LOOK ACADEMIC PUBLISHERS
OPEN ACCESS

INTERNATIONAL JOURNAL OF ENVIRONMENTAL & SCIENCE EDUCATION
2016, VOL. 11, NO. 12, 5676-5686

The Development of Discovery-Inquiry Learning Model to Reduce the Science Misconceptions of Junior High School Students

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ABSTRACT

The main objective of this research was to develop discovery inquiry (DI) learning model to reduce the misconceptions of Science student level of secondary school that is valid, practical, and effective. This research was an R&D (research and development). The trials of discovery inquiry (DI) learning model were carried out in two different classes in SMPN 2 Maros, South Sulawesi. The results of the study after two trials showed that the discovery inquiry (DI) learning model have been valid, practical, and effective. The discovery inquiry (DI) learning model is stated to be valid because the assessment of all learning components conducted by validator meets the elements of validity. It is stated to be practical because the discovery inquiry (DI) learning component is fully implemented, and the ability of teachers to manage learning is at the high category. It is stated to be effective because the misconceptions of Science student are in the medium category. The activities of students in learning are fulfilled the ideal time achievement, and the results of the students' questionnaire give the positive respond to discovery inquiry (DI) learning. It is concluded that the discovery inquiry (DI) learning model to reduce the misconception of Science students meets the criteria of valid, practical, and effective.

KEYWORDS
Discovery inquiry, misconceptions of science, learning model

ARTICLE HISTORY
Received 13 April 2016
Revised 14 June 2016
Accepted 19 June 2016

Introduction

Every nation in the world recognizes that education is a right of all children. Education has been regarded as a human right which should be owned and enjoyed freely by all the children. As stated in the Universal Declaration of Human Rights 1948 Article 26 (1) states that:

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> "Everyone has the right to education. Education shall be free, at least in the elementary and fundamental stages. Elementary education shall be compulsory. Technical and professional education shall be made generally available and higher education shall be equally accessible to all on the basis of merit"

The various issues concerning the future of education still continue to reap the never-ending debate. The government has made various efforts to improve the quality of education in Indonesia, including the allocation of education funds 20% of the state budget, allowance certifications for educators, enforcement of educational autonomy, until changing the curriculum. The effort is expected to give assurances of holistic educational purposes. Education is so instrumental in maximizing the human potential. Ki Hajar Dewantara as educational leaders in Indonesia struggled to advance the nation regardless Race, Cultures and Nations. Through Sekolah Taman Siswa, which he founded, he struggled to build a protégé of Indonesian human being free inwardly and outwardly, noble his intellect, and healthy physical to become a member of a useful and responsible public for the harmony of the nation, the homeland, as well as people in general (Sukardjo 2012 : 99). Education holds a very big role against human dignity, maximizing human potential so they have dignity and good morale (M Yamin, 2013: 2).

The researchers found that one of the low ability of students in the field of science is due to the occurrence of errors or misconceptions concept of science among students. The problem of Science misconceptions has become a common problem and happens to students at all levels of schooling. According to Kadim Masykur in Simarmata (2008), the concept of error in the field of Science has occurred everywhere and occurs at low levels of education to higher education. In this case, based on a preliminary survey conducted by researchers to students of SMP Negeri 2 Maros, South Sulawesi has identified the misconceptions of Science to the students, which have an impact on the low mastery of concepts owned by the students. In terms of learning tools that are used in schools, the researchers observed that science teaching devices that are used both books learners and Students Work Sheet still general and not specifically designed in order to reduce the occurrence of Science misconceptions. It is feared that if this continues over time without any attempt to solve it, then students who have misconceptions especially those still sitting in junior high schools, will find it difficult and failed in mastering the advanced science concepts. The mastery of the low basic concepts in understanding the material of Science will allow a false understanding of the concept and the subsequent effect on the learning outcomes of the students. This is proved from several studies indicates that one of the low cause of the Physics result is the misconception of students (Tayubi 2005, Adnyani et al, 2013; Iriyanti.N.P et al, 2012). The student often interprets the concept that is considered difficult in accordance with pre-conception that he already owns. Sometimes, the interpretation of students is not in accordance with the concept agreed by experts. A different concept is called as misconceptions or false concepts (Suparno, 2005). Another name from the term misconceptions is intuition, alternative concept, alternative framework and naive theory (Taufik, 2012, Yunitasari.W. et al. 2013).

