Free Inquiry Learning Model with Experimental Methods on The Learning Outcomes of Class X Students of Senior High School on The Subject of Motion

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Abstract

The number of students who complain about the difficulty of learning physics is due to the many formulas and calculations so that the teachers always vary their teaching methods so that the material taught can be absorbed by students through this research, which is expected to overcome these problems. In addition, this study also aims to see the effect of applying the free inquiry learning model with the experimental method on student learning outcomes. This research procedure uses a quasi-experimental method. The sample in this study were all students of SMAN 1 Kolaka in class X which consisted of 10 classes totaling 400 people. In testing the pre-test data, the first ability of students in both classes is the same. After learning motion material in the experimental class with the Free Inquiry Learning Model with the experimental method, and the control class with the experimental method, the post-test data obtained with the experimental class average value being higher than the control class. The test results show that the free inquiry learning model on student learning outcomes in motion subjects can significantly improve student learning outcomes.

Key words: Free Inquiry Learning, experimental method

INTRODUCTION

The development of the ability and the formation of a dignified national character and civilization to educate the nation's life is the main function of Indonesia's national education, by developing the potential of students to become human beings who have noble character, faith and fear to God Almighty, healthy, knowledgeable, competent, creative, independent , and become responsible citizens (Arisa & Simamora,2014). Various problems faced by education in Indonesia to day are caused by the low quality of education. By continuing to develop curricula, teaching materials, learning models, and evaluation systems towards national and international standards. One of the efforts made by the government to do this goal is to develop the 2013 curriculum. Permendikbud Number 65 of 2013 about Process Standards, that the learning

model is prioritized in the implementation of the 2013 curriculum through the Inquiry Based Learning model, project-based learning model, and problem-based learning model (Problem Based Learning) and discovery learning models. (Discovery Learning) (Puspita & Jatmiko, 2013).

Various types of inquiry learning models were applied, one of which was the free inquiry learning model which was modified as a modification of two inquiry approaches, namely: the guided inquiry approach and the free inquiry approach by(quoted in the book Januar, 2011). With this approach, students cannot choose or decide on problems to be studied independently, but students who learn with this approach accept problems through their teachers to solve and still get guidance from their teachers (Jauhar, 2011). Less guidance than guided, unstructured inquiry. In the free inquiry approach, the teacher limits the provision of guidance so that students first try to find solutions independently. When there are students who cannot solve a problem, guidance can be provided indirectly by providing examples that are relevant to the problem at hand or through discussions with students in other groups research (Eristya & Aznam, 2019)

The modified free inquiry learning model can effectively improve student learning outcomes as well as train students' critical thinking skills. This is because students are directly involved in organizing the learning process. So that it can be used to train students' critical thinking skills as well as to familiarize students with andragogy learning styles that place students as learning subjects research by (Hadi, Susantini & Agustini, 2018)

Experimental methods are implemented real or virtual. Where the activity in question is in the form of an experiment testing the truth of a physical theory through observation, measurement and interpretation. Demonstration of physical events or symptoms, thus helping students to build their own knowledge, improve skills, and be directly involved in making observations research by (Arifin, Sudarti & Lesmono, 2016). The experimental method is a way of presenting lessons, where students conduct experiments by experiencing something they have learned. In the teaching and learning process, with the experimental method students

are given the opportunity to experience or work on their own, follow a process, observe an object, state or process something. Thus students are required to experience for themselves, seek the truth, and draw conclusions from the processes they are experiencing research by (Shofiah, Bektiarso, & Supriadi, 2017). From the opinions of several experts above, it can be concluded that the experimental method is a way of presenting learning material where students conduct experiments by experiencing to prove themselves a certain question or hypothesis. The objective of the experimental method according to research by (Abimanyu & Sulo, 2008) a). Students are able to deduce facts, information or data obtained, b) Students are able to design, prepare, implement and report experiments, c) Students are able to use inductive thinking logic to draw conclusions from facts, information or data collected through experiments, d) Students are able to think systematically, have high discipline, live an orderly and neat life.

The problem that is the topic under study can give or guide students according to the existing curriculum references. In this learning students do not choose or decide problems to be studied individually, but students who learn with this approach receive teacher problems to solve and still receive guidance, but the guidance provided is less than inquiry learning and is not structured according to (Madulara, 2012).

