

The Effectiveness of Student's Worksheet Containing Ethnoscience in Hydrolysis of Salt to Increase the Science Literacy of High School Student

Agnes Ariningtyas¹, Sri Wardani²

^{1,2}Chemistry Education Department, Science and Mathematics Faculty, State University of Semarang, Indonesia

Abstract: *The process of learning science in the classroom should lead students to literate about science and technology. Learning activities should utilize optimally potential environment, especially the local culture so that the learning more meaningful but in reality this has not always done by the teacher. Test result and evaluation of PISA 2015 showing mastery material Indonesia students also still classified as low. One effort that can be done is implement the learning by design is student's worksheet (LKS) containing ethnoscience. This research aims to develop is LKS as ethnoscience-laden material hydrolysis of salt to enhance the literacy of science high school students. This research is the development of research or Research and Development (R & D). The Research Design used was a pretest and post test control group design. Research data obtained by the method of interview, observation, documentation, the now, and test. The results showed that ethnoscience charge is LKS to improve science literacy on the material the hydrolysis of salt has developed increase the content aspect of the students in class experiments with the acquisition of N-Gain of 0.71 in high context aspect category of students with obtaining N-Gain amounted to 0.73 in a high category and aspects of the process of science students with obtaining N-Gain of 0.50 in that category are, and the students gave positive response towards implementation is LKS as a charged ethnoscience salts are developed in the category of good or of 77.67%*

Keywords: worksheet, hydrolysis, ethnoscience, scientific literacy

1. Introduction

The development of science and technology affects various aspects of life from both the aspects of economic, political, social, and cultural facilities including education. Education is very important in the face of the development of science and technology. Education is an important investment in generating human resources. A good education is one of the means to print high-quality human resources. Qualified human resources is an important factor in development in the era of globalization that puts science and technology.

Learning is a process that granted by teachers to train students in the learning process and acquire knowledge, skills, and attitudes. Learning activities should be in close proximity to the environment. Learning activities should utilize optimally potential environment so learning more meaningful but in reality this has not always done by the teacher. Teachers need to recognize and preserve culture in the life of (Wardani *et al.* 2013). The learning that takes place at this time are likely to be contextual. The potential of local environment especially local culture, less underutilized by the teacher in the learning process, when combining the learning culture can be beneficial for all students (Gondwe & Longnecker, 2015). Knowledge the original and traditional science to modern providing a platform where teachers can start discussions through the principles of organizing, habits of mind, skills and procedures and knowledge (Aiken & Ogawa, 2007)

Learning science processed should lead students to literate about science and technology. One characteristic of learning ethnoscience according to Holbrook & Rannikmae (2009) is the development of a positive attitude towards science.

Learning by ethnoscience emphasizes the achievement of an integrated understanding of in just a deep understanding (Krajcik *et al.* 1999). Students learn to relate the material learned in class with the context of his life and the relationship between science and technology learning in school so that not only are informatif but also are practical and useful in life. One of the dimensions in the study of science is a science learning intended to obtain a relationship between science technology and society (Chiapetta & Koballa, 2010).

The measurement of the ability of science literacy conducted by the Program for International Student assessment (PISA). Test results of PISA in 2012 showed that science literacy ability of students in Indonesia are still at the lowest position IE ranking 64 of 65 countries. Indonesia get a total score of 382 scientific competence of an average score of 501 (OECD, 2012). Result test and evaluation of PISA 2015 mastery of the material students are also still belongs to Indonesia. Score the achievement of Indonesia for science students was ranked 62 with a score of 403 from 70 countries being evaluated (PISA, 2015). Based on the results of the analysis of the test results and the evaluation of the PISA study results that are obtained by IPA students in Indonesia has not been practical in nature that are useful in public life (Hayat, 2011). Schwartz *et al.* (2006), conducted a study to assess the literacy development of chemical high school students on the lesson of basic chemistry and advanced chemistry. The research results showed that generally the science literacy learning in the understanding of the chemical and its benefits against the functional level of science literacy turned out recently to explain the phenomenon of chemically and not enough plays against multidimensional literacy, i.e. read and understand short articles in chemistry.