The researchers saw that one of the causes of the Science misconception among junior high school students is the learning model used by a Science teacher still use the old paradigm. The researchers assess that most Science teachers,

especially Physics still teaching Science based on the textbook, with emphasis on lecture and occasionally asked questions. Students have to follow the way of learning that is selected by the teacher and obediently studying the sequence that assigned by teachers. Students are less to get the opportunity to be actively involved. The learning is generally exam-oriented so, the result of learning occur just a transfer of information from the teacher to the student. Learning its only memorize the concepts, theories or formulas, so it does not provide a deep understanding of the concepts being studied. It is relevant with Taufik.M (2013: 43) who said that the conventional learning is strongly suspected as a barrier to achieve the remediation of misconceptions and adequate understanding of the concept. The finding of such issues is supported by Ilahi (2012) said that Science learning is not providing opportunities for students to find and implement their own ideas.

Therefore, teachers need to implement a model of Science learning to change the old paradigm and overcome these weaknesses in order to realize the expected Science learning goals. The learning model that suitable to enable students and is expected to reduce the misconceptions of Science is *discovery-inquiry* learning model. By *discovery-inquiry* learning model, the students are actively involved in acquiring the concepts and principles and the teachers encourage the students to gain experience by doing activities that enable them to find the concepts and principles for themselves (Slavin, 1994). When the students find a concept that contradicts with the initial concept, there will be a cognitive conflict on children's cognitive structure. The stimulation of cognitive conflict in Science learning will greatly assist in the process of assimilation to become more effective and meaningful. The use of *inquiry-discovery* learning model is not only relevant with the steps of the scientific method but also relevant to the learning theories such as Piaget's theory of cognitive, conditioning, and constructive (Nirvana, 2013).

The knowledge gained by learning the invention (discovery) allows the knowledge that last a long time or is more easily remembered. Some studies show that *discovery-inquiry* learning model is very superior and effective to be used in learning, especially for Science learning. The research conducted by Abdisa (2012) on the effect of *guided discovery* learning in teaching Physics conclude that there is a difference between *guided discovery* learning, demonstration, and expository in rotational motion of matter in the lecture. On the basis of the significance obtained from those three, the level of achievement is high, medium and low. This was confirmed by several studies showed that the model of *discovery-inquiry* proved to be effectively used in learning. (Yusnita.R et al, 2014, Istikomah et al, 2013, Wenning.C.L, et al., 2011) The research conducted by Fajar.DM. (2013) found that the inquiry learning model is significantly capable of lowering the misconception of dynamic electricity material. So, it is assumed that learning using *discovery-inquiry* learning model, not only guiding the students to deeply investigate about the concept (inquiry) but also familiarize the students in solving the problem. The invention concept (discovery) is expected to reduce the occurrence of Science misconceptions among the students.

Problem of Research

The problem statement in this research is how to design a *discovery inquiry* learning model to reduce the misconceptions of Science student level of secondary school that is valid, practical and effective.

Objective of the Study

The objective of this research is to create a design of *discovery inquiry* learning model to reduce the misconceptions of Science student level of secondary school that is valid, practical and effective.

Significance of the Study

The significances of the research are:

i. Produce the *discovery-inquiry* learning model that is expected to reduce the Science misconceptions for Junior High School student.
ii. Give contribution to teachers in general and science teachers of junior high school in particular about *discovery-inquiry* learning model.

Method

Types of Research

The type of this research was development research. To initiate the development of this research, it conducted preliminary research to uncover the Science concepts that are prone to misconceptions among students. The preliminary research result used as support material in the development of learning model.

Research Subject

The research was conducted at eight grade student of SMP Negeri 2 Maros Academic Year of 2015-2016. The characteristics of all eight grade of SMP Negeri 2 Maros Academic Year of 2015-2016 were relatively same, because the process of class formation was randomly did and not by the level of capability. The research subjects selected 2 class out of 10 classes namely, VIII-A and VIII-C.

Research Variable

The main variable in this study is *discovery inquiry* learning model. While the other variables to consider or be involved in the development of *discovery inquiry* learning model is (1) the misconceptions of Science students, (2) the effectiveness of normative models, namely compatibility between learning model theoretically with the implementation in the classroom, and (3) the effectiveness of correlative model that can be observed from the students' activity in the learning process.

Research Introduction

The preliminary study conducted to reveal the general overview of the implementation of Science teaching at Junior High School level and the Science misconceptions that happened to the students.