Based on the description above, the author aims to combine free inquiry learning with experimental methods with the theme of application of free inquiry learning models with experimental methods on physics learning outcomes of class x students of Sma Negeri 1 Kolaka which can improve student learning outcomes on the subject matter of motion which is carried out in the semester. Even. In addition, this method is also expected to improve children's cognitive, affective and psychomotor skills as evidenced by improving student learning outcomes.

The purpose of this study was to see the effect of student learning outcomes in class X high school on the subject of motion through the free inquiry learning model with the experimental method.

METHOD

This research was conducted at SMA Negeri 1 kolaka in the odd semester of the 2019/2020 school year. The sample of this research is all students of class x which consists of ten parallel classes. The sample was chosen because this school is a favorite school in kolaka district which has the most students. Through random sampling to get class x g as the experimental class using the free inquiry learning model with the experimental method and class x b as the control class students who are taught the lecture learning model. A quasi-experimental experimental design is a study in which experimental subjects in the control class and the experimental class must be selected randomly, so that there is no bias in class choice, as can be seen in table 2 according to Rahmawati (2018).

Group	Pretest	Treatment	Posttest
E_1	O_1	X_1	Y_1
E_2	O_2	X_2	Y_2

Information:
E1: Class With Free Inquiry Method Treatment With Experimental Method,
E2: Class With Lecture Method Treatment,
O1: Pretest Value Class-1
O2: Pretest Value Class-2
X1: Free Inquiry Learning Model With Experimental Methods
X2: Learning With The Lecture Method
Y1: Posttest Experimental Class-1
Y2: Posttest Experimental Class-2

The ability of students to be tested in this study is the results of the experimental class students against the control class students. The first stages in this research are through the preparation of research instruments, tests of student learning outcomes and observation of the level of student activity in learning physics. The instrument is used to measure learning outcomes which are arranged in the form of multiple choice. The student learning outcomes test consists of thirty (30) questions in the form of multiple choice with four choices, namely a, b, c, and d. This test was given 2 times, namely at the pretest and posttest. Before students are given pre-test and post-test questions, students are given a grid of questions about motion so that students can answer questions correctly on the test. The data analysis carried out includes (1) analysis to see the normality and homogeneity of research instruments, (2) analysis of the influence of learning models with structured learning methods in improving student learning outcomes, by analyzing the differences between pre-test and post-test learning on learning outcomes and levels. student activities, (3) data analysis of test results was carried out to see the improvement of student learning outcomes on the concept of motion by describing the data on the pretest and posttest -the test results of each student (Holden & Sahyar, 2015). The method of analysis used in this study uses two methods, namely descriptive statistical methods and inferential statistics. The data tested using descriptive methods include the average value, pre-test, post-test and n-gain. To find out that the application of the free inquiry model with the experimental method has an effect on students' conceptual understanding, a normalized gain formula is used by (Sofiah, 2017; Wijanto, 2008).

$$\langle g \rangle = \frac{\langle S_{post} \rangle - \langle S_{pre} \rangle}{100 - \langle S_{pre} \rangle}$$

The data used in this research is inferential statistical data through independent t-test. This independent t-test is used by researchers to test the data hypothesis. is there a difference after free inquiry learning is modified by the experimental method or not. After the data is tested for normality and homogeneity, the data will be t-tested independently to see if there are differences in treatment between the experimental class and the control class.

The data used in this study is inferential statistical data through independent t-test. This independent t-test was used by researchers to test the data hypotheses. whether there is a difference after the inquiry learning is freely modified by the experimental method or not. After the data was tested for normality to find out whether the research data was normal or not, a data homogeneity test of variance was then carried out to see if the data was homogeneous or not. Next, the researchers conducted an independent t-test to see if there was a difference in treatment between the experimental class and the control class.