Volume 6 Issue 7, July 2017

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Ethnoscience is a system of knowledge and cognition (ideas/thoughts) typical for a particular culture. The emphasis is on knowledge or software system that is typical of a society (Sudarmin, 2014). Learning by ethnoscience according to Sardjiyo in Pannen (2005) one way is to associate the science that will be studied with a culture where students come from. Sayakti (2003) stated that the importance of learning to use the approach of local culture and the environment as a source of learning so that the learning process more meaningful for students. Emdin research (2011) shows that connect between science and culture can affect the improvement of the results of academic learners. Research results Rahayu, *et al* (2006) about the effectiveness of the local culture-based learning gives better results because the pemvelajaran lasted more meaningful for students. There are various ways of incorporating culture into education, one of which is to create a student's worksheet (LKS) containing ethnoscience.

Research Trnova (2014) states that teachers should create new modules and to focus on student learning activities. Development of LKS containing ethnoscience can be used to improve science literacy students. Learning by digging the concept, process and application of science, students can apply the knowledge taught in school and knowing the facts of science in daily life that thrive in the community, so that students can be "literate" Science (OECD, 2009).

Ethnoscience will be discussed in the hydrolysis of salt this one is the use of borax to make salt gendar. The region itself is an area of Ungaran named Kaliulo, Kecamatan Pringapus, Semarang that produce natural borax water. The local community often call it by the name of banyu gendar. Banyu gendar is often utilized society Ungaran and surroundings to make traditional foods such as lontong, ketupat and gendar. Banyu gendar which was later used as an introduction in ethnoscience for further study boraks compounds of salt and can undergo hydrolysis. They don't know that there is an element of salt and hydrolysis in the gendar banyu so it can be used for food.

In fact, not many students know that boraks is application of hydrolysis of salt. Boraks if dissolved in the water that is Alkaline hydrolysis occurs because composed of strong base and weak acid based on this, the required literacy sufficient to give an idea to the students so that students are able to understand and master the subtopik this by maximizing what is available. This is in accordance with one of the aspects of the context of science on Science Literacy PISA PISA assessment 2015 i.e. about health and natural resources (OECD, 2013).

Based on the background which has been described above, then the outline of the problem in this research are (1) whether the student Worksheet chemical hydrolysis of salt-laden material ethnoscience developed can improve science literacy high school students, (2) how does the student response against chemical-laden Student Worksheet materials ethnoscience hydrolysis of salts are developed?

The objectives to be achieved in this study are: (1) analyzing the increase in science literacy of students through the student Worksheet a charged ethnoscience salts are Etchant

material developed, (2) analyze student response against the student Worksheet a charged ethnoscience salts are Etchant material developed.

2. Method

This research is research development or *Research and Development* (R & D). On the research of the development of this type of research is used to produce worksheets students charged ethnoscience in hydrolysis of salt to increases literacy science high school students of Class XI.

The development Model used by researchers using instructional systems development model expressed by (Thiagarajan Trianto in 2010), and semmel semmel (model 4) are modified. 4-D model consists of four stages of development that is *Define* (definition), *Design* (design), *Develop* (development), and *Disseminate* (spread). Stage *Disseminate* (spread) is not done because the consideration of implementation time and consideration that on stage *Develop* (development) has been generated is LKS containing ethnoscience in hydrolysis of salt is good (*valid*).

The draft test effectiveness, according to Sugiyono (2011) testing can be done by way of comparing between the control and the experimental class. Form design research *Control Group Design* can be seen on Pictures 1.

