DEVELOPMENT OF SCIENCE TEACHING MATERIALS BASED GUIDED DISCOVERY FOR TRAINING SCIENCE PROCESS SKILLS

Yuliana Anggraini Imran *, Rudiana Agustini, Titik Taufikurohmah
Postgraduate Science Education Universitas Negeri Surabaya, Surabaya, Indonesia
* Email: yulianaimran.227@gmail.com

Abstract

This study aims to produce science teaching materials based guided discovery for training science process skills. This study adapted to 4D (four D models) that consists define, design, develop, and disseminate, but in this research is done until the develop stage. Teaching materials include syllabus, lesson plan, worksheets, student books, and science process skill test. Feasibility of teaching material from the aspect of validity, practicality and effectiveness. Descriptive data were analyzed quantitatively. The validity results showed that teaching material is very valid. Practicality of teaching material show with the value of implementation learning process is excellent category and is supported by the activity of science process skills that have been shown in the study. The effectiveness of the teaching materials obtained from the increase pretest to posttest results of students science process skills with high category N Gain score and as much as 98 % of students responded positively to learning guided discovery model. Based on the results, we can conclude that teaching materials based guided discovery that has been developed has been qualified validity, practicality, and effectiveness so that it can be used to train science process skills.

Keywords: *Teaching material, guided discovery, science process skills*

Abstrak

Penelitian ini bertujuan untuk menghasilkan bahan pengajaran sains berdasarkan penemuan terbimbing untuk pelatihan keterampilan proses sains. Penelitian ini disesuaikan dengan 4D (empat model D) yang terdiri dari mendefinisikan, merancang, mengembangkan, dan menyebarluaskan, tetapi penelitian ini dilakukan sampai tahap pengembangan. Bahan ajar termasuk silabus, rencana pelajaran, lembar kerja, buku siswa, dan tes keterampilan proses sains. Kelayakan bahan ajar dari aspek validitas, kepraktisan dan efektifitas. Data deskriptif dianalisis secara kuantitatif. Hasil validitas menunjukkan bahwa bahan ajar sangat valid. Kepraktisan bahan ajar menunjukkan dengan nilai implementasi proses pembelajaran kategori sangat baik dan didukung oleh aktivitas keterampilan proses sains yang telah ditunjukkan dalam penelitian. Keefektifan bahan ajar yang diperoleh dari peningkatan hasil pretest ke posttest keterampilan proses sains siswa dengan skor N Gain kategori tinggi dan sebanyak 98 % siswa merespons secara positif terhadap pembelajaran model penemuan terbimbing. Berdasarkan hasil, kita dapat menyimpulkan bahwa bahan ajar berdasarkan penemuan terbimbing yang telah dikembangkan memiliki validitas, kepraktisan, dan efektivitas yang berkualitas sehingga dapat digunakan untuk melatih keterampilan proses sains.

Kata kunci: *Bahan ajar, penemuan terbimbing, keterampilan proses sains*

INTRODUCTION

Natural Sciences is the systematic study of history and natural phenomena were obtained from the thought and investigation of scientists who conducted the experiment skills and using the

scientific method. Process of training science is giving students a direct experience in developing and mastering the ability to find out about scientific nature (Mitarlis & Mulyaningsih, 2009).

Carin (1993) states that natural science consists of three parts, consisting of a scientific attitude, scientific process and scientific products. Scientific attitude makes the students have a good personality included in growing curiosity, and can be cooperative with the others. Natural science as a process consisting of scientific behavior and skills needed in getting the process as well as foster knowledge, while science as a form of information products, ideas, facts, theories, concepts, and the laws of science which is considered as scientific knowledge. Learning science in the school curriculum is taught with reference to prevailing in Indonesia.

Curriculum is a scheme and composition about learning substance. This learning substance used to get achievement of learning in the school (UU No 23, 2013). The improvement of curriculum in Indonesia is from year to year. It was an attempt by the government to increase a quality of education in Indonesia. Curriculum 2013 is a curriculum that is currently widely used in Indonesia. The curriculum in 2013 developed a design of the teacher centered on the learner centered. Instructional design on the 2013 curriculum emphasis on the application of science process skills (Permendikbud 68, 2013).