RESULT AND DISCUSSION

The steps of the modified free inquiry learning model according to (Eristya & Aznam, 2019) can be seen in the following table:

Table 1. Stages of implementing the free inquiry learning model with experimental methods

Step	Teacher Activity	Students Activity
Orientation	The teacher conveys the learning topic and learning objectives. When learning activities take place in the classroom, the teacher also provides motivation and provides problems at the beginning of learning to be solved.	Students listen to the teacher's explanation about the topic of learning, learning objectives, motivation and take notes on the problems presented by the teacher.
Formulate problems	The teacher divides the students into several groups.	Students gather in groups that have been distributed by the teacher
Formulate a hypothesis	The teacher guides students to formulate hypotheses through groups and find the variables individually.	Students formulate hypotheses and variables used in the formulation of problems that have been given by the teacher
Data collection	The teacher asks students to see the tools and materials that have been provided, formulate experimental sketches and decide experimental work procedures in discussion groups.	Students see the tools and materials provided, formulate experimental sketches and decide experimental work rules in discussion groups.
	The teacher asks students to explain the experiment that has been designed.	Students explain the experiments that have been designed in class
Hypothesis Test	The teacher provides opportunities for students to analyze experimental results based on independent data tabulations, and students can discuss and answer some of the questions that have been included in the worksheet.	Students analyze the experimental results based on data tabulation while discussing also answering some questions on the worksheet..
Conclusion Withdrawal	The teacher asks students to conclude about the results of the experiment.	Students conclude the results of the experiment

In the first stage the teacher provides motivation, conveys the theme, the learning objectives also convey the problem to be solved so that at this stage students will be motivated to learn and can develop their affective and cognitive abilities for 5 minutes. Phase two the teacher divides students into several groups to solve the problem. will be done, where at this stage students will learn to work together in groups to solve problems given by the teacher for 5 minutes. In the third stage, students will be trained to make hypotheses as well as determine the independent variables and the dependent variable in the problem to be solved for 10

minutes. Stage four students will be trained to determine experimental sketches and experimental procedures will also carry out experiments or practicum according to the procedures students have while discussing with group friends. At this stage the psychomotor, affective and cognitive abilities of students are trained for 45 minutes. Stage five students will be trained to analyze experimental data and answer the questions listed in each student's worksheet for 20 minutes. Stage six students will be trained to conclude the results of their experiments for 5 minutes.

The lecture method is to explain the lesson material orally carried out by the teacher. The steps in the lecture method are: 1) the teacher formulates the learning objectives to be achieved, 2) the teacher conveys the main material to be studied. 3) The teacher will motivate students. 4) The teacher will explain the learning material sequentially so that students can listen to the teacher's explanation. 5) The teacher will conclude the subject matter. (Ranabumi, Rohmadi & Subiyantoro, 2017).

The problem will be used as a topic to be researched where the teacher is still given or guides students according to existing curriculum references. In this learning, students do not choose or determine problems to be researched individually, but students who learn with this approach accept teacher problems to be solved andstill receive guidance, but the guidance provided is less than guided and unstructured inquiry learning based on (Eristya, & Aznam, 2019).

The experimental method is a way of presenting learning materials where students conduct experiments by experiencing to prove themselves a question or hypothesis that is learned by conducting experiments, students can move optimally so that students can master the concept to the maximum as well (Andiasari, 2015). The experimental method is also often called an experiment, namely a way of presenting lessons, where students conduct experiments by experiencing what they are learning (Subekti & Ariswan, 2016).

Table 2. Description of the increase in student learning outcomes in the experimental class and control class

Score	Experimental class	Gain	
		Control class	
Maximum	0.89	0.75
Minimum	0.19	0.07
Average	0.55	0.35
Variance	0.05	0.04
Standard deviation	0.25	0.21

