The effectiveness of Scientific-Inquiry Learning Model to Improve Scientific Thinking Skills of Grade X student of High School in Gowa Regency

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Abstract. The purpose of this study is to test the effectiveness of book of Scientific - Inquiry (SI) learning model which has been developed by Jusniar (2015) with an average of 3.20 with a coefficient of expert judgment index equal to a valid category, the practicality of the perception of the average student 89.47% and the average teacher 90.05% who responded positively to the application of models and tools. This study was conducted at three schools with different characteristics SMAN 1 Bajeng (Accreditation), SMAN Bontonompo (Accreditation B) and SMAN WestBajeng (Accreditation B). The research design used is quasi experiment with pre-test and post-test control group design. The instrument used to collect data is 1) the observation sheet process of scientific thinking skills, 2) questionnaire user perception and 3) test the product of scientific thinking skills. The Results of effectiveness testing of the SI model viewed from two aspects: the enforceability of Scientific Inquiry learning through observation and testing processes Scientific Thinking Skills (KBI) products. Observation process includes the ability / skills to formulate the problem, observe, hypothesize, ask questions, collect data, discussion and conclusion) the experimental class for each to: SMAN 1 Bajeng average KBI groups with both category and 76.79% enough category 23 , 21%, SMAN 1 Bontonompo good category 73.21%, 23.22% and sufficiently less 3.57%. And for SMAN 1 west Bajeng good category 67.86%, 28.57% and lacking sufficient at 3.57%. The effectiveness of the learning model Scientific-inquiry of the test results ANACOVA with SPSS for windows 20.0 was obtained respectively: 1) SMAN 1 Bajeng significance of the implementation of the model 0000 with a contribution of 26.2% against the influence of SI models KBI students; 2) SMAN 1 Bontonompo significance of the implementation of the model 0000 with a contribution of 44.9% influence model (SI) to KBI students; 3) SMAN 1 WestBajeng significance of the application of the model 0000 with a contribution of 24.0% influence on the KBI student models; meaning of the three schools that made the object to the implementation of the model and the device is considered effective to increase the KBI high school students on test material electrolyte and non-electrolyte solution.
Keywords: Scientific Thinking Skills, Scientific-Inquiry Learning Model

INTRODUCTION

Curriculum 2013 as improvement of curriculum based on competency (CBC) and unit level educational curriculum (KTSP) on 2006 that hope can complete the previous curriculum to increasing education quality in Indonesia that relatively low. It's influenced by so many factors, one of them is educators' resources. Low level of students' thinking skills in Indonesia according to Mustaji (2013) which is analysis-synthesis thinking and evaluation-creation caused by teachers that less to involve students' thinking skills. As a result, the ability of students is only related to knowing skills, understanding, and using which is still a low level thinking category. Research results by Rapiq (2003) showing that basic knowledge of chemistry science in junior high school students in Makassar city is very low (39,37%), teachers not completely implementing innovative approaches that put students as the centre of learning. Masitoh (2011) revealed that model or design of learning undertaken by teachers is not varied and still centred on the teacher as well as underutilization available media. Consequently, students become uncreative and uncritical in thinking process.

For senior high school (SHS) student, chemistry is not enthused and interested lesson. Observation conducted by interviewing some students and chemistry teachers in some school generally shows that students are less interested in learning chemistry because of the materials which is full of concept, laws, formulas, and calculation. For chemistry teachers in SMAN 1 Bajeng, the problem is special obstacle because it makes most of student less enthusiastic to attend learning process. The problem is foreseen to happen because of several things: 1) teaching model used by chemistry teachers is still dominated by direct instruction mode, 2) student are less involved in finding concept through inquiry process (Processing information theory of Gagne), 3) students are not accustomed to apply or use steps of scientific thinking. In learning process which is 5M (Observing, asking, reasoning, trying, and communicating), 4) due to limited time which becomes one factor why students are less accustomed to ask.

To resolve the issue, then the chemistry learning needs to involve students directly through scientific-inquiry model. The model which is same with inquiry is guided discovery which was done by Muharram and Jusniar (2013) and it can increased the active participation SHS students in learning and definitely can give

positive respond not only for student but also for teacher. Thinking skills according to Marzono et al. (1988), is integral and basic parts in learning process. Thinking skills dimension that must be developed are skills: 1) discovering and finding information, 2) cultivating information, 3) problem solving, 4) making decision. Therefore, researcher team want to deepen it by applying the blend of scientific approach and inquiry model that have developed in the first year to see the influence to SHS students' scientific thinking skills. Besides that, scientific-inquiry model that have developed on electrolyte and non-electrolyte solution or other experiments will be socialized to all of SHS chemistry teachers in Gowa regency.

