Jurnal Penelitian dan Pembelajaran IPA JPPI
Vol. 6, No. 2, 2020, p. 283-301 p-ISSN 2477-1422 e-ISSN 2477-2038

# Teaching Science Books Based on *Bakpia* Local-Potential to Improve Students' Critical Thinking and Communication Skills

**(**Received 2 August 2020; Revised 22 November 2020; Accepted 22 November 2020)

**Wilda Muhimmatun Nisa [1], Insih Wilujeng[2*]**

[1]Department of Sceince Education, Graduate School,
Universitas Negeri Yogyakarta, Yogyakarta, Indonesia

Corresponding Author: *insih@uny.ac.id

**DOI: 10.30870/jppi.v6i2.8716**

## Abstract

This study is aimed at determining the effectiveness of the use of a science textbook integrated with the local potentials of *bakpia* in improving the critical thinking and communication skills of the junior high school students. The study was a quasi-experiment with a pretest-posttest control group research design. The experiment and control groups were taken by cluster random sampling by considering the location of the school, which is within proximity of the local potentials in question. The study was conducted in the 7$^{th}$ grade, at one of the junior high schools in Yogyakarta, both for the experiment and control classes. The research instruments were an open-reasoned multiple-choice test and observation sheets to obtain data on students' critical thinking skills and communication skills. Data analysis was done by the Manova difference test assisted by the SPSS 2.0 computer program with a significant value lower than 0.05. Results showed that the value of the partial *Eta* squared from the Manova test was 0.981, indicating that the effectiveness of the science textbook integrated with the *bakpia* local potentials to improve students' critical thinking and communication skills was in the "high" category. The test of between subject effects of the Manova test showed a significance value of students' critical thinking and communication skills of less than 0.05. Therefore, it can be said that the science textbook was effective in increasing students' critical thinking and communication skills, simultaneously. A limitation to the study can be in the fact that the study is not conducted directly in the *bakpia* factory and that it involves only 60 subjects for both the experiment and control groups. The integrated textbook of *bakpia* local potentials can be used as a reference for future researchers with other local potentials. The local potential integrated book can also become an alternative-learning mode, e.g.: based on STEM, with materials suitable for local potentials in other regions.

Keywords: Integrated Science Teaching Book, Local Potential, Critical Thinking, Communication Skill

## INTRODUCTION

Science learning is expected to introduce the environment, nature, and excellence of a region (Wibowo, 2013). Learning with integration of local potentials is still rarely done because of many obstacles, such as lack of teachers' understanding in integrating local potentials with an appropriate topic and great distance between the location of the local potentials and the school so that it requires a lot of money and time to visit local potential sites (Widyaningrum, Sarwanto and Karyanto, 2013). The use of teaching books integrated with local potentials is needed so that the learning process will be in accordance with the conditions of the school environment and support the basic framework and curriculum structure of the junior high school science topics. Integrating learning with local potentials has an important role in the 21st century learning (Jumriani and K. Prasetyo, 2017), i.e.: it can train students to discover various facts and build concepts holistically, meaningfully, authentically, and actively, that will lead to 21st century skills which include creative processing, critical thinking, communicating, and collaborating (4C). These skills can help students prepare themselves for the current global era, which is undergoing many changes (Ormerod, 2013; Dwiyogo, 2017; Erdogan, 2019). These changes also demand that education must develop students' critical thinking at all levels (Zhou, Huang and Tian, 2013).

One of the 21st century skills that must be taught explicitly in the learning process is the critical thinking skill. Students who have mastered critical thinking skills tend to be able to quickly identify information, learn problems systematically, formulate innovative questions, utilize ideas or information, and evaluate and modify to produce the best ideas (Karakoc, 2016; Hidayah, Salimi and Susiani, 2017). Learning that can improve critical thinking has not been developed (Santos, 2017), in fact, based on preliminary studies that has been done, students' critical thinking is still low so that it must be improved (Nisa, Nafiah and Wilujeng, 2020). This is because the learning process in schools is still dominated by teachers so that students' critical thinking skills are still low (Utami, Ramalis and Saepuzaman, 2016; Nisa, Nafiah and Wilujeng, 2020). Students only memorize rather than develop the power of thoughts during the learning process, so that students are weak in conveying ideas and analyzing and they tend to be dependent on others (Patonah, 2014; Hadi, Susantini and Agustini, 2018). When students are not encouraged to think critically, they tend to lack communication abilities (Bakic-Tomic, Dvorski and Kirinic, 2015). On

the other hand, students who have good critical thinking skills can communicate important ideas (Hidayah, Salimi and Susiani, 2017).

The communication skill is one of the life skills, so that the ability to process and produce knowledge needs to be developed in science learning (Bakic-Tomic, Dvorski and Kirinic, 2015; Suyatna *et al.,* 2018). Communication skills need to be taught to equip future scientists with written or oral communication skills (Brownell, Price and Steinman, 2013; Sari, Murni and Sjaifuddin, 2016). Lack of communication skills still occurs in schools. Learning in the class is passive because the majority of classroom interactions are limited to teachers and students and teachers lack socialization in teaching (Brownell, Price and Steinman, 2013; Sari, Murni and Sjaifuddin, 2016). It is from this fact that learning has not been integrated with innovative learning models (Sari, Murni and Sjaifuddin, 2016). Students' activities do not take into account explaining answers using the correct language, putting ideas into pictures, choosing to be a listener in discussions, and being brave to ask questions if there are difficulties (Yusof and Halim, 2014). Students' low communication skills are also influenced by their low self-confidence so that it is difficult for them to express suggestions when learning (Oktasari *et al.*, 2019; Siregar, Rosli and Maat, 2020). Very few students are active in communicating information causing the class to be passive.