The increase in learning outcomes is also seen in the data on the gain value of the experimental class and control class students. Where the average gain score of the experimental class is 0.55 and the control class is 0.35 the greatest value of the experimental class is 0.89 while the control class is 0.75. So that a significant increase in the experimental class. Graphically, the increase in science-physics learning outcomes in the motion subjects of the experimental class and control class students can be seen in Figure 3.
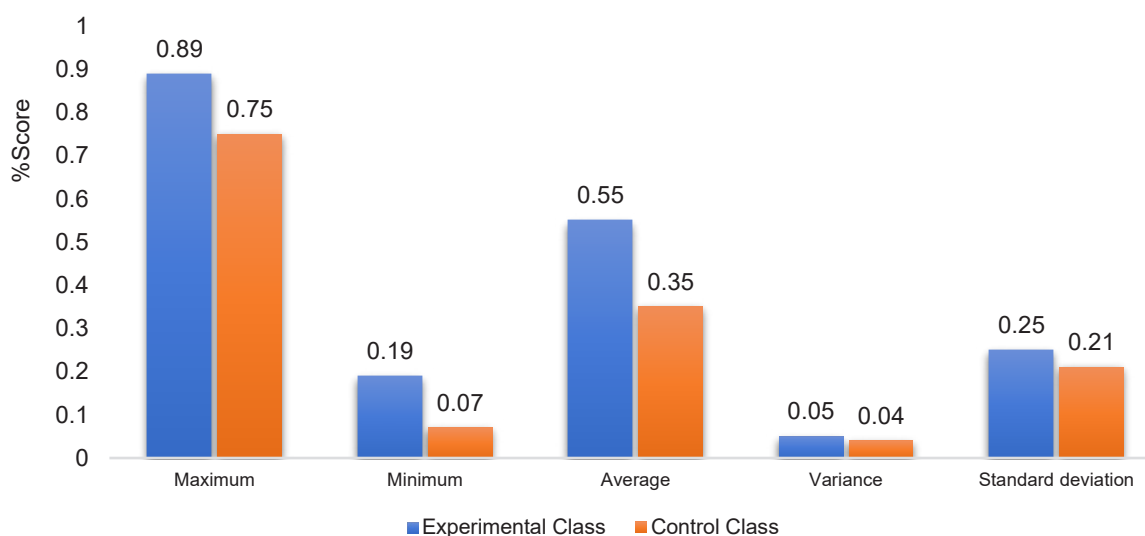
Figure 1. The Profile of the Increased Learning Outcomes of Experiment Class Students and Control Class Students

Based on Figure 1, it can be seen that the profile of the increase in student learning outcomes in the experimental class, the average score is in the greatest group and the average score increases more than the control class. The standard deviation and variance values show that the experimental class has increased. The increase in science learning outcomes of control class students has almost the same variance, namely 0.05 and 0.04. So that the increase in student learning outcomes is quite significant after learning using the free inquiry learning model using the experimental method. The modified free inquiry learning model is effectively used to train students' abilities and skills as shown by an increase in N-Gain scores, both N-Gain for each student and N-Gain for each indicator which has a positive correlation with understanding the concept by (Hadi, Susantini, & Agustini, 2018)

Based on Figure 1, it can be seen that the profile of the increase in student learning outcomes in the experimental class, the average score is in the greatest group and the average score increases more than the control class. The normality test is used to decide whether the data is normally distributed or not. The normality test was carried out on student process skills data both before and after treatment in each sample group. The normality test was carried out using a univariate approach, namely by performing the Kolmogorov-Smirnov test at the 5% significance level. The decision criterion used is if the significance value is greater than 0.05 then H0 is accepted (Kholilurrohman & Suryadarma, 2019).

The results of the homogeneity test of the variance data on the science-physics learning outcomes of the experimental class students and control class students are presented in Table 3.

Table 3. Homogeneity Test Results Data Variance Student Learning Outcomes in Experiment Class and Control Class

Data	F_{hit}	F_{tab}	Information
Pre-test	1,40	1,84	Homogeneous
Post-test	1.39	1,84	Homogeneous
Gain	1,09	1,84	Homogeneous

Based on Table 3 above, it can be seen that the pre-test, post-test and gain data show that the data is homogeneous. The homogeneity test aims to make sure that the data set to be measured comes from a homogeneous (same) population. The calculation of homogeneity was carried out by researchers when they wanted to compare behavior (variance) in two population groups (Widhiarso, 2011). The population used

was the experimental class and the control class. Because the student data in the experimental class is homogeneous, then the data will be tested for the hypothesis using the independent t-test equation.

The results of the average difference test for the experimental class students 'gain data and the control class students' gain data obtained a t_{count} value of 3.704 and a t_{table} value with a two-party test at α 0.05 and dk 59

obtained 1.675. Because $t_{count} > t_{table}$ is 3.704> 1.6725, it can be concluded that Ho is rejected, meaning that the average gain value of the experimental class students 'learning outcomes is much better than the average gain value of the control class students' learning outcomes. To see a complete recapitulation of the results of data analysis with the t-test can be seen in Table 4.