Problem of this research is discovering (describing and analysing) whether there is influence of developed scientific-inquiry learning model to students' scientific thinking skills on electrolyte and non-electrolyte solution socialized scientific inquiry learning model to all of SHS chemistry teachers in Gowa regency.

Scientific Inquiry Learning Model

Piaget defined that inquiry method is method where students doing experiment by their selves, looking for problem, problem solving, and connecting one invention to another invention (Mulyasa, 2009). Inquiry cycle which is a series of activities doing by student in order to find their selves, are 1) observation, 2) questioning, 3) hypothesis, 4) data gathering, 5) conclusion. Then, it can be described by the following activity: 1) formulating problem, 2) observing, 3) analysing and concluding, 4) presenting observation result (Sagala, 2006).

Gulo in Trianto (2009) said that inquiry is not only developed the intellectual ability but also all the existed potency, including the emotional development. Inquiry skill is a process that begin by formulating problem, hypothesizing, collecting data, analysing data and making conclusion.

According to Roestiyah (2008), inquiry contain a higher mental process level. Such as formulating problem, designing an experiment, doing an experiment, collecting and analysing data, making conclusion. Cultivate objective, honest, curious, open-minded, and so on. Finally able to achieve mutually agreed conclusion. When students do all the above activities, it means that students are doing inquiry.

Inquiry learning model is learning model the students as the learning centre where students are given the freedom to do an experiment (trial and error), guessing, using intuition, investigating, and making conclusions also allow teachers to conduct guidance and directions for helping students to use ideas, concepts, and skills they have to find new knowledge (Purnomo, Mardiyana, and Triyanto, 2011). Inquiry learning is a learning model that was developed by the cognitive view of learning and principles of constructivism. Based on PermendikbudNu.65 year 2013 about the standard of primary and secondary education, the learning process on 2013 curriculum is expected to apply learning models that have been suggested in the 2013 curriculum which is project-based learning, problem based learning, discovery learning, inquiry, and problem solving. As signs implementation or learning standpoint, used scientific methods.

Scientific method is a way to implement the learning process that based on the phenomenon and the fact that going through to the process of results activities such as observing, questioning, reasoning, trying and communicating. The scientific method considers that the learning process should not be based on things that are not objective as expected, fantasy, legend or fairy tale. This makes the interaction between teachers and students should also be based on a proven fact (Ministry of Education and Culture, 2013).

In the implementation of inquiry learning model that includes applied the scientific method to produce a Scientific-inquiry model which is expected to further enhance scientific skills and student learning outcomes. Simply, the model of learning scientific - inquiry can be seen in Table 1.

Learning Phase	Activity	
	Teacher	**Student**
Preliminary phase (Preliminary observations)	• Delivering learning objective to students • Helping students to form group that consists of 4-5 students • Connecting matter that will be study with the matter at the previous meeting. • Raising issues related to the topic of material but also associated with student life	1. Listening to the explanation given by the teacher. 2. Establishing a heterogeneous group 3. Engaging in apperception activities(Queries) 4. Analyse the initial problem early given using the experience in life. (Reasoning)
Formulation of the problem Phase	• Guiding students to formulate problems • Explaining how to conduct discovery solution of problems in students.	• Developing a problem formulation • Reading and recording the issues that raised by teachers (Observe and ask). • Listening to the teacher's explanation on how to perform the discovery activities.
Asking Assumptions or Hypothesis Phase	• Guiding the students filed assumptions of the problems compiled	• Writing a hypothesis or temporary presumption
Data Collection Phase (Continued Observation)	• Directing and guiding students to conduct experiments based students worksheet prepared. • Discuss a discovery activities. • Asking students to write down his findings on the paper sheet activities.	• Conducting experiments based students worksheet (trying), while collecting data and analysing data that found (reasoning) • Write result of experiments on students worksheet perform discovery on a sheet of paper.
Discussion Phase	• Guiding students in activities to unite opinion (discussion). • Providing information/strengthening, corrections on students in discussion if necessary	• Discuss (give opinions regarding the results of experiments that conducted) between groups. • Ask questions if there is not understood (reasoning).
Conclusion Phase	• Ask a few students about the conclusions from the discussions	• Communicate the conclusions (Communicating).