Research Development

The learning model that would be developed in this research was *discovery inquiry* learning model to reduce the misconception of Science students. The stages of the development learning model referred to the development model stages proposed by S.Thiagarajan, Semmel and Semmel (Four-D models). While the components that were included in the model referred to learning model components proposed by Joice, Weil, and Shower (1992), namely: (a) syntax, (b)

social system, (c) the principle of reaction, (d) support systems, and (e) the impact of instructional and companion.

The stages of the development *discovery inquiry* learning model to reduce the misconceptions of Science students were as follows:

a. Defining Stage

This stage was to identify and study about: (1) learning models as a comparison oriented to several elements, among others: the syntax, the underlying theory, and the research results of the models (in particular, study the *discovery inquiry* learning model in reducing the Science misconceptions), (2) learning theories related to *discovery inquiry* learning and Science misconceptions, (3) Science curriculum at Junior High School level, the condition of the students and the environment as a support system, and so on.

b. Designing Stage

The main activity in this stage was to design *discovery inquiry* learning model to reduce the misconceptions of Science students. The details of the main activities at this stage include: (1) designing the syntax learning or *discovery inquiry* learning activity to reduce the misconceptions of Science students, (2) designing the social systems, namely the role of educators and students in *discovery inquiry* learning activities along with the rules and signs that must be followed along in the process of Science learning, (3) designing the principles of reaction namely, the description of what the teachers required in responding every action and behavior of students, particularly their questions, (4) designing a support system or condition required by the model. These conditions include: conditions of the students, the atmosphere of learning, learning facility, learning media and learning devices.

c. Development stage

This stage includes: (1) requesting the opinion of experts, (2) conducting the implementation of prototype I trial that conducted in eight grade of SMP Negeri 2 Maros Academic Year 2015/2016, (3) conducting a revision of prototype I based on the results of testing and consideration by the researchers, experts, and teachers. The revision activities carried out against things that are deemed necessary for each component of the model. From the results of the study, it was designed the prototype II to be tested. Furthermore, it revised again on the components that are considered necessary, then tested again (trial II). The learning materials for prototype II was the concept of Vibration and Optics. In this second trial, it used the prototype final *discovery inquiry* learning model on VIII-A grade of SMP Negeri 2 Maros. The learning material in the final prototype was still same, namely the concept of Vibration and Optics.

Technique of Data Analysis

The data analysis was conducted by referring the research problems. Based on the research problem, the data analysis was done in two ways, quantitative and qualitative. To answer the test results of Science misconceptions, it used descriptive statistical analysis by N-gain normalization test. In addition, to clarify the interpretation of the results of the analysis, the data acquisition was also described in the form of diagrams.

For the development research, the dominant analysis activity is qualitative and it has been implied in a whole series of activities that carried out in each stage

of the development of learning model. This analysis was conducted on all components of the model that was done by Joice, Weil, and Showers (syntax, social system, the principles of reaction, support systems, and the impact of instructional and accompanist) among others, pay attention to (1) the learning device, (2) teaching-learning activities, and (3) the effectiveness of learning.

Results and Discussion

The results obtained at each phase of development regard to the development process of *discovery inquiry* model can be described as follow:

Stage 1: Defining

Before carrying out the research, the researchers identified a model of learning and Science misconception by providing observation sheet to the Science teachers at SMP Negeri 2 Maros. Based on the results of the initial study that had been done, it was revealed that students in the school generally had Science misconceptions on some specific Science concepts and it needed a specific Science learning model to reduce the Science misconception. The model was expected to have valid, practical and effective criteria.

Stage 2: Designing

The results design of *discovery inquiry* learning model was to establish the format of the book models, namely (1) Rational, (2) Support Theories, (3) *Discovery Inquiry* learning model, and (4) The Direction of Model Implementation. The rational development of discovery inquiry learning model included the things which become the primary consideration or the important basic of *discovery inquiry* model to reduce the Science misconceptions. It also included the results of the research that support the development. In the section about the supporting theories, it stated some related theories, namely (1) the philosophical basis of *discovery inquiry* model, (2) the psychological basis of *discovery inquiry* model, and (3) the learning theory basis. In the section of *discovery inquiry* learning model, it discussed about the basic concept of *discovery inquiry* learning model, the characteristics of *discovery inquiry* learning model, the components of *discovery inquiry* learning model, and the evaluation applied in learning.