Table 4. Recapitulation of the results data analysis with the t-test

Tested Data	T_{count}	t_{table}
Pre-test	-0,165	1,670
Post-test	4,85	1,670
Gain	3,704	1,670

Based on the results of observations and analysis that learning using the free inquiry learning model method has a significant effect on student learning outcomes, it can be seen clearly in the pre-test and post-test results which before had an average score of students in the experimental class of 60.60 but After learning is carried out the average score increases to 85 while the control class using experimental methods the pre-test average score is 61.95 with the posttest acquisition of 77.40 so that the free inquiry learning model is not only suitable for college but also suitable for SMA / SMA level. So it is proven that the modified free inquiry model can help students get scientific concepts that students must learn, (Shofiyah, 2017).

The modified free inquiry model optimizes the process of accepting learned concepts because students are more active and involve more senses (Hadiati, 2012). In the modified free inquiry learning model, students are given the freedom to develop skills to hypothesize, see, carry out investigations, process data, and draw conclusions, so that they can help improve student achievement (Mandala,

2012). Based on the test results, the modified inquiry learning model was proven to improve student learning outcomes and to increase student creativity and achievement. This research is in line with the findings (Kholilurrohman & Suryadarma, 2019) that at least the role and guidance of educators in learning activities constructs / builds ideas into new experiences that are explored in the form of performance in learning. With a modified free-question approach it is proven to be able to cut the role of educators as a single informant and too dominant in learning. For further research development, a modification of the approach that is useful for maximizing students' critical thinking skills can be carried out. In addition, the modified independent inquiry method can also arouse students' curiosity and interest so that students are motivated to do practical work (experiment) and process the data obtained. A Ginanjar (2015) Student learning motivation in groups of students taught through inquiry learning is better than students taught through direct learning methods in groups of students with high scores and groups of students with low scores by (Nurhadi, Zural, Zubir & Rosba, 2018)

CONCLUSION

Through the free inquiry learning model with experimental methods on the learning outcomes of class X high school students in the subject of motion, it was proven to improve by looking at the post-test average score which was significantly increased in the experimental class students who were higher than the control class as well as affective abilities, The psychomotor and cognitive abilities of the experimental class students were shown to improve during the learning process due to the students being directly involved in the learning process through experiments they carried out in class or in the laboratory. The enthusiasm of students appears when formulating problems, making hypotheses, determining variables as well as making procedures, conducting experiments, analyzing data tabulations together, answering questions on worksheets to concluding the experiment. While the lecture method used in the control class is not suitable for physics material because students experience a point of saturation during the learning process because the discussion of the material is only centered on the teacher and students are less involved in the learning process. It is recommended for physics teachers to try to use this model and method to improve students' affective, cognitive and psychomotic abilities so that students' interest and learning outcomes can increase more optimally.

REFERENCES

Abimanyu S. & La Sulo S.L. (2008). *Strategi Pembelajaran.* (4 pages 1-). Jakarta : Depdiknas.

Andiasari L. (2015). Penggunaan Model Inquiry dengan Metode Eksperimen dalam Pembelajaran IPA di SMPN 10 Probolinggo. Jurnal Kebijakan dan Pengembangan Pendidikan Volume 3, Nomor 1, 15-20 ISSN: 2337-7623; EISSN: 2337-7615.

Arifin, Z., Sudarti, S., & Lesmono, A. D. (2016). Pengaruh Model Quantum Learning Disertai Metode Eksperimen Terhadap Hasil Belajar Fisika Siswa Di Sma Negeri Kalisat. *Jurnal Pembelajaran Fisika*, *4*(4), 365-370.

Arisa, Y., & Simamora, P. (2014). Pengaruh Model Pembelajaran Inquiry Training Terhadap Hasil Belajar Siswa pada Materi Pokok Fluida Statis. *Jurnal Inpafi*, *2*(4), 54–60.

Astra dan Sumiati. (2008). *Metode Pembelajaran*. Jakarta : Wacana Prima.

Eristya, A. M. & Aznam, N. (2019). Natural Science Learning with Modified Free Inquiry to Develop Students' Creative Thinking Skills. *Journal of Physics: Conference Series*, *1233*(1). https://doi.org/10.1088/1742-6596/1233/1/012107.

Ginanjar A, 2015. The Influensce Of Inquiri Method In Motivating The SMP' Student. JURNAL KEPENDIDIKAN, Volume 45, Nomor 2, Halaman 123-129 learning,

Hadi SA, Susantini E, and Agustini R, (2018). Training of Students' Critical Thinking Skills through the implementation of a Modified Free Inquiry Model. *Journal pf Physics: Conference Series, 947(1).* doi:10.1088/1742-6596/947/1/012063.