Scientific Thinking Skills in Scientific-Inquiry Learning

Thinking, according to Schafersman, S.D (1991), is thinking properly in order to know the world relevantly and reliably. Thinking is the activity that focuses to explore the idea, give various probabilities and look for the right answer. According to Dimyati (1996), realization of thinking appears in the individual ability to read, write, think and observe. Thinking skills (Depdiknas, 2002a) is an integral part of education process involving 1) finding information skill, 2) cultivating information skill, 3) making decision skill, 4) problem solving skill. The development of thinking skill (Harris, 1998) cover 4 things, they are (1) analysing ability, (2) teaching student to understand statements, (3) following and creating a logic argument, (4) eliminating the wrong path and focusing on the right path. The development of thinking skill is the basic to develop the scientific thinking skill.

Scientific thinking skill (Kemendikbud, 2013) is the skill that is produced by applying the scientific and inquiry method. It involves observing skill, questioning, reasoning, trying and communicating. Scientific skill (Widhy, 2013) is one of the products that is expected in science process learning standard, specifically in

having scientific skill, thinking skill, and thinking strategy. The characteristic or standard of scientific-inquiry students (Gultom, 2013) is having critical thinking ability and creative thinking that involve the ability of observing, questioning, reasoning, trying, and communicating. Scientific approach in learning process involves observing, questioning, trying, cultivating, presenting, concluding, and creating. McCollum in Widhy (2013) said that the important components in teaching using scientific approach are teacher must present a learning that can foster a sense of wonder, improving the observation skill, push for analysis, and require communication.

Application of scientific-inquiry model that involve observation, formulating problem, hypothesizing, collecting data, and concluding through observing, questioning, reasoning, associating and communicating activity has a probability or potential to make the students have the scientific basic skills in analysing problems, communicating and associating concepts. At last, students will be accustomed and having scientific thinking skills.

Preliminary Study and Achieved Results

Various research results about the development of learning models in order to improve the learning quality, including scientific thinking skills, are: the development of inquiry learning strategy by Aryulina, D (2005) for science experiment, development of constructivist learning by STM approach in chemistry learning in senior high school (Rusmansyah, 2001), application of learning model and formal reasoning to improve student learning outcomes (Wirtha&Rapi, 2008), realistic constructivist learning by cooperative setting to improve the learning quality (Tanrere, 2007), Jusniar's research (20011) about the development of experiment starter by utilizing the environment materials that can improve the students' character values. Applying guided discovery model that have been done by Muharram &Jusniar (2013) is able to improve the active participation of senior high school student in learning and get positive response from both students and teacher. Jusniar, et al (2014) have developed science generic skill-based assessment that's expected to be able to increase the collegian basic skills in the experiment of physical chemistry I. Jusniar&Sumiati (2015) have developed a valid and practice scientific-inquiry learning model tool. The whole model is effective to alter the learning orientation from teacher centre into student centre. The changes of students' behaviours, such as activity, interests, motivation, creativity, reasoning and student learning outcomes, are indicated the improving of student scientific thinking skills.

The preliminary studies that have been done and related with the student scientific thinking skills are: the development of critical thinking skill to prepare the collegian entering globalization era (Liliasari, 2000) through applying science learning model. The result gives a positive impact in the collegian reasoning pattern, such as improving the proportional and combinatory logic. The improving of student's inquiry ability in acid-base through guided worksheet activity technique (Fernonika T, 2009). The improving of collegian's inquiry ability in biotechnology (Zulfiani, 2006). The fundamental principal in inquiry thinking ability is also the indicator to determine the scientific thinking skill, such as 1) doing observation, 2) questioning, 3) reasoning, 4) doing experiment to verify data, 5) communicating (making decision).

Research Method

This extensive implementation research is conducted in three senior high school in Gowa Regency, they are SMAN 1 Bontonompo, SMAN 1 west Bajeng and SMAN 1 Bajeng. School category used according to school accreditation, location and the age of school. Category A is represented by SMAN 1 Bajeng (superior

school), located in town and have been operated for more than 10 years. Category B is represented by SMAN 1 Bontonompo (school with accreditation B located in town or out of town and has been operated for more than 10 years). Category C is represented by SMAN 1 west Bajengwhich is a relatively new because it established for less than 5 years. The first step is socialization to all chemistry teachers about theory and scientific-inquiry model especially developed for chemistry subject needed experiment. Thus, research applied to student through quasi-experiment in electrolyte and non-electrolyte solution for applying the theory and model book made in year I.