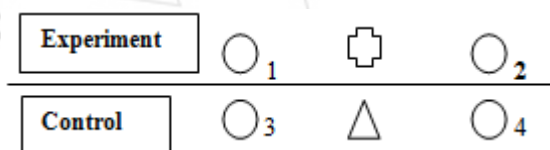


Figure 1: Design Research *Control Group Design*

Description
 ○ : Initial Test same as the ultimate test
 + : Learning chemistry with student worksheets containing ethnoscience to improve science literacy in the classroom-circling
 Δ : Learning chemistry in Chemistry is LKS with the control class

The data of the test results of students before and after treatments, were analyzed by means of comparing test scores of the start and end of test. The increase that occurred before and after the study was calculated with the formula factor g (*N-gain*) developed by Hake (1999).

Data capture method used in this research are (1) the method of interview, (2) methods of the now, (3), documentation methods, (4) the observation method of affective, and (5) test method.

The instruments that will be used in advance done test validity (validity of invalid constructs, validity content, and the validity of the grain problem/question form), the reliability question form/matter of distinguishing power, grain, and the grain problem difficulty. Grain question form/matter used for the *pre test* and *post test* in this research is now a problem/grain meets the criteria. Based on the analysis of the trial data question form and matter obtained

31 grain question form response, 20 items of multiple choice and 5 reserved essay meets the criteria valid.

3. Result and Discussion

The design of student worksheet a containing ethnoscience in hydrolysis of salt aims to improve science literacy students. This research and development to produce a product in the form of is LKS contain ethnoscience so that learners can learn two things at once i.e. studied chemistry and culture about danger of gendar which frequently consumed by the community since the hereditary, given in the area of Kecamatan Pringapus, Semarang, there is a spring that is often used in the blend makes gendar. Research and development of this device aims to obtain a valid learning device and it deserves so that is used as a reference in the learning activities.

SMA N 1 Ungaran in general students of Class XI SCIENCE lesson 2016/2017 year divided into 7 classes have similar characteristics and no superior class means spreading in every class there are students who are classified as high, medium, and is classified as low-kognitifnya from the side. Students that became the subject of the research is the class XI IPA 3 as a class experiment that was given the treatment of learning using a charged is LKS AS ethnoscience and XI IPA 2 as a control class that are LKS using chemical treatment.

The difference in the results of the science literacy of the students look upon the process of learning that goes on control of or processed class experiments. On the class control of most of the students have not been able to identify and apply the scientific knowledge on the concept of the hydrolysis of salt. Study on the experimental class most students are able to identify words kungsi search for scientific information as well as being able to portray a clear and logical relationship in answering questions.

The Result of Scientific Literacy of Student

Aspects of the content on the science literacy of the students is measured using a multiple choice question. Aspects of content emphasizes the ability of understanding and knowledge into science curriculum including knowledge gained through other information sources that are available. Measurement of the content aspects of improvement done Test N-Gain to know the average increase in the learning results between experiments with grade control by using multiple choice question. The research value of *pre test* and *post test* experimental classes as well as classes of controls on tests with multiple choice question presented table 1.

Table 1: The value of the results of *Pre test* and *Post test* multiple choice Question (Content Aspect)

| Average | Class Experiment | Classcontrol |
|------------------|------------------|--------------|
| <i>Pre test</i> | 31,36 | 37,31 |
| <i>Post test</i> | 79,47 | 68,19 |

Based on Table 1 can be known that an increase in on aspect of student content before and after learning as seem in figure 2.

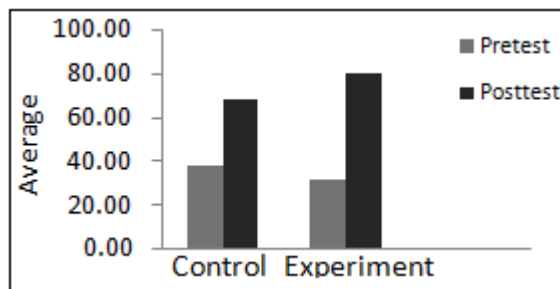


Figure 2: Improved aspect of the Student Content before and after Study

The increase in the value of understanding the aspects of content on students course of study ethnoscience-laden device. Research Sudiarmika (2010) declared a local nature science more applicable because of the emphasis on usability and reinforced with scientific discoveries. Learning science by involving local culture will help students learning science in line with the beliefs of students without regardless of raw concept that applies universally. Teachers are expected to integrate into the local culture of learning science and science literacy measurement tool developed in a cultural context, considering that Indonesia has a rich culture of learning so that students become more meaningful.