Indonesia's current national education system provides excellent opportunities for teachers as implementers of learning to raise local issues that have the potentials to support learning. The natural-science subject matter in the Indonesian 2013 curriculum is highly relevant to be integrated with local potentials. However, in reality, science learning has not been linked to the local potentials existing around students (Setiawan and Wilujeng, 2016; Andriana *et al.*, 2017; Dewi *et al.*, 2017). Based on observations at one of the public Junior High Schools in Yogyakarta, the science teacher knows the local potentials around the school, but science learning never utilizes these potentials because the teacher does not understand how to integrate the local potentials with the science topics so that the teacher merely refers to the printed electronic school book unsupported by textbooks integrated with local potential contents. Science learning only uses textbooks printed by the government in which lesson examples may not be appropriate for certain schools. One public Junior High School in Yogyakarta has conducted practicum sessions but

still uses instructions from the electronic book that does not integrate local potentials. As a result, the practicum activities expected by the teacher to foster critical thinking have not been optimized. During the learning processes in class, teachers often give science teaching books to students, but the books are read individually and there are no discussions among students. Students answer their worksheet (in the teaching books) by only copying the answers onto their handbooks; so, it does not sharpen their critical thinking and communication skills.

As critical thinking and communication are 21st century skills to think and work, these skills must be possessed by students as early as possible so that students can process and apply what they learn (Vuojärvi, Eriksson and Vartiainen, 2019). Critical thinking can be improved through student-centered learning, which places students as individuals who have and need the knowledge activities to be developed into meaningful understanding (Rahayuni, 2016). This can also be applied to students' communication skills. By integrating learning with local potentials, students can know firsthand what is being learned so that the learning becomes more meaningful.

Indonesia is a country rich of local potentials in the forms of cultures and natural resources in each region. There are abundant regional potentials including local potentials related to the world of entrepreneurship, especially home industry. In this study, the local potentials raised as the research object is the home industry of *bakpia*, which is Yogyakarta's special pie. The science book integrated with the local potential of *bakpia* is expected to facilitate students with learning of tools and materials needed in the process of the pie production. The process of *bakpia* making consists of several steps where there are some scientific methods such as phase changes or transformations (e.g.: *bakpia* butter is mixed, then is made into a circular shape), chemistry changes (e.g.: the processes of soaking and roasting green beans), physical changes (e.g.: green bean lapping process by a milling machine), mixture separation (green bean swamping and filtering for three days). Furthermore, there are also basic materials regarding substances and their characteristics, good inputs of knowledge for the 7th grade students of the Junior High School.

Previous related study included the use of videos and natural science learning tools integrated with local potential (Agung, 2015; Lathifah and Wilujeng, 2016; Dewi, Suryadarma and Wilujeng, 2018; Nugroho and Wilujeng, 2019). However, the local potentials

mentioned in the textbook have not been used.

The research problems can be addressed by conducting learning that uses attractive, effective, and efficient textbooks. Hence, its application can motivate, guide, and lead students to learn. This study aims to determine the effectiveness of the use of science teaching books integrated with the local potentials of *bakpia* to improve the junior high school students' critical thinking and communication skills.

## METHOD

The study was conducted in the 7$^{th}$ grade of a Junior High School in Yogyakarta, both for the experiment and control classes. The students aged between 12 and 14 years old who took science subjects in the first semester of the 2019/2020 academic year. The experiment and control groups each consisted of 30 students. The experiment group was a class whose learning process was conducted using the science books integrated with the local potentials of *bakpia*. The research instruments were an open-reasoned multiple-choice test and observation sheets to find out the students' critical thinking and communication skills. The multiple-choice test was given to students before and after the treatment, while the observation was carried out during the treatment process (in four meetings each lasting for 120 minutes).

The critical thinking problem sheet consisted of 15 questions which had been tested by a validator in empirical validation to get the reliability of the questions. In the experiment class, the critical thinking problem sheet was integrated within the *bakpia*'s local potentials, while in the control class, the learning process did not have the *bakpia* integration. However, the type of problems or questions in both classes had the same critical thinking indicators. The critical thinking skill indicators were categorizing, stating results, expressing reasons, providing solutions, and making conclusion. The observation sheet, which was used to find the communication skills in both classes, had the same characteristics. Communication skill indicators in this study included verbal communication (active communication and delivery of observation) and non-verbal communication (presenting data in graphs or tables). The critical thinking items for the experiment class were subjected to the Pearson Correlation significance value. There were 16 valid items out of the 25 items tested with a Cronbach Alpha value of 0.746. The reliability of the experiment class items was included in the "high" category. Critical thinking items for the control class were also based on the Pearson

Correlation significance value. There were 17 valid items out of 25 items tested with a Cronbach Alpha value of 0.764. The reliability of the control class items was also included in the "high" category.

This study was a quasi-experiment method with a pretest posttest control group design. The experiment and control classes were taken using cluster random sampling by considering the location of the school with the local potentials raised. The learning process of the experiment class utilized the science book integrated with the *bakpia* local potentials. The independent variables of the study were the science book, i.e.: integrated with the *bakpia* local potentials and the electronic book. The dependent variables were students' critical thinking skills and communication skills. The research design can be observed in Figure 1. The study was conducted in four meetings (each meeting lasted for 120 minutes). The instructional process used the scientific approach consisting of five steps, i.e. observing, asking question, collecting information, associating, and communicating.