Research Design

This research is quasi-experiment conducted in three senior high school in Gowa Regency, they are SMAN 1 Bajeng, SMAN 1 Bontonompo, and SMAN 1 Bajeng Barat. Independent variable in this research is learning model, while students' scientific thinking skill is the dependent variable.

Quasi-Experiment design used in this research is Randomized Control Group Pre-test post-test Design. The research variable consist of dependent and independent variable. Learning model is the independent variable and students' scientific thinking skill is the dependent variable. Research design can be seen in Picture 1.

Pre-test	Treatment	Post-test	
K	R	O_1	-	O_3
E	R	O_2	T	O_4

Exp:

O_1 = pre-test of control class (taught through direct instruction model)

O_2 = pre-test of experiment class (taught through Scientific – Inquiry model)

O_3 = post-test of control class (taught through direct instruction model)

O_4 = post-test of experiment class (taught through Scientific – Inquirymodel)

Data Collecting Technique

Data collecting in this research using instrument: 1) students' learning outcomes test (scientific thinking skill) 2) observation sheet of students activity to collect data about students' scientific skill in learning process; 3) Observation learning of teacher activity, used to collect teacher activity data related to the learning implementation that can improve students' scientific thinking skills. Indicator of scientific thinking measuring in learning process in the class related to the ability of; 1) formulating problem, 2) observing, 3) questioning and arguing, 4) hypothesizing, 5) collecting and analysing data, 6) discussing, and 7) concluding

Data Analysis Technique

Data analyse using descriptive and inferential statistic. Data collected from observation result of students' activity related to scientific thinking skill and teacher is analysed qualitative descriptively through analysis of evaluation and reflection by two steps, as like data reducing, displaying data, and

concluding. Students' learning outcomes test (scientific thinking skills) counting using Analysis of Covariant (Anacova) by using SPSS for windows 2.0

Indicator of learning model affectivity achieved

Indicator of socialization affectivity and application of learning model measured according to: 1) the existence of a good response from the chemistry teachers to theory and model socialization that have been conducted. 2) The increasing of students' scientific thinking skill at least 75% of each aspect is conducted. 3) The existence of a significant influence from the application of scientific-inquiry model to students' scientific thinking skill using ANACOVA.

RESULT AND DISCUSSION

Description of scientific-inquiry model implementation

The affectivity of scientific-inquiry learning model can be seen from the observation of learning implementation process, as like table 2.

Table 2. Percentage of scientific-inquiry model implementation in three senior high school in Gowa Regency.

Aspects	Skills/ Activities	SMA N 1 Bajeng			SMA N 1 Bontonompo			SMAN 1 west Bajeng		
		%(3)	%(2)	%	3(%)	2 %	1(%	3%	2%	1%
Formulating problem	Identifying keyword problems	62,5	25		50	37,5	12,5	50	37,5	12,5
	Identifying problem	62,5	25		50	37,5	12,5	50	37,5	12,5
	Writing for formulating problem	62,5	25		50	37,5	12,5	50	37,5	12,5
Observing	observing	87,5	12,5		87,5	12,5		75	25	
Questioning & Arguing	Asking questions	75	25		62,5	37,5		62,5	37,5	
	Giving argument/idea or response	75	25		62,5	37,5		62,5	37,5	
Hypothesizing	Formulating hypotheses	75	25		62,5	25	12,5	62,5	25	12,5
Collecting & analysing data	Collecting information/data	75	25		75	25		62,5	37,5	
	Analysinginformation	75	25		75	25		62,5	37,5	
Discussing	Teamwork	87,5	12,5		87,5	12,5		75	25	
	presenting discussion results	87,5	12,5		87,5	12,5		87,5	12,5	
Concluding	Summing up the concept (associate)	87,5	12,5		87,5	12,5		87,5	12,5	
Average		80,35	19,64		73,21	23,22	3,57	67,86	28,57	3,57

The Table 1 showed that the SMAN 1 Bajeng with featured category school district shows that the average adherence to all stages of the learning Scientific - Inquiry accomplished 100% with 80.35% classification done well and done quite well 19.65%. SMAN 1 Bontonompo accomplished 96.43% to 73.21% classification done well and done enough 23.22%. SMAN 1 west Bajeng accomplished 96.43% to 67.86% classification done well and done enough 28.57%. To SMA 1 Bontonompo and SMAN 1 west Bajengno/less accomplished respectively by 3.57%. This indicates that this model effectively applied.

