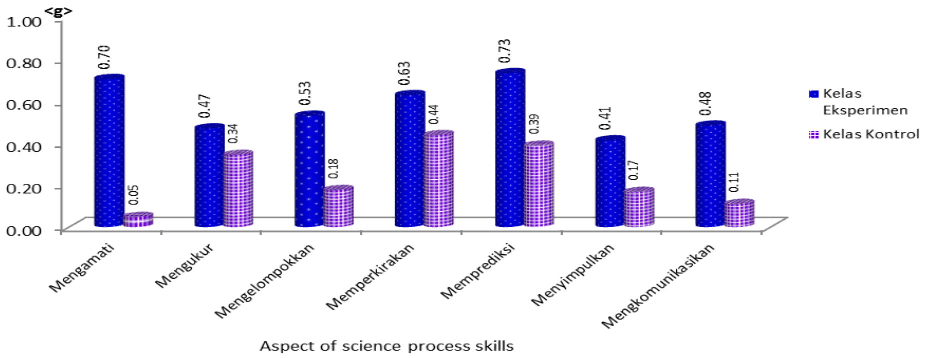

Figure 3. Comparison graph <g> of every aspect of science process skills between the experimental class and control class in the main trial test

perience (Healey & Jenkins, 2000; Knobloch et al., 2007). Basic theory of learning experiences shows that the relationship between context and content gave the students the chance to learn and transfer the overlapping concept that is complementary (Balschweid, 2002).

CONCLUSION

Based on the results and discussion of research and development of science learning instruments it can be concluded that: (1) the eligibility of integrated science learning instruments was in excellent category for its lesson plan and students' worksheets; and (2) the application of scientific-approach-based learning instruments was effective to improve the process skills and cognitive learning outcomes of students of class VII SMPN 1 Bulakamba.

The application of the integrated learning instruments was to improve science process skills and cognitive learning outcomes of students on the topic of science objects and observations in SMP Negeri 1 Bulakamba. Scientific approach recommended by Permendikbud no. 65 year 2013 on Standards for Primary and Secondary Education Process concurrently with the implementation of Curriculum 2013 in some schools/areas. Accordingly, the science teacher in Brebes and other areas with onion agriculture potencies can utilize the learning instruments developed for the learning process on the topic of science object and observations. Further research can be conducted to determine the effectiveness of an integrated scientific-approach-based learning instrument in the other science subjects.

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