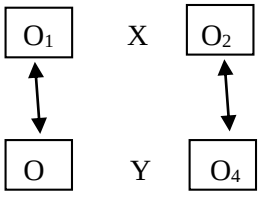


Figure 1. Pretest-Posttest Control Group Design

Information:

X = Learning process using Science Teaching Books Integrated with Local Potentials of "Bakpia"
Y = Learning process using electronic textbooks
$O_1$ = Pretest of critical thinking and communication in the experiment class
$O_2$ = Posttest of critical thinking and communication in the experiment class
$O_3$ = Pretest of critical thinking and communication in the control class
$O_4$ = Posttest of critical thinking and communication in the control class

The analysis of the effectiveness of the science book integrated with local potentials used the Manova difference test assisted by the SPSS 2.0 computer program with a significance value of less than 0.05. Before conducting the Manova analysis, there were eight assumption prerequisites that were passed to provide valid results, i.e.:

1) Assumption 1: Two or more dependent variables have to be measured in the interval or ratio level.
2) Assumption 2: The independent variable has to be more than two or more categories, i.e.: independent groups.
3) Assumption 3: If the observation is independent, then there can be no relation between observations in each group or between groups.
4) Assumption 4: There must be an adequate sample size

5) Assumption 5: There can be no *outlier* in each group of the independent variable groups for any dependent variable. The test assumption is from the results of the *box plot.*
6) Assumption 6: There should be multivariate normality. The testing assumption is done by *Kolmogorov-Smirnov* and *Shapiro Wilk* test with a significance level of 0.05.
7) Assumption 7: There should be a linear relation between every variable dependent pairs for every independent variable group. The testing assumption is seen by the value of linearity with a significance level of 0.05.
8) Assumption 8: There should be homogeneity of the covariant-covariant matrices. The testing assumption is seen by the value of *Levene's test* and *Box's M* with a significance level of 0.05.

The Manova test was used to know whether there were differences in the students' critical thinking and communication skills. The improvement value of students' critical thinking and communication skills can be determined from the value of the partial *eta* squared, whereas the results of the test of between subject effect analysis was used to state that the science book integrated with local potentials can improve students' critical thinking and communication skills, simultaneously. The use of the teaching science book integrated with local potentials is said to be effective in increasing students' critical thinking and communication skills if the significance level was less than 0.05.

## RESULTS AND DISCUSSION

The effectiveness of the science textbook integrated with local potentials is analyzed using the Manova test and satisfies all the eight assumptions of the prerequisite tests. The use of the Manova test is to determine the effect of the integrated textbook on local potentials in increasing critical thinking and communication skills, simultaneously. Assumptions 1 to 4 are carried out without statistical tests, while assumptions 5 to 8 use the application of the SPSS 2.0 statistical software program. The test of Assumption 1 is fulfilled with the existence of two dependent variables, namely critical thinking and communication skills. Assumption 2 is fulfilled because the independent variable is learning using the science book integrated with local potentials of *bakpia* and the electronic book. Assumption 3 is fulfilled because the observation independence is satisfied, which means that there is no relation between observations in each group. Assumption 4 is fulfilled because this study has a sample size of 30 students

each for the experiment and control classes.

Testing Assumption 5 that there are no outliers in each group of the independent variables for any dependent variable uses the Box plot test. The Box plot test results to determine univariate outliers in each variable are presented in Figures 2 and 3. Based on the box plot data, there are no outliers in the univariate data.

The multivariate normality test is done on each experiment and control class. The test uses the Kolmogorov-Smirnov and Shapiro-Wilk tests with a significance level of 0.05. The results of the multivariate normality test analysis of students' critical thinking and communication skills can be observed in Tables 1 and 2, respectively. Based on Tables 1 and 2, it can be seen that after the Kolmogorov-Smirnov and Shapiro-Wilk tests, the significance values of students' critical thinking and communication skills are greater than 0.05 both for the experiment and control classes. It can be deduced that the data of students' critical thinking and communication skills are normally distributed both in the experiment and control groups.

The linearity test is performed on the dependent variables, namely students' critical thinking and communication skills. The linearity test results can be observed in Tables 3 and 4. The linearity test results indicate that the correlation of each variable is significant. Significant correlations are concluded through sig. (2-tailed) for each variable correlation, which is smaller than 0.05. The linearity test results also show a positive correlation between students' critical thinking skills and communication skills.

The homogeneity analysis is tested using Levene's test and Box's M. The results of the homogeneity Levene's test can be seen in Table 5. Based on Table 5, it can be seen that the significance values of students' critical thinking and communication skills are greater than 0.05. Hence, it can be said that the students' critical thinking and communication skill data are homogeneous both in the experiment and the control groups. The Box's M homogeneity test results can be seen in Table 6. Based on Table 6, it can be observed that the value of Box's M test is 3.298 with a significant value of 0.365 (> 0.05). It can be said that the data are homogeneous. Hence, the test results are in accordance with the Manova's assumptions; therefore the analysis can be continued.

The Manova test is conducted after the prerequisite testing. The hypotheses in the Manova test are given as follows:

*$H_0$: There is no difference in the average of students' critical thinking and communication skills between the experiment and control groups.*

*$H_1$: There are differences in the average of students' critical thinking and communication skills between the experiment and control groups.*

The research hypothesis can then be decided after conducting the Manova test by looking at the significance value obtained. The results of the Manova test are presented in Table 7.

Based on Table 7, the significance value obtained from the Manova test is 0,000, which is smaller than 0.05. Hence, it can be concluded that $H_0$ is rejected and $H_1$ is accepted. Based on the results of the Manova test there is a significant difference between the average values of students' critical thinking and communication skills in the experiment and control groups. The improvement of students' critical thinking and communication skills can be seen from the Partial *Eta* Squared value. Based on Table 7, the Partial *Eta* Squared value is 0.981, which shows that the effectiveness of the science book integrated with local potentials of *bakpia* is in the "high" category.