Figure 2. Percentage of Implementation the scientific-inquiry model stages either three category of senior high school

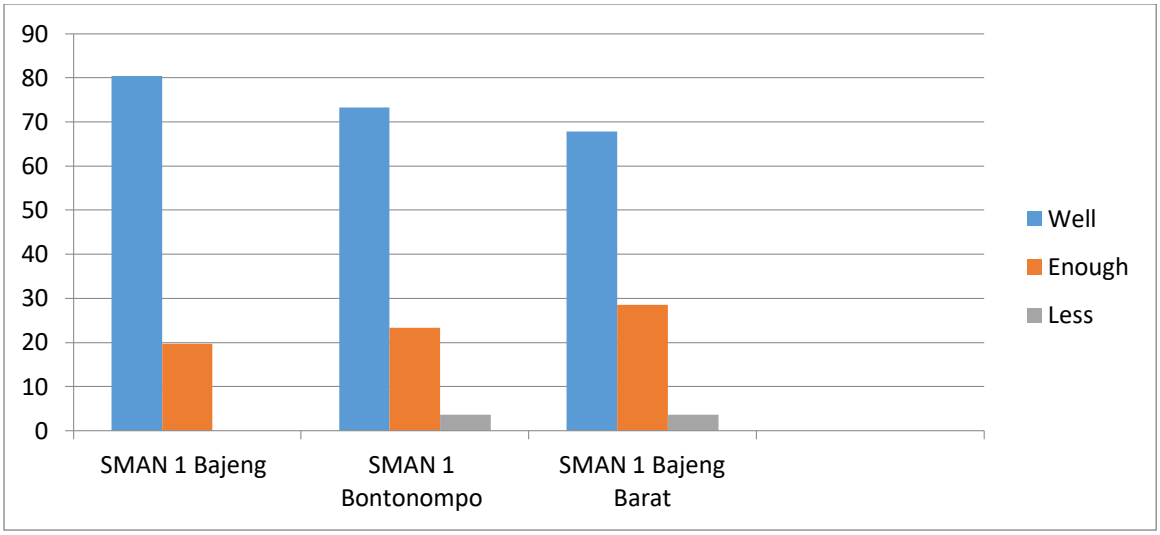
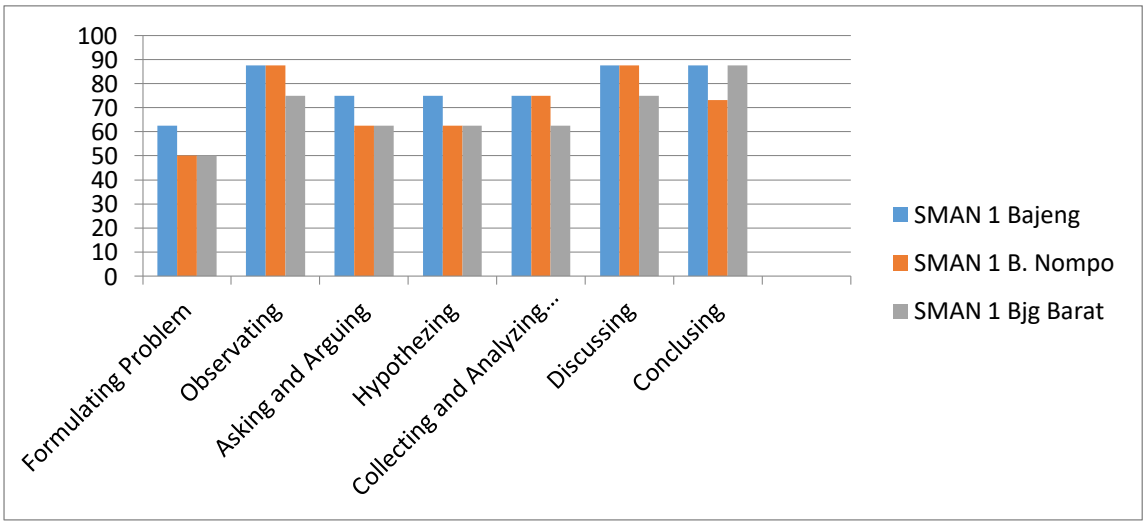
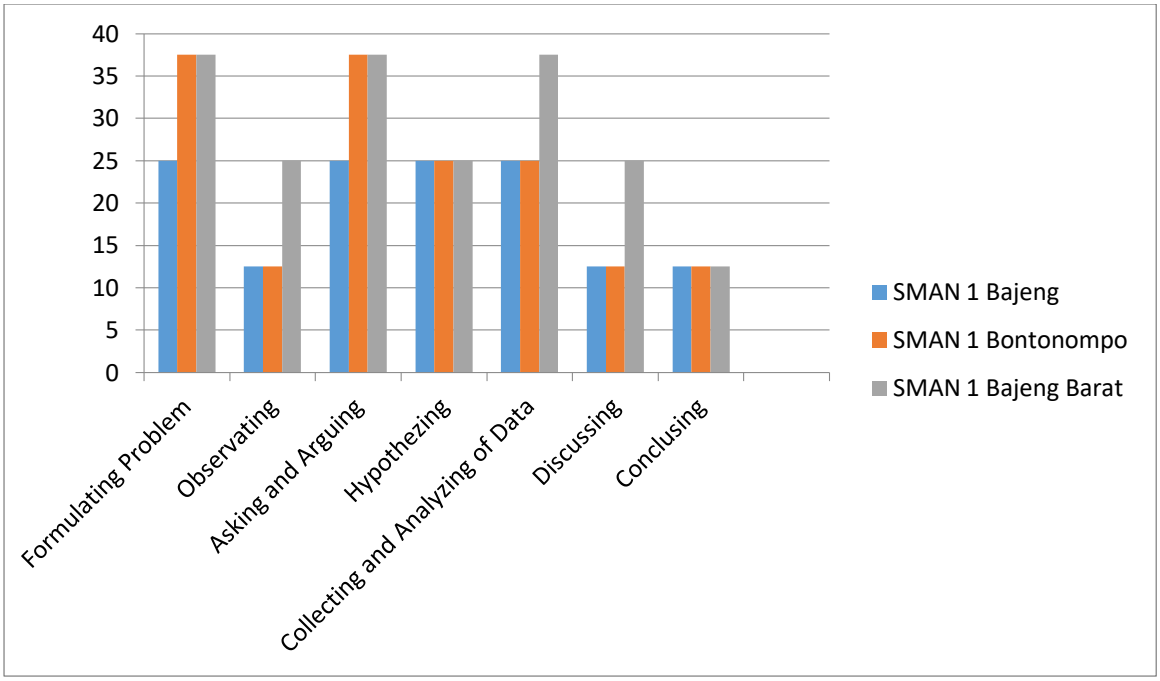