Hadiati, S. P. (2012). Termodifikasi Pada Materi Fluida Statis. *Jurnal Edukasi Matematika Dan Sains, 1*(1), 1–3.

Hadi SA, Susantini E, Agustini R, (2018). Training of Students' Critical Thinking Skills through the implementation of a Modified Free Inquiry Model. Journal of Physics: Conf. Series 947 (2018) 012063 doi :10.1088/1742-6596/947/1/012063

Holden S. D. & Sahyar. (2015). Pengaruh Model Pembelajaran Inkuiri Terbimbing Berbasis Eksperimen Riil dan Laboratorium Virtual terhadap Hasil Belajar Fisika Siswa. *Jurnal Pendidikan Dan Kebudayaan*, *21*(3), 299. https://doi.org/10.24832/jpnk.v21i3.192.

Jauhar, M. (2011). *Implementasi Paikem: dari behavioristik sampai konstruktivistik*. Prestasi pustaka Publisher.

Kholilurrohman, K., & Suryadarma, I. G. P. (2019). the Effect of Modified Free Inquiry Approach on Student'S Process Skill and Science Attitudes. *Journal of Science Education Research*, *3*(1), 67–80. https://doi.org/10. 21831/jser.v3i1.27630.

Mandala, I. P. (2012). Pengaruh Model Pembelajaran Inkuiri Bebas Terhadap Hasil Belajar Kimia Siswa Kelas Xi Ipa Sma Negeri 1 Gianyar Ditinjau Dari Sikap Ilmiah. *Jurnal Pendidikan Dan Pembelajaran IPA Indonesia*. 12(2).

Nurhadi, Zural M M, Zubir Y and Rosba E (2018). The Development Test of Practical Work Module of Animal Structure Using Modified Free Inquiry. J. Phys.: Conf. Ser. 1108 012011

Puspita, A.T. & Jatmiko, B. (2013). Implementasi Model Pembelajaran Inkuiri Terbimbing

(Guided Inquiry) Terhadap Keterampilan Berpikir Kritis Siswa Pada Pembelajaran Fisika Materi Fluida Statis Kelas Xi Di Sma Negeri 2 Sidoarjo. *Jurnal Inovasi Pendidikan Fisika*, *2*(3), 121–125. https://jurnalmahasiswa.unesa.ac.id/index.php/inovasi-pendidikan-fisika/article/view/3655/1961

Rahmawati, F. (2018). Perbedaan Pendekatan Inkuiri Terbimbing (Guided Inquiry) dan Pendekatan Inkuiri Semi Terbimbing (Modified Free Inquiry) Terhadap Keterampilan Berpikir Kritis Siswa SMP. *Journal of Chemical Information and Modeling*, *53*(9), 1–7. https://doi.org/10.1017/CBO9781107415324.004

Ranabumi R, Rohmadi M, Subiyantoro S, 2017. Penggunaan Metode Ceramah Dalam Pembelajaran Menulis Teks Eksposisi Pada Siswa Kelas VII-B SMP Negeri 5 Kediri. Education and Language International Conference Proceedings Center for International Language Development of Unissula (ELIC). Vol 1 No. 1

Shofiah, R. I., Bektiarso, S., & Supriadi, B. (2017). Penerapan Model POE (Predict-Observe-Explain) dengan Metode Eksperimen Terhadap Hasil Belajar IPA & Retensi Siswa di SMP. *Jurnal Pembelajaran Fisika*, *6*(4), 356–363.

Shofiyah, N. (2017). Penerapan Model Pembelajaran Modified Free Inquiry untuk Mereduksi Miskonsepsi Mahasiswa pada Materi Fluida. *SEJ (Science Education Journal)*, *1*(1), 19. https://doi.org/10.21070/sej.v1i1.836

Subekti Y, Ariswan A. 2016. Pembelajaran Fisika dengan Metode Eksperimen untuk Meningkatkan Hasil Belajar Kognitif dan Keterampilan Proses Sains. Jurnal Inovasi Pendidikan IPA, 2 (2) http://journal.uny.ac.id/index.php/jipi

Widhiarso W. (2011). *Uji hipotesis komparatif*. FP UGM.Yogyakarta

Wijanto, S. (2008). *Structural equation modeling dengan listed 8.8: konsep dan tutorial* (3 (1)). Graha Ilmu.