In the section of the direction of model implementation, it discussed two main parts, namely the planning and the implementation of learning. In the planning section, it discussed about the things that need to be prepared so, the *discovery inquiry* learning model can be occurred in a practical and effective, namely (1) Lesson Plan, (2) Students Text Book, (3) Student Worksheet, (4) Task Sheet, (5) Learning Media, and (6) Science Misconception Test. In the section of implementation learning, it discussed the syntax implementation of *discovery inquiry* learning model which consisted of seven phases, namely: Phase 1: explaining the learning objectives, phase 2: the orientation of students in problem (problem statement), Phase 3: giving stimulation, phase-4: formulating the hypotheses, phase-5: conducting the investigation and discovery (experiment), phase-6: presenting the results of the investigation and discovery (verification), and the phase-7: deducing (generalization).

The Results of Designing Learning Tool

In the design phase, the instruments of learning that designed had set the format and the selection of related elements such as: (1) Lesson Plan, (2) Student Text Book, (3) Student Worksheet, and (4) Science misconception test.

In this phase, the Lesson Plans that were successfully designed based on syntax discovery inquiry learning model by taking the consideration related with other components such as reaction principle, social systems, and the impact of instructional and accompanist impact. The draft results of student text book referred to the subject of vibration and light. Student text book was designed referred to the basic competence, learning objectives and implementation guidelines.

In the initial design, the Science misconception test had successfully designed 30 test items of true false type (T-F). This instrument was a test item of Science misconception which designed to measure the success of its reduced Science misconception. The design of the test was based on the study and the results of the preliminary observations about the Science material that prone to have misconceptions in SMP Negeri 2 Maros.

The Results of Designing Research Instruments

The validity instruments that produced in the design phase was to define the aspects of assessment and indicators in every aspect related to (1) the validation analysis requirement sheet of the development model (2) the validation sheet of *discovery inquiry* (DI) learning model, (3) the validation sheet of the implementation of learning model, (4) the validation sheet of the capability of managing model (5) the validation sheet of students' activity (6) the validation sheet of students responses questionnaire sheet, and (7) the validation format of learning device (Lesson Plan, Student Text Book, and the sheet of Science misconception test.

The practicality instruments that successfully designed covered the observation sheets, namely: (1) The observation sheet of the implementation of learning model and (2) The observation sheet of the teachers' ability to manage the learning. While the effectiveness instruments which designed include: (1) The evaluation sheet of Science misconception test, (2) Students' activity observation sheet, and (3) Students responses questionnaire sheet.

Stage -3: Development

a. Test Results of Validity

The validation result of *discovery inquiry* (DI) learning model showed that the average value of total validity of *discovery inquiry* (DI) learning model was Y = 3.40. If this value was confirmed on the validity criteria of *discovery inquiry* (DI) learning model, then it categorized as valid ($2.5 \leq M \leq 3.5$). So, in terms of all aspects of the *discovery inquiry* (DI) learning model, it had met the criteria of validity.

The validation results of learning device for 3 (three) Lesson Plans that developed had the same value that was Y = 3.79 (very valid). There were eight (8) Students Worksheet that developed and all of them had the same validation value that was Y = 3.71 (very valid). The students' text book which consisted only one had the validation value of X = 3.61 (very valid) and for the Science misconception that developed had the average value of Y= 3.42 (valid). So, in terms of all aspects of learning tools such as lesson plans, student worksheet, student text book and Science misconception test then it stated that it had met the validity criteria.

In brief, the analysis result of validity instrument showed that: (1) The assessment result of the analysis requirement sheet of the development of

discovery inquiry (DI) model by validator got an average scored Y = 3.55 (very valid) with the reliability coefficient R = 0.943, (2) The assessment result of *discovery inquiry* (DI) model by validator got the average value of total X = 3,38 (valid) with the reliability coefficient R = 0.863, (3) The assessment result of observation sheet of the teachers' ability to manage the learning by validator for all aspects got an average scored X = 3, 42 (valid) with the reliability coefficient R = 0.857, (4) The assessment result of observation sheet of the implementation of learning model by validator for all aspects got an average scored = 3,39 (valid) with the reliability coefficient R = 0.857, (5) The assessment of evaluation sheet of Science misconception test obtained an average validation value with the total of = 3.42 (valid), (6) The average value of total validity of students' activity observation sheet for all aspects was = 3.81 (very valid) and (7) The average value of total validity from students responses questionnaire sheet to all aspects was = 3.81 (very valid). So, if it reviewed from all aspects, then all the instrument sheets had met the criteria of validity.