Improved aspect of the context, the measurement is done with Test N-Gain to know the average increase in the learning results between experiments with the control class through the tests with *essays*. The value of *pre test* and *post test* experimental classes as well as classes of controls on tests with *essay* presented in table 2.

Table 2: The value of the results of *Pre test* and *Post test* question *essay* (aspects of context)

| Average | Classroom Experiments | Control Class |
|------------------|-----------------------|---------------|
| <i>Pre test</i> | 15.44 | 28.63 |
| <i>Post test</i> | 77.06 | 60.36 |

Based on the table 2 above can be known that an increase in on aspects of student content before and after such learning appears in Figure 3.

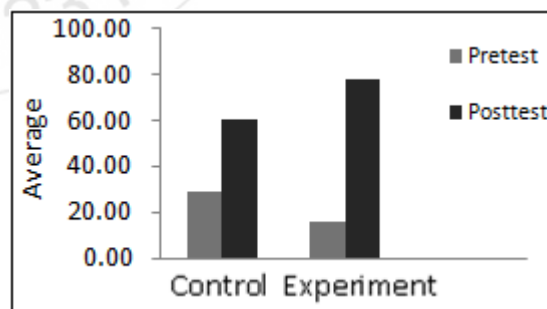


Figure 3: The improvement of aspects of the context of Students before and after Study

The difference in the literacy ability of science students in the class and grade control experiments indicated from *posttest* students answers, where the literacy ability of science students on aspects of content and context in the classroom experiment is better if compare with grade control. A good learning materials, one of which should contain LKS contain the interaction between science, technology and society as it is LKS contain ethnoscience

developed by researchers. This interaction is intended to give you an idea of the influence of science on society. Aspects of scientific literacy (*scientific literacy*) alluded to the application of science and how technology helps human life (Allchin, 2014).

Improved aspect of the process of science, the measurement is performed with the Test N-Gain to know the increase of the average results of learning among the Group experiments with control through practical observation class I with lab course II. The assessment of this aspect of the process of science are presented in table 3.

Table 3: The value of the results of *Pre test* and *Post test* Assessment aspects of the process of science

| Average | Classroom Experiments | Control Class |
|------------------|-----------------------|---------------|
| <i>Pre test</i> | 58.83 | 53.42 |
| <i>Post test</i> | 79.56 | 70.24 |

Based on table 3 above may be aware that an increase in the aspects of the process of science on the practical value of I and the practical observation II as shown in Figure 4.

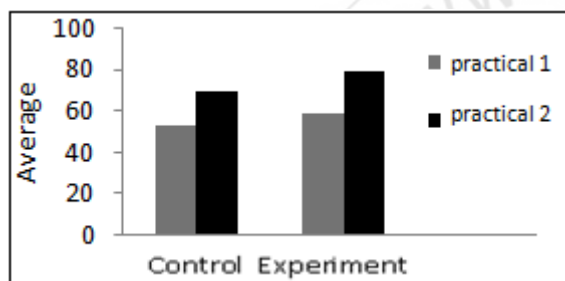


Figure 4: The improvement of aspects of the process of Science Students On Practical lab course I and II

Improved aspect of the process of science that is not too high on the class of this experiment one cause that is the practical beginning of learning so that students are not used to process sainsnya process. This is due to the habit of learning in students do practical work at the end of the matter. Students are also not used to form their own knowledge actively through interactions with the environment, because the conceptual development are the result of interactions between the concept that there has been a new experience so that a process of learning does not constitute a transfer of knowledge. The magnitude of the increase between the *pre test* and *post test* after test normalized, then retrieved the value of the N-Gain content aspects, aspects of the context, this aspect of the process of science is presented in table 4.