The Manova test also provides the results of the test between subject effects. These results serve to show that the teaching science book integrated with local potentials of *bakpia* can improve students' critical thinking and communication skills. The test results can be seen in Table 8. The test results show that the significance value of students' critical thinking and communication skills is less than 0.05, so that there is a difference between the experiment and control groups after the treatment. Based on these results, the hypothesis is accepted so that the science book integrated with local potentials of *bakpia* can improve critical thinking and communication skills, simultaneously.

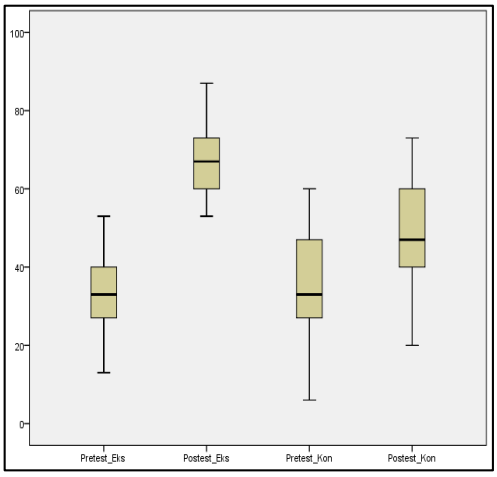


Figure 2. Box Plot of Critical Thinking Skills

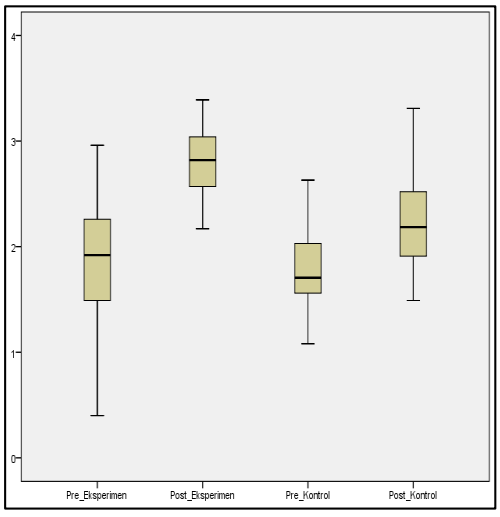


Figure 3. Box Plot of Communication Skill

Table 1. Normality test results of critical thinking skills

| Test | Kolmogorov-Smirnov Sig. | Shapiro-Wilk Sig. | Note |
|---|---|---|---|
| Pretest Experiment Group | 0.150 | 0.238 | Normally Distributed |
| Posttest Experiment Group | 0.082 | 0.083 | |
| Pretest Control Group | 0.057 | 0.403 | |
| Posttest Control Group | 0.171 | 0.268 | |

Table 2. Normality test results of communication skills

| Test | Kolmogorov-Smirnov[a] Sig. | Shapiro-Wilk Sig. | Note |
|---|---|---|---|
| Pretest Experiment Group | 0.200 | 0.675 | Normally Distributed |
| Posttest Experiment Group | 0.200 | 0.391 | |
| Pretest Control Group | 0.200 | 0.652 | |
| Posttest Control Group | 0.200 | 0.472 | |

Table 3. Linearity test results of the posttest

| Posttest | Result | Sig. (2-tailed) |
|---|---|---|
| Critical Thinking Communication | Significant | 0.000 |

Table 4. Linearity test results of the pretest.

| Pretest | Results | Sig. (2-tailed) |
|---|---|---|
| Critical Thinking Communication | Significant | 0.001 |

Table 5. The results of Levene's test

| Levene's Test of Equality of Error Variances[a] | | | | | Note |
|---|---|---|---|---|---|
| | F | df1 | df2 | Sig. | |
| Critical Thinking | 1.731 | 1 | 58 | 0.193 | Homogeneous |
| Communication | 1.406 | 1 | 58 | 0.241 | |

Table 6. The results of Box's M test

| Box's M Test of Equality of Covariance Matrices[a] | |
|---|---|
| Box's M | 3.298 |
| Sig. | 0.365 |

Table 7. Manova test results.

| Multivariate Tests[a] | | | |
|---|---|---|---|
| | Effect | Sig. | Partial *eta* Squared |
| Group | Pillai's Trace | 0.000 | 0.981 |
| | Wilks' Lambda | 0.000 | 0.981 |
| | Hotelling's Trace | 0.000 | 0.981 |
| | Roy's Largest Root | 0.000 | 0.981 |

A local potential is a specific resource owned by a region that can be utilized to develop the region (Agung, 2015; Anisa, 2017). A local potential is considered as basic knowledge because it has closeness to students so that it can improve students' skills in learning (Wilujeng, Prasetyo and Suryadarma, 2018). A local potential can be integrated into science learning and can improve students' critical thinking (Sari, Murni and Sjaifuddin, 2016; Wangsa P. *et al.*, 2017). Students need to be frequently invited to practice critical thinking, whose training must start at an early age (Changwong, Sukkamart and Sisan, 2018). Students who are not encouraged to think critically lack the ability to communicate the results of their work to their peers, family, and community (Cirino *et al.*, 2017). The integrated textbook of *bakpia* local potential is a book that deals with learning materials linked to the *bakpia* local potentials, starting from student activities, explanation of material, unique things about *bakpia* that students may not know, and problem sheets as competency tests. The activities in the book refer to the indicators of critical thinking and communication skills so that students are trained and their skills improve.