b. Test Results of Practicality Model

Based on the result analysis of the implementation of syntax components during trial I, it obtained an average score of the implementation of syntax components M = 1.70, social interaction component M = 1.65, the principle reaction component M = 1.72, the instructional component and the accompanist impact M = 1.79, the supportive learning device component (support system) M = 1.89. It can be concluded that on average, all the components of the implementation of *discovery inquiry* (DI) learning was fully implemented ($1.5 \leq M \leq 2.0$). While on trial II, it obtained an average score of the implementation of syntax components M = 1.80, social interaction component M = 1.83, the principle reaction component M = 1.87, the instructional component and the accompanist impact M = 1.88, the supportive learning device component (support system) M = 1.97. It can be concluded that on average, all the components of the implementation of *discovery inquiry* (DI) learning in trial II was fully implemented ($1.5 \leq M \leq 2.0$).

The analysis result of teachers' ability to manage the *discovery inquiry* (DI) learning in trial I was the average value of the teacher's ability to manage learning in introductory activities had a value of 3.46 (high), the core activity was 3.42 (high), the closing activity was 3.46 (high), the ability to manage was 3.50 (very high), the aspects of classroom atmosphere was 3.50 (very high). While in trial II, the average value of a teacher's ability to manage learning in introductory activities had a value of 3.54 (high), the core activity was 3.50 (high), the closing activity was 3.42 (high), the ability to manage the time was 3.42 (very high), the aspects of classroom atmosphere were 3.67 (very high). So, in terms of all aspects of learning management, then *discovery inquiry* (DI) learning model in trial I and II stated had met the criteria of practicality.

c. Test Results of the Effectiveness Model

The results of the effectiveness *discovery inquiry* (DI) learning model on each trial were analyzed by observing the activity of students, students' questionnaire responses and the result test of Science misconception. At the trial I and II, the observation result of students showed that 9 out of 10 categories of students' activity met the PWI Tolerance Interval (%) which is determined. This showed that in terms of the aspects of the students' activity, the *discovery inquiry* (DI) learning model trials I and II had met the criteria of effectiveness.

Based on the data from the response of students, it obtained that 26 students of trial I and 24 students on trial II, generally responded positively to the learning model, learning tools, learning atmosphere in the classroom, the way teachers teach, and the language used in the learning device. The students felt happy in conducting an experiment/observation during the lesson. This showed that in terms of the aspects of the students' response, the *discovery inquiry* (DI) learning model in trials I and II had met the criteria of effectiveness.

Based on the result test of Science misconception that had been achieved in pretest and posttest on trial I reached the classical mastery learning. The calculation of the normalized gain analysis (test N-Gain) found that the average value of the N-Gain was overall 0.32 or in the middle category. However, the number of students who have increasing score had not met the requirement (less than 70%). This showed that the *discovery inquiry* (DI) learning model on trial I stated had not been effective to reduce the Science misconception, so it needed to be reflected and made revision.

Based on the result test of Science misconception that had been achieved in pretest and posttest on trial II reached the classical mastery learning of 86%. Based on the calculation of the normalized gain analysis (test N-Gain) found that the average value of the N-Gain overall by 0.48 or middle category. In this case, the number of students who have increasing score had already met the requirement (over 70%). This showed that *discovery inquiry* (DI) learning model on the trial II declared to be effective to reduce the Science misconception.

Therefore, in terms of the overall indicator validity, practicality and effectiveness of the model, it can be concluded that *discovery inquiry* (DI) learning model after going through phase I and II trials deemed to have met the criteria of validity, practicality and effectiveness.

Stage -4: Dissemination

Dissemination was the socialization of the result of the development research of *discovery inquiry* (DI) learning model that had been done on a limited basis at the meeting of science teachers at SMPN 2 Maros. The dissemination was the exposure result of the development research held at the teacher forum in SMK Pratidina Makassar. The spread of discovery inquiry (DI) learning model was also done through a scientific journal published by the website.