Table 4: The value of N-Gain *Pre test* and *Post test*

| Science Literacy | Classroom Experiments | Control Class |
|-----------------------------------|-----------------------|---------------|
| Content Aspects | 0.71 (high) | 0.57 (medium) |
| Aspects of the Context | 0.73 (high) | 0.44 (medium) |
| Aspects of the Process of Science | 0.50 (medium) | 0.36 (medium) |

Based on the results of the interview against the chemistry teacher on condition of early studied, seen that learning is often done using methods lectures, though sometimes the discussion, so that students are not yet entirely active at the learning activities in the classroom. Teachers also have never make learning materials or LKS themselves in the learning

process and have not been hooking existing cultural of society in the introduction to the study of chemistry.

Based on preliminary research results obtained, then needed a learning device that suits your needs. Therefore, the learning device electrically ethnosience. The presentation of the material in it is LKS as a charged ethnosience stimulated learners to build the concept. On the material is LKS in the earlier this ethnosience charge, introduced the traditional salt-making way. Description of material beginning with the questions with the aim to direct learners in order to conclude the material he had learned. After being stimulated with questions, followed by a presentation of the concept and continued with the task group. Learning that is used in this study is a cooperative learning that emphasizes the use of peer friends and relations of cooperation between friends of the associate in a group orientation toward literacy enhancement science of student.

In this study, the next is to make the design (*design*) early learning-based device problems on material hydrolysis, in this draft is 1. This draft is a learning device which consists of a syllabus, RPP, is LKS contain ethnosience and evaluation. This initial design was further validated by experts to find out the level of validity of the device. This is the beginning of the validation stage development. The results of the validation of the device by experts produce valid criteria for all aspects of learning an instrument or device with some revisions.

Based on the results of the validation of the devices used in a simulation class worthy or limited trials to find out the readability of the device in the form of student response. The observer also provide input for the repair of the device has been created. Furthermore, the data and information obtained at this stage of development is used to repair, so the resulting learning devices in the form of two drafts which can then be tested on a test run.

Based on the results of this research, that the results obtained *post test* on the content, retrieved the price t calculate 4.246; while the price of $t_{(0.95) (70)}$ of the Results obtained $1.99 t_{count} > t_{table}$, concluded there is a difference between learning outcomes and experimental group control group. It can be concluded that the results of the study on the experimental group by using the content is LKS contain ethnosience better learning results than the control group is LKS by use of chemicals.

The increase in the results of the study on aspects of content obtained through test N-Gain. Classroom experiments obtained a score of the control class and obtain 0.71 score 0.57. Based on the criteria of the test N-Gain, an increase in the results of the study on the experimental class content entered in the high criteria while increasing learning results on a control class entered in the criteria are. This shows that the improvement of the learning results content aspects of experimental group was greater than in the control group, and the increased ability of experiment class content aspects better than on the control class. Based on this it can be inferred the ability of mastery on the content of the experimental class higher than the class of control, because it is LKS contain ethnosience used on the experimental class

while the class control is LKS as usually ordinary chemical wear. On LKS contain ethnoscience, students are invited to get to know cultures in the community i.e. one traditional salt making process, then students are introduced to the use of the often confused boraks on traditional food like gendar. In addition, in the area of Kecamatan Pringapus, Semarang, there is a water spring named banyu gendar, often used for mixed communities make gendar, lontong and ketupat, which is the traditional hereditary. Based on the results of the experiment, it turns out that contain gendar banyu boraks with few levels harmful to health if consumed cumulatively. This is LKS contain ethnoscience form students more interested in learning chemistry and developed the concept of the chemical expected so that aspects of content on a more controlled experiment class.