The *bakpia* is a local potential of the pie industry that can be integrated in science learning because the raw materials and the process of making it can be discussed in the topics of Substances and their Characteristics in Grade VII. Classification of materials can be studied in the tools and materials for making the pie. Examples of solid objects are tools used in bakpia *making* such as grinders, ovens, and pans which are made of metal. *Bakpia* ingredients in solid forms are sugar, flour, and green bean as the *bakpia* stuffing. *Bakpia* ingredients in liquid forms are oil and water. The substance in the process of *bakpia* making in the gas form is the LPG gas, which is used in cooking and baking the pie. Another science topic integrated with *bakpia* is that of Substance Changes. Physics changes in the process of *bakpia* making are the crushing of the green beans, grinding of the green beans, grinding of the pie dough, and shaping of the *bakpia* into round dough. Chemical changes in the process of *bakpia* making are changes in color on the surface of the pie after being roasted, soaking and steaming the contents of the green beans, mixing all the *bakpia* ingredients to form the *bakpia* dough that is ready to be roasted. One of the processes of the *bakpia* making is the soaking of the green beans stuffing for three days and then filtering the green beans. Eventually, mixture separation is conducted upon the flour in order to obtain clean and smooth flour.

The science teaching book integrated with *bakpia* local potentials is one that integrates the *bakpia* into the topic of Substances and their Characteristics in the 7th Grade of the Junior High School. Students are expected to be skilled and accustomed to think critically because the learning uses a scientific approach (observing, asking questions, gathering information, associating, and communicating) with learning activities referring to indicators of critical thinking. In the observing step, students observe videos of the pie materials and the process of the pie making which is followed by the students asking and writing questions related to the observed videos. In this phase, students collect information by reading materials and practicing according to the integrated instructional book of the *bakpia* local potential. At the association stage, students discuss in groups the materials in the book by questions and answers. By the discussion, students who have poor understanding of the material can improve their understanding with the help of other students who have better understanding (Chotimah *et al.*, 2017). As a result, students have better understanding and are able to draw conclusions of the learning problems. After the discussion, they communicate the results to the class in a class presentation. Communication trained in presentations is more challenging than communication trained by writing or reading (Bower *et al.*, 2013). At the end, the students are piloted to make a conclusion of the learning activities that have been taking place. This method of integrating local potentials gives teachers new activities and experiences of presenting instructional materials in the learning teaching processes.

During the learning using the science integrated books, the students in the experimental group tend to be more active in asking questions and giving opinions than the students in the control group do. This happens because the material is in accordance with the students' environment so they are already familiar with the object integrated in the learning material. They gain new knowledge experiences from the inclusion of the detailed explanation of the pie making process. IT turns out that *bakpia* local potentials can be integrated in the learning processes. In contrast, in the control group, the students tend to be passive because they are not so familiar with what they are learning (not in accordance with students' environment) so that they merely learn what is given in the book that might not be found in their daily lives. Though communication is an important skill that must be possessed in the 21st century, to have good communication, students must get

trained or get used to communicate (Ibrahim *et al.*, 2019). This result is in accordance with the study by Wangsa *et al.* (2017) that states that learning integrated with local potentials can improve students' communication skills because students tend to ask questions, answer questions, and give opinions. Communicative productivity is related to the frequency of presenting, asking questions, and answering questions in presentation sessions (Cameron *et al.*, 2020).

Integration of local potentials is one way of involving close involvement of students into the learning process since students currently hardly recognize the values of local potentials around them (Anggraeni and Mundilarto, 2020). Committing local potentials to the learning process provides different experiences to students and makes learning more contextual and meaningful. It, thus, gives deeper understanding; students are motivated to know more about science; eventually, their soft skills are increasing (Khoiri, 2016). The students are more active and their way of thinking is more refined in obtaining information directly so that they are able to improve their critical thinking and communication. It seems to be in the same line with (Anisa (2017) who states that learning becomes more meaningful if it is carried out on things that are close to students, and then, are real in daily life. The integrated learning of local potentials also provides a direct example of problem solving strategies in real everyday life (Jumriani and K. Prasetyo, 2017) so that students are able to improve their critical thinking and communication.

The effect of the science book integration is shown by the difference in the results of students' critical thinking and communication skills between the experimental and control groups. Based on the results of the Manova test of differences conducted on the posttest scores, it is found that the integrated science book with significantly influences students' critical thinking and communication skills. This is based on the acceptance of $H_1$ obtained from the significance value of the Manova test of 0.000, which is smaller than 0.05. The Partial *Eta* Squared value is 0.981. This shows that the effectiveness of the science book integrated with the *bakpia* local potentials is in the "high" category. Moreover, the results of the Test of between Subject Effect shows that the significance value of students' critical thinking and communication skills is less than 0.05 so that the hypothesis is accepted and it can be stated the science book integrated with the local potentials of *bakpia* can simultaneously improve

students' critical thinking and communication skills.

At the beginning of the study, students were asked to observe a video of a *bakpia* manufacturing process to stimulate them with a learning material. Presenting videos at the beginning of learning can also stimulate students' attention in learning something (Ainley and Ainley, 2011; Arnone *et al.*, 2011). When local potential integrated learning takes place, students are active during learning by asking questions to teachers or having discussion with their friends. Students' communication skills are sharpened when they have discussions sessions. Students' communication skills need to be improved because these skills can increase their emotional and social maturity as well as their intellectual abilities (Brownell, Price and Steinman, 2013; Hardianti, Taufiq and Pamelasari, 2017; Mercer-Mapstone and Kuchel, 2017; Afandi *et al.*, 2019). After observing the video about the process of *bakpia* making, students conducted a practicum in making the pie. In this process, students can directly see, observe, analyze, and classify the solid, liquid, and gas materials, as well as changes in the substances and shapes of the pie. Students can also analyze the physical and chemical changes that occur during the process of the bakpia making. Classification of matters, changes in form, changes in physics, and changes in chemistry are the sub chapter of Matter and its Characteristics. Natural science learning integrated with local potentials can upgrade students' ability to do research and analyze all information related to learning materials against the learning resources that are being studied (Anisa, 2017).