Conclusion

Based on the research results, the researchers present some conclusions. First, science learning at Junior High School level, especially in SMP Negeri 2 Maros has not been fully focused on scientific learning approach centered on the student and the students still have Science misconceptions on the concept of vibration and optics. Second, the discovery inquiry (DI) learning model to reduce the misconception of Science students meets the criteria of validity based on the results of the validation of experts and practitioners against the components of the model and the developed learning tools. Third, the discovery inquiry (DI) learning model to reduce the misconception of Science students meets the criteria of practicality because the implementation of discovery inquiry (DI) learning has been accomplished entirely and the ability of teachers to manage discovery inquiry learning is at the high category. Fourth, the discovery inquiry (DI) learning model to reduce the misconception of Science students meets the criteria

of effectiveness because the activity of students has been achieved based on the criteria of achieving the ideal time. Generally, students responded positively to discovery inquiry (DI) learning model. The Science misconception has been reduced for students significantly.

Disclosure statement

No potential conflict of interest was reported by the authors.

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References

Abdisa, G. (2012). T*he effect of guided discovery on students' physics achievement*. Journal Physics Education, *(Online),* 6(4), 193-199

Adnyani, N.W, dkk. (2013). *Pengaruh strategi pembelajaran konflik kognitif terhadap penurunan miskonsepsi fisika ditinjau dari gaya kognitif siswa kelas x di SMA Negeri 1 Bebandem*. Jurnal Universitas Pendidikan Ganesha

Fajar.DM dkk. (2013). *Pengaruh penggunaan model pembelajaran inkuiri (inquiry learning) terhadap penurunan miskonsepsi pada materi listrik dinamis kelas X SMAN 2 Jombang*. Laporan Penelitian

Ilahi, T M. (2012). *Learning of discovery strategy & mental vocational skill*. Jogjakarta: DIVA Press

Iriyanti.N.P et al.(2012). *Identifikasi miskonsepsi pada materi pokok wujud zat siswa kelas VII SMP Negeri 1 Bawang tahun ajaran 2009/2010*. Laporan Penelitian. FKIP Universitas Sebelas Maret Surakarta

Joyce.B, Weil.M, Calhoun.E. (2009). *Models of teaching*. Terjemahan. Edisi Kedelapan. Yogyakarta: Pustaka Pelajar

Istikomah dkk. (2013). *Pengembangan perangkat pembelajaran metode discovery learning untuk pemahaman sains pada anak TK B*. Laporan Penelitian. Prodi Pendidikan Dasar Program Pasa Sarjana. Universitas Negeri Semarang

Nirwana. (2013). *Penggunaan model inquiry berbasis ICT untuk meningkatkan hasil belajar pada mata kuliah sejarah fisika mahasiswa Prodi Pendidikan Fisika Jurusan Pendidikan MIPA*. FKIP: Universitas Bengkulu. Prosiding Seminar

Simarmata,U. (2008). P*enerapan model konstruktivis dalam pembelajaran fisika di SMU dalam upaya menanggulangi miskonsepsi siswa*. Jurnal Universitas Negeri Medan, ISSN:1907-7157

Sukardjo,M. dkk. (2012). L*andasan pendidikan konsep dan aplikasinya*. Depok: PT Rajagrafindo Persada

Suparno, P. (2005). *Miskonsepsi & perubahan konsep pendidikan Fisika*. Jakarta: PT Gramedia Widiasarana Indonesia

Taufik.M. (2012). *Remediasi miskonsepsi mahasiswa calon guru fisika pada konsep Gaya melalui penerapan model siklus belajar (learning cycle) 5E*. Jurnal UNS Semarang

Tayubi,Y.R, (2005). Identifikasi miskonsepsi pada konsep-konsep fisika menggunakan Certainty of Response Index (CRI*). Jurnal Universitas Pendidikan Indonesia. 3*/XXIV/2005

Wenning.C.L, et al. (2011). Scientific Inquiry in Introductory Physics Courses. *Journal Of Physics Teacher Education. 6*(2).

Yamin. (2013). M. *Paradigma baru pembelajaran*. Jakarta: Ciputat Mega Mall Anggota IKAPI

Yunitasari.W. et al. (2013). *Pembelajaran direct instruction disertai hierarki konsep untuk mereduksi miskonsepsi siswa pada materi larutan penyangga Kelas XI IPA Semester Genap SMA Negeri 2 Sragen*. Jurnal FKIP UNS Surakarta

Yusnita.R et al. (2014). *Pengembangan perangkat pembelajaran berbasis penemuan terbimbing (guided discovery) dengan pendekatan somatic, auditory, visual, intellectual (SAVI) pada materi pokok peluang Kelas IX SMP Tahun Pelajaran 2013/2014*. Jurnal PPs Universitas Sebelas Maret Surakarta.