Aspects of the context of the experimental class, get the average of 77.06 and the control group get results 60.36. Upon calculation, obtained t_{count} amounted to 4.735 while t_{table} of 2.00. The results obtained, to calculate $t > t_{\text{table}}$, it can be concluded that there is a difference between the control group and eksperimen group, so it is concluded the results of the study on the experimental group context by using the LKS negatively charged ethnoscience better than the control group study results by using the LKS chemicals ordinary. The increase in the results of the learning aspects of the context of the experimental group obtained through the N-Gain test and obtained a score of 0.73 whereas in the control group gained score 0.44. Based on the criteria of the test N-Gain, an increase in the results of a study on aspects of the context class experiments with high criteria are the class of the control criteria are. The increase in the results of the learning aspects of the context of the experimental group was greater than in the control group.

Aspects process science, experimental classes get the average 79.56 and the control group gained an average of 70.24. Upon calculation, obtained t_{count} of 4.894 whereas t_{table} of 1.99. The results obtained, to calculate $t > t_{\text{table}}$, it can be concluded that there is a difference between the class eksperimen and class control, so it was concluded that the results of a study on the process of science experiments using the Group LKS contain ethnoscience better learning results than the control group is LKS by use of chemicals ordinary. The increase in the results of the learning process aspects of science in experimental group obtained through the N-Gain test and obtained a score of 0.50 while in the control group gained score 0.36. Based on the criteria of the test N-Gain, an increase in the results of a study on the process of science aspects of both groups are also included in the criteria. Although the definitions of the same criteria, the increase in the results of the learning process aspects of science in experimental group was greater than in the control group.

The percentage of the value of understanding the aspects of content and context aspects on, certainly not from a device of learning and the learning model used. Research Sudiatmika (2010) declared a local nature science more applicable because of the emphasis on usability and reinforced with scientific discoveries. Learning science by engaging the local culture will help students learning science in line with the beliefs of students without regardless of raw concept that applies universally. Teachers are expected to integrate into

the local culture of learning science and science literacy measurement tool developed in a cultural context, considering that Indonesia has a rich culture of learning so that students become more meaningful.

A similar study is also conducted by Sudarmin & Rahayu (2015) about the development of the module IPA-oriented ethnoscience the theme of energy in life. Based on the results of the analysis of the results of the study in this study, only 4 students from 34 students who expressed satisfaction in the *pre test*, but after using the module and do *post test*, ketuntasannya increased to 30 students from 34 learners with the highest gain of 0.58 criteria are. This study tested for learners middle school. These results indicate that the integrated IPA modules developed for effective use in learning the IPA.

On further research by Anwari (2015) biology learning modules about the development-oriented local wisdom in the National Park of Mount merapi. This learning module is worth used. It is based the results of research with keidealan presentation 94.87 reviewer% (very good), 1 media expert with the presentation keidealan 93.95% (very good), and 3 *peer reviewers* with the presentation keidealan 84.59% (good). This research aims to provide only local value to the learners know the potential and local culture that exists around them. Whereas, in this research, besides getting to know potential and local culture, also did the translation of the original science into science scientific.

The percentage of the value of understanding the aspects of content and context on aspects other than, of course, influenced from the device of learning but also influenced by the learning model used. Research by Gencosman & Dogru (2012) mentioned that learning through cooperative model type STAD had a huge influence to increased academic achievement of students when compared to traditional learning. Merits for the superior group can better motivate students to get to the next tests will be provided so that each group would seek the maximum in order to achieve the Group's success.

Cooperative learning Model used in this study as revealed in a research conducted Wachanga & Mwangi (2004) indicates that the cooperative methods used in *co-operative class experiment* (CCE) affect student achievement compared to *regular class* (RC). The results of research by Wachanga & Mwangi, i.e. the method used in the experiment classes (CCE) can facilitate students so that achievements in learning chemistry in class eksperimen is better than on the methods on the class control or *regular class* (RC). Cooperative learning model is part of the teaching curriculum, because learning cooperative (*cooperative learning*) arises from the concept, that students would be easier to find and understand a difficult concept if they are discussing with friends.