The results of this study are supported by that conducted in (Rubini, Septian and Permana, 2019) that textbooks are very effective as supporting materials to improve students' critical thinking. Other studies (Jumriani and K. Prasetyo, 2017; Wangsa P. *et al.*, 2017; Vuojärvi, Eriksson and Vartiainen, 2019) also show that local potentials can be integrated in science learning and can improve students' critical thinking. In other studies, it is shows that science learning that integrates local potentials can train students to conduct research activities independently (Kalelioğlu and Gülbahar, 2014; Kurniawati *et al.*, 2017). Students who are not encouraged to think critically lack the ability to communicate the results of their work to their peers, family, and community (Forawi, 2016; Cirino *et al.*, 2017). Finally, a study by Wangsa, *et al.* (2017) states that inquiry learning can improve students' communication skills because it requires students to ask questions, answer

questions, and give opinions. The science book integrated with the local potentials of *bakpia* making requires students to be active while learning. In this study, learning using the science book is also evident to be able to improve students' critical thinking and communication skills.

## CONCLUSION

The value of the Partial *Eta* Squared from the Manova test is 0.981. This shows that the effectiveness of the science book integrated with the *bakpia* local potentials is in the "high" category. The results of the Test of Between Subject Effect from the Manova test also show the science book can simultaneously improve students' critical thinking and communication skills. However, we also acknowledge some limitations of this study. The learning activities are only done inside the class and not yet directly in the *bakpia* factory. Another limitation of the study is the fact that it only involves 60 students of the Junior High School; further research needs to be done with a broader sample. Then, there is also a fact that the learning process is only carried out as many as four meetings of 120 minutes each; an estimation is possible that, if the duration of learning is increased, more indicators of critical thinking and communication can be observed. This can be mediated by learning activities using *bakpia* ingredients, e.g.: flour, sugar, oil, water, and green beans, and displaying the *bakpia* making process. Finally, a suggestion can be proposed wherein local potential integrated books can become an alternative learning mode (for example, based on STEM) with materials that are suitable for the local potentials in various regions.

## ACKNOWLEDGEMENT

We would like to thank the Ministry of Research, Technology and Higher Education for funding this research through the 2020 Master Thesis Scheme

## REFERENCES

Afandi *et al* 2019, 'Development frameworks of the Indonesian partnership 21 st -century skills standards for prospective science teachers: A Delphi study', *Jurnal Pendidikan IPA Indonesia*, vol. 8, no. 1, pp. 89–100. doi: 10.15294/jpii.v8i1.11647.

Agung, L 2015, 'The Development of Local Wisdom-Based Social Science Learning Model with Bengawan Solo as the Learning Source', *American International Journal of Social Science*, vol. 4, no. 4, pp. 51–8.

Ainley, M. and Ainley, J 2011, 'Student engagement with science in early adolescence: The contribution of enjoyment to students' continuing interest in learning about science', *Contemporary Educational Psychology*, vol. 36, no. 1, pp. 4–12. doi: 10.1016/j.cedpsych.2010.08.001

Andriana, E. *et al* 2017, 'Natural science Big Book with Baduy local

wisdom base media development for elementary school', *Jurnal Pendidikan IPA Indonesia*, vol. 6, no. 1, pp. 76–80. doi: 10.15294/jpii.v6i1.8674.

Anggraeni, T. E. and Mundilarto, M. 2020, 'The Development of Local Wisdom-Based Physics Cognitive Ability Assessment Instrument for Senior High School Students', *Jurnal Penelitian dan Pembelajaran IPA*, vol. 6, no. 1, pp. 102–40. doi: 10.30870/jppi.v6i1.5718.

Anisa, A 2017, 'Meningkatkan keterampilan berpikir kritis peserta didik melalui pembelajaran IPA berbasis potensi lokal Jepara', *Jurnal Inovasi Pendidikan IPA*, 3(1), p. 1. doi: 10.21831/jipi.v3i1.8607.

Arnone, M. P. *et al* 2011, 'Curiosity, interest and engagement in technology-pervasive learning environments: A new research agenda', *Educational Technology Research and Development*, vol. 59, no. 2, pp. 181–98. doi: 10.1007/s11423-011-9190-9

Bakic-Tomic, L., Dvorski, J. and Kirinic, A 2015, 'Elements of Teacher Communication Competence: An Examination of Skills and Knowledge to Communicate', *International Journal of Research in Education and Science*, vol. 1, no. 2, p. 157. doi: 10.21890/ijres.54372.

Bower, M. G. *et al* 2013, 'Assessing preservice teachers' Presentation capabilities: Contrasting the modes of communication with the constructed impression', *Australian Journal of Teacher Education*, vol. 38, no. 8, pp. 110–131. doi: 10.14221/ajte.2013v38n8.1.

Brownell, S. E., Price, J. V. and Steinman, L 2013, 'Science Communication to the General Public: Why We Need to Teach Undergraduate and Graduate Students this Skill as Part of Their Formal Scientific Training', *Journal of Undergraduate Neurosci¬ence Education*, vol. 12, no. 1.

Cameron, C. *et al* 2020, 'The role of scientific communication in predicting science identity and research career intention', *Plos One Scientific Communication*, vol. 15, no. 2, pp. 1–18. doi: 10.1371/journal.pone.0228197.