Figure 1. Average of Implementation Learning Process with Scientific-Inquiry Model



Observation results of Implementation Scientific-Inquiry models on three high school for each stage showed that for the category of done well seen that at the stage of observing fine each for SMAN 1 Bajeng and SMAN 1 Bontonompo of 87.5% and SMAN 1 West Bajeng 75 % this stage to maximize the ability/scientific skills students which is observing. Asking and arguing stage each for SMAN 1 Bajeng by 75%, while for SMAN 1 Bontonompo and SMAN 1 west Bajeng 62.5%, this stage to maximize the skills of the students asking. Collecting and analysing data on each of SMAN 1 Bontonompo and SMAN 1 Bajeng by 75%, while for SMAN 1 west Bajeng 62.5%, this stage maximizes students' reasoning skills. Discussing stage for each of SMAN 1 Bajeng and SMAN 1 Bontonompo of 87.5%, while for SMAN 1 west Bajeng by 75%, this stage maximize student comprehension skills of associates. Conclusing stage SMAN 1 Bajeng, SMAN 1 Bontonompo and SMAN 1 Bajeng Barat 87.5%, this stage to maximize the scientific skills of students in summing up the concept.

Figure 3. Description sufficient percentage of category three SHS for each stage of Scientific Inquiry Model



Implementation Scientific-Inquiry models on three high school for each inquiry stage showed that for the category of performing well enough at each stage of formulating the problem SMAN 1 Bajeng of 25% was SMAN 1 Bontonompo and SMAN 1 west Bajeng by 37.5%, observing stage for SMAN 1 Bajeng and SMAN 1 Bontonompo 12.5% and SMAN 1 west Bajeng 25%, asking and arguing stage each for SMAN 1 Bajeng by 25%, while for SMAN 1 Bontonompo and SMAN 1 west Bajeng 37.5 % this stage to maximize the students skills of asking. Collecting and analysing data on each of SMAN 1 Bontonompo and SMAN 1 Bajeng by 25%, while for SMAN 1 west Bajeng by 37.5% this stage maximizes students' reasoning skills. Discussing and concluding stage same for all three schools was 12.5% this stage to maximize the scientific skills of students in associate and conclude the concept.

Based on Figure 1 and Figure 2 about implementation stage description (done well and done enough category) learning with scientific-inquiry model, thus all of stage start from formulating problem untilconclusion showed that applied over 75% that means every stage done well and showed effectiveness of process.

Effectiveness Testing with ANACOVA

The results obtained with the analysis of covariate for SMAN 1 Bajeng as in Table 3, SMAN 1 Bontonompo in Table 4 and SMAN 1 west Bajeng in Table 5.

Table 3. ANACOVA processing results for SMAN 1 Bajeng

Source	Type III Sum of Squares	Df	Mean Square	F	Sig.
Corrected Model	534.027(a)	2	267.013	10.321	.000
Intercept	21417.287	1	21417.287	827.813	.000
X * Y	534.027	2	267.013	10.321	.000
Error	1500.583	58	25.872		
Total	412215.010	61			
Corrected Total	2034.610	60			

a R Squared = .262 (Adjusted R Squared = .237)

Table 3 showed that the implementation of the scientific-inquiry model influenced on scientific thinking skills in class X SMAN 1 Bajeng with significance of 0.000. Scientific-inquiry model percentage contribution towards scientific thinking skills of students amounted to 26.2% for SMAN 1 Bajeng.

Table 4. ANACOVA processing results for SMAN 1 Bontonompo

Source	Type III Sum of Squares	Df	Mean Square	F	Sig.
Corrected Model	1126.727(a)	2	563.363	24.896	.000
Intercept	20108.582	1	20108.582	888.633	.000
X * Y	1126.727	2	563.363	24.896	.000
Error	1380.349	61	22.629		
Total	424048.870	64			
Corrected Total	2507.076	63			

a R Squared = .449 (Adjusted R Squared = .431)

Table 4 showed that the scientific-inquiry model effect on scientific thinking skills with significance 0.000. The scientific-inquiry models percentage contribution towards scientific thinking skills of students of class X SMAN 1 Bontonompo amounted to 44.9%.

Table 5. ANACOVA processing results for SMAN 1 west Bajeng

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	343.855(a)	2	171.927	8.978	.000
Intercept	15583.257	1	15583.257	813.716	.000
x * y	343.855	2	171.927	8.978	.000
Error	1091.591	57	19.151		
Total	380570.950	60			
Corrected Total	1435.446	59			

a R Squared = .240 (Adjusted R Squared = .213)

Based on Table 5 showed that the implementation of the scientific-inquiry model effect on scientific thinking skills in students of SMAN 1 with significance 0.000. The scientific-inquiry models percentage contribution towards scientific thinking skills of students of class X SMAN 1 west Bajengamounted to 24.0% WestBajeng

Discussing

Effectiveness of learning model book from learning process implementation side by using all of stage reach 70% with category done well and done enough. From the three school as samples shows that SMAN 1 Bajeng with accreditation A and as a favourite school has highest implementation percentage of scientific-inquiry with done well 80.35% and done enough 19,65%. SMAN 1 Bontonompo has 96.43% with done well 96.43% and done enough 23.22%. SMAN 1 west Bajenghas 96.43% with done well 67.86% and done enough 28.57%. Stage that still has lowest percentage of implementation for three school is formulating hypothesis, according to chemistry teacher nor did students state that they are not familiar with using hypothesis.

Testing the effectiveness of the model through the book of scientific thinking skills that tests in three schools showed Anacova seen that the test results showed that all three school show that scientific-inquiry is effective models to improve scientific thinking skills of high school students, especially in experiment matter.

CONCLUSION

Book models and devices based on the results of the implementation of the three schools with different categories declared effective from implementation stage of the learning process and the results of scientific thinking skills test students on the material electrolyte and non-electrolyte solution.

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