The research that has been done with regard to science literacy that's been done, among others by Kurniawan (2013) research carried out one of them aims to improve science literacy in HIGH SCHOOL using *task* character. His research results showed, after following this their learning activities to better understand the concept of matter and the

students can use the knowledge of science in everyday life, as well as be able to draw conclusions based on the evidence relating to science.

Other studies regarding science literacy conducted by De Boer (2000) concludes, that though well-intentioned, standards-based education has the potential to inhibit the creativity of master class and the students. With the aim of broad freedom of *benchmarking* and *high stake testing*, local schools make each teacher will have more eksibilitas to select the contents of their own science and teachers can teach with their own forces and for the benefit of their students. In addition, they will be free to experiment creatively with the pedagogical approach is not possible in the current standards-based education.

Student Responds

Learning with a charged is LKS AS ethnosience also is expected to get a positive response from the students. The research results obtained based on the data that the student has a good or positive response in the amount of 77,67%. This shows that is LKSas a charged with learning ethnosience has been done to provide a high interest in students. According to them via the question form response stated that after following this learning activities they better understand the concept of material hydrolysis of salt in particular and the students can use the knowledge of science in everyday life, as well as be able to draw conclusions based on the evidence relating to science.

It also looks at practical activities and discussion in class with regard to aspects of the context, most of the students participated in such activities play an active role, from the start of discussions in each group until such time as presentai in front of the class. At the end of the learning group and to quiz is given with the highest value will get the reward for students being encouraged to compete each other and understand the lessons well. The members of the Group also ensure Member group so familiar with the material being taught. This research shows that the use of the device is LKS AS ethnosience-laden material hydrolysis of salt can successfully enhance science literacy students. A good learning materials, one of which should contain LKS AS the interaction between science, technology and society as it is LKS AS a charged ethnosience developed by researchers. This interaction is intended to give you an idea of the influence of science on society. Aspects of scientific literacy (*scientific literacy*) alluded to the application of science and how technology helps human life(Allchin, 2014).

A study conducted in SMA Negeri 1 Ungaran, using electrically is LKS AS ethnosience can improve the literacy of science students on aspects of content, context, and the process of science students. Learning is done to dig the concept, applications and process science, so students can apply the knowledge taught in school and knowing the facts of science in everyday life, so students can "literacy" of science. Students are also expected to have the ability to use scientific knowledge, identify questions, and draw conclusions based on evidence, in order to make a decision with regard to nature.

4. Conclusion

Based on the results of the research on the application of the design of student worksheet a charged material ethnosience hydrolysis of salts to increase science literacy high school students then concluded: (1) implementation of Worksheets Students charged ethnosience salts are Etchant developed materials can increase the content aspect of the students in class experiments with the acquisition of N-Gain of 0.71 in high context aspect category of students with obtaining N-Gain amounted to 0.73 in a high category and aspects of the process of science students with obtaining N-Gain of 0.50 in the category medium, (2) Students give a positive response toward the implementation of Student Worksheet a charged ethnosience salts are Etchant material developed in the category of good or of 77.67%.

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Author Profile



Agnes Ariningtyas is a candidate of master of education on Chemistry Education of graduate school-State University of Semarang (UNNES)-Indonesia. She is now a teacher in MAN Temanggung-Indonesia. Her recent research is in developing model of teaching especially with cooperative STAD. The field of research in education is on science literacy.



Sri Wardani is a doctor on Chemistry Education of graduate school-Indonesia University of Education. She is now a lecturer in State University of Semarang (UNNES)-Indonesia. Her Expertise is in teaching-learning on chemistry. Her recent research is in developing models of teaching chemistry, especially with practical problem based learning.

Figure Legend

Figure 1. Design Research *Control Group Design*

Figure 2. Improved aspect of the Student Content before and after Study

Figure 3. the improvement of aspects of the context of Students before and after Study

Figure 4. the improvement of aspects of the process of Science Students On Practical lab course I and II