Changwong, K., Sukkamart, A. and Sisan, B 2018, 'Critical thinking skill development: Analysis of a new learning management model for Thai high schools', *Journal of International Studies*, vol. 11, no. 2, pp. 37–48. doi: 10.14254/2071-8330.2018/11-2/3.

Chotimah, H. *et al* 2017, 'Biology Module Development Using Think Pair Share Strategy to Improve Critical Thinking Skill of Vocational High School Students', *International Journal of Science and Research (IJSR)*, vol. 6, no. 6, pp. 157–63. doi: 10.21275/ART20174177.

Cirino, L. A. *et al* 2017, 'Broadening the voice of science: Promoting scientific communication in the undergraduate classroom', *Ecology and Evolution*, vol. 7, no. 23, pp. 10124–30. doi: 10.1002/ece3.3501.

Dewi, E. C., Suryadarma, I. G. P. and Wilujeng, I. (2018) 'Using Video Integrated with Local Potentiality to Improve Students' Concept Mastery in Natural Science Learning', *Journal of Physics: Conference Series*, vol. 1097, no.

1. doi: 10.1088/1742-6596/1097/1/012001.

Dewi, I. P. M. *et al* 2017, 'The effect of science learning integrated with local potential of wood carving and pottery towards the junior high school students' critical thinking skills', *Jurnal Pendidikan IPA Indonesia*, vol. 6, no. 1, pp. 103–09. doi: 10.15294/jpii.v6i1.9598.

Dwiyogo, F. D. P. S. W. W. D 2017) 'Effects of Problem Based Learning Strategy and Achievement Motivation on the Student?s Critical Thinking Abilities', *International Journal of Science and Research (IJSR)*, vol. 6, no. 6, pp. 707–13. doi: 10.21275/ART20173230.

Erdogan, V 2019, 'Integrating 4C Skills of 21st Century into 4 Language Skills in EFL Classes Vacide Erdoğan', *International Journal of Education and Research*, vol. 7, no. 11, pp. 113–24.

Forawi, S. A 2016, 'Standard-based science education and critical thinking', *Thinking Skills and Creativity*, vol. 20, pp. 52–62. doi: 10.1016/j.tsc.2016.02.005.

Hadi, S. A., Susantini, E. and Agustini, R 2018, 'Training of Students' Critical Thinking Skills through the implementation of a Modified Free Inquiry Model', *Journal of Physics: Conference Series*, vol. 947, no.1, doi: 10.1088/1742-6596/947/1/012063.

Hardianti, R. D., Taufiq, M. and Pamelasari, S. D 2017, 'The development of alternative assessment instrument in web - based scientific communication skill in science education seminar course', *Jurnal Pendidikan IPA Indonesia*, vol. 6, no.1, pp. 123–9. doi: 10.15294/jpii.v6i1.7885.

Hidayah, R., Salimi, M. and Susiani, T. S 2017, 'Critical Thinking Skill: Konsep Dan Inidikator Penilaian', *TAMAN CENDEKIA: Jurnal Pendidikan Ke-SD-an*, vol. 1, no. 2, p. 127. doi: http://dx.doi.org/10.30738/tc.v1i2.1945.

Ibrahim, M. Y. *et al* 2019, 'Communication skills: Top priority of teaching competency', *International Journal of Learning, Teaching and Educational Research*, vol. 18, no. 8, pp. 17–30. doi: 10.26803/ijlter.18.8.2.

Jumriani, J. and K. Prasetyo, Z 2017, 'Important Roles of Local Potency Based Science Learning to Support the 21st Century Learning', *European Journal of Engineering and Formal Sciences*, vol. 1, no. 1, p. 6. doi: 10.26417/ejef.v1i1.p6-16.

Kalelioğlu, F. and Gülbahar, Y 2014, 'The Effect of Instructional Techniques on Critical Thinking and Critical Thinking Dispositions in Online Discussion', *Journal of Educational Technology & Society*, vol. 17, no. 1, pp. 248–58.

Karakoc, M 2016, 'The Significance Of Critical Thinking Ability In Terms Of Education', *International Journal of Humanities and Social Science*, vol. 6, no.7, pp. 81–4.

Khoiri, A 2016, 'Local Wisdom PAUD to Grow Student's Soft Skills (Study Cash: Development RKH On Science Learning)', *Indonesian Journal of Early Childhood Education Studies*, vol. 5, no.1, pp. 14–7. doi: 10.15294/ijeces.v5i1.11271.

Kurniawati, A. P. *et al* 2017, 'The effectivenes of science domain-based science learning integrated with local potency', *AIP*

*Conference Proceedings*, 1868. doi: 10.1063/1.4995185.

Lathifah, I. N. and Wilujeng, I 2016, 'Pengembangan perangkat pembelajaran integrated science berbasis kearifan lokal', *Jurnal Pendidikan Matematika dan Sains*, vol. 4, no. 2, pp. 110–19. doi: 10.21831/jpms.v4i2.12920.

Mercer-Mapstone, L. and Kuchel, L 2017, 'Core Skills for Effective Science Communication: A Teaching Resource for Undergraduate Science Education', *International Journal of Science Education, Part B: Communication and Public Engagement*, vol. 7, no. 2, pp. 181–201. doi: 10.1080/21548455.2015.1113573.

Nisa, W. M., Nafiah, Z. and Wilujeng, I 2020, 'Profile of critical thinking skills in student's SMPN 1 Kalipare at topic of substance and its characteristics', *Journal of Physics: Conference Series*, vol. 1440, no. 1, pp. 3–7. doi: 10.1088/1742-6596/1440/1/012081.

Nugroho, S. D. and Wilujeng, I 2019' 'Improving Cognitive Learning Outcomes through Science Learning Videos Integrated with Local Potencies', *Journal of Physics: Conference Series*, vol. 1227, no. 1. doi: 10.1088/1742-6596/1227/1/012036.

Oktasari, D. *et al* 2019, '3D Page-Flipped Worksheet on Impulse-Momentum To Develop Students' Scientific Communication Skills', *Jurnal Pendidikan IPA Indonesia*, vol. 8, no. 2, pp. 211–9. doi: 10.15294/jpii.v8i2.15737.

Ormerod, R. J 2013, 'Research skills for the future: A consultant's perspective', *Journal of Research Practice*, vol. 9, no.1

Patonah, S 2014, 'Elemen Bernalar Tujuan pada Pembelajaran IPA melalui Pendekatan Metakognitif Siswa SMP', *Jurnal Pendidikan IPA Indonesia*, vol. 3, no.2, pp. 128–33. doi: https://doi.org/10.15294/jpii.v3i2.3111

Rahayuni, G 2016, 'Hubungan Keterampilan Berpikir Kritis Dan Literasi Sains Pada Pembelajaran Ipa Terpadu Dengan Model Pbm Dan Stm', *Jurnal Penelitian dan Pembelajaran IPA*, vol. 2, no. 2, p. 131. doi: 10.30870/jppi.v2i2.926

Rubini, B., Septian, B. and Permana, I 2019, 'Enhancing critical thinking through the science learning on using interactive problem based module', *Journal of Physics: Conference Series*, vol. 1157, no. 2). doi: 10.1088/1742-6596/1157/2/022001.

Santos, L. F 2017, 'The Role of Critical Thinking in Science Education.', *Journal of Education and Practice*, vol. 8, no. 20, pp. 160–73.

Sari, I. J., Murni, D. and Sjaifuddin, S 2016, 'Peningkatan Kecakapan Komunikasi Siswa Menggunakan Pembelajaran Bilingual Preview Review Dengan Setting Jigsaw Pada Konsep Pengelolaan Lingkungan', *Jurnal Penelitian dan Pembelajaran IPA*, vol. 2, no. 2, p. 121. doi: 10.30870/jppi.v2i2.741.

Setiawan, D. and Wilujeng, I 2016, 'The development of scientific-approach-based learning instruments integrated with red onion farming potency in Brebes Indonesia', *Jurnal Pendidikan IPA Indonesia*, vol. 5, no. 1, pp. 22–30. doi: 10.15294/jpii.v5i1.5785.

Siregar, N. C., Rosli, R. and Maat, S. M. 2020, 'The effects of a discovery learning module on geometry for improving students' mathematical reasoning skills, communication and self-confidence', *International Journal of Learning, Teaching and Educational Research*, vol. 19, no. 3, pp. 214–28. doi: 10.26803/ijlter.19.3.12.

Suyatna, A. *et al* 2018, 'Developing interactive e-book of relativity theory to optimize self-directed learning and critical thinking skills', *AIP Conference Proceedings*, 2014(September). doi: 10.1063/1.5054469.

Utami, D. A., Ramalis, T. R. and Saepuzaman, D 2016, 'Penerapan Model Pembelajaran Inkuiri Abduktif Untuk Meningkatkan Keterampilan Berpikir Kritis Dan Penguasaan Konsep Siswa Pada Materi Dinamika', *Jurnal Penelitian dan Pembelajaran IPA*, vol. 2, no. 2, p. 176. doi: 10.30870/jppi.v2i2.943

Vuojärvi, H., Eriksson, M. and Vartiainen, H 2019, 'Cross-boundary collaboration and problem-solving to promote 21st century skills-students' experiences', *International Journal of Learning, Teaching and Educational Research*, vol. 18, no. 13, pp. 30–60. doi: 10.26803/ijlter.18.13.3.

Wangsa P., P. G. *et al* 2017, 'Upaya Meningkatkan Kemampuan Komunikasi dan Pemahaman Konsep Siswa melalui Pembelajaran Inkuiri Berbantu Teknik TSTS (pada Materi Gerak Lurus di SMAN 6 Bandung)', *WaPFi (Wahana Pendidikan Fisika)*, vol. 2, no. 2, p. 27. doi: 10.17509/wapfi.v2i2.8274.

Wibowo, A 2013, *Manajemen Pendidikan Karakter di Sekolah*. Yogyakarta: Putaka Belajar

Widyaningrum, R., Sarwanto, S. and Karyanto, P 2013, 'Pengembangan Modul Berorientasi Poe (Predict, Observe, Explain) Berwawasan Lingkungan Padamateri Pencemaran Untuk Meningkatkan Hasil Belajar Siswa', *Bioedukasi: Jurnal Pendidikan Biologi*, vol. 6, no. 1, p. 100. doi: 10.20961/bioedukasi-uns.v6i1.3920.

Wilujeng, I., Prasetyo, Z. P. and Suryadarma, I. G. P 2018, 'Integrating Local Wisdom in Natural Science Learning', in *1st International Conference of Innovation in Education*, pp. 182–186. doi: 10.2991/icoie-18.2019.42.

Yusof, F. M. and Halim, H 2014, 'Understanding Teacher Communication Skills', *Procedia - Social and Behavioral Sciences*, 155(October), pp. 471–76. doi: 10.1016/j.sbspro.2014.10.324.

Zhou, Q., Huang, Q. and Tian, H 2013, 'Developing Students' Critical Thinking Skills by Task-Based Learning in Chemistry Experiment Teaching', *Creative Education*, vol. 4, no. 12, pp. 40–5. doi: http://dx.doi.org/10.4236/ce.2013.412A1006.