Science process skills are procedural, experimental, and systemic science skills as a basis for science (Arabacioglu & Unver, 2016; Dogan & Kunt, 2016; Limatahu et al., 2018; Limatahu & Mubarok, 2020; Karsli & Ayas, 2014; Sudiarman et al., 2015; Suyidno et al., 2018; Yunita et al., 2017). Ibrahim (2010) states that the science process skills are divisible into two process that is basic process skills and integrated process skills. Basic process skills useful as a support for the integrated process skills. Science process skills consist of observation, measurement, and classification, communication, questioning skills and interpretation / prediction. Integrated process skills are the skills of the highest process involving various basic process skills. Integrated skills process consists of preparing the formulation of the problem, identify variables, formulate hypotheses, the formulation of an operational definition of variables, designing scientific experiments, carry out experiments, and drawing conclusions.

Based on interviews with grade science teacher at junior high school 5 Pamekasan, the teacher said that the school has implemented a curriculum of 2013. Science teacher of eight class junior high school 5 Pamekasan stated that the students have been guided to experiment using science process skills but science process skills of students is still low at 72 % of students have not completed the test-science process skills, only a part of the process skills that students can understand like observing activity, Students still need teachers to understand some of the science process skills. That's because the students have not been fully active in learning. This is evidenced by the results of the pre-study questionnaire science process skills test. The questionnaire results pre-study through a test science process skills showed that students skills in observing by 70 %, formulate research questions 10 %, measure (compare) 2 %, classifying 5 %, and deduce 54 %, with the incompleteness classical is 72 %. This results shows that students science process skills needed to be trained so that students can master the science process skills and able to become active learners.

Based on these problems, needed a solution efforts. One such effort is by applying the learning model that makes the students active so that the learning can be centered on the student and science process skills can be trained. Learning model that allows able to involve and engage students actively is a guided discovery model. This research suitable with research by Susanti (2016) which states that the model can train science process skills of the students.

Guided discovery invites students to engage actively in the process of the invention of concepts, ideas, and principles of self-assisted and guided by the teacher. Teachers guide and direct students to resolve problems. The advantages of this model is students trained to find the concepts taught himself through the learning experience or experiment so as to make a longer memory (Carin, 1993). Guided discovery model is suitable for trained science process skills. Teaching material is

also needed to support the teaching and learning activities. Teaching material can be directed to a learning model that can make student-centered learning, one of which is a teaching material based guided discovery model. Teaching material consists a syllabus, lesson plan (LESSON PLAN), student books, student worksheet, and science process skill test. Teaching material must fulfilled a requirements of validity, practicality, and effectiveness.

Based on the analysis between expectations and realities, then growing an idea and thoughts to develop teaching material based guided discovery model on material food additives. The development of teaching materials is expected to train science process skills of students. Some research supports the development of guided discovery teaching material is the research by Akinbobola & Olufuminiyi (2015) shows that the model guided discovery is the most effective model in the process of knowledge transfer physics. Research conducted by Qomariyah (2014) suggests the application of the guided discovery can train science process skills of students. Based on the above explanation, the author will develop science teaching materials based guided discovery to train science process skills. The purpose of this research to development of science teaching materials based guided discovery for training science process skill.

RESEARCH METHOD

The aims of this research is to develop a teaching material based guided discovery to practice science process skills of students on material food additives. This study adapt to the 4D model that consists of define, design, develop, and dessiminate. However, this study only done to develop stage. Developed teaching material consists a syllabus, lesson plans, worksheets, student books, and test science process skills. This research tested at students of class VIII C, VIII D, and VIII I SMPN 5 Pamekasan (i.e. public junior high school in Indonesia) in the academic year 2017/2018. Science process skills students are assessed using a pretest and posttest. Pretest serves to measure the ability of students before the learning. While the post-test to measure the ability to work after learning.

The methods in this research consists of validation, test methods, methods of observation, Cronbach's alpha method, and questionnaire. The instruments used consist of the validation sheet, implementation sheet and student activity sheets, test science process skills sheets, and student response sheet. The data analysis technique consists of analyzing data validity, implementation analysis, analysis of student activities, students' science process skills analysis, and analysis of student responses.

RESULTS AND DISCUSSION
Validity of Teaching Material

Validity of teaching material consists a syllabus, lesson plans, worksheets, student books, and test students of science process skills. The results of teaching materials validity can be observed in the Figure 1. Based on the Figure 1 can be seen that the value of the syllabus validation results are categorized as very valid 3.60, lesson plan 3.72 categorized as very valid, Worksheet 3.81 with very valid category, the student book is 3.71 categorized as very valid, and science process skills test is 3.81 categorized as very valid. Based on the validation results, it can be said that the teaching materials is very valid to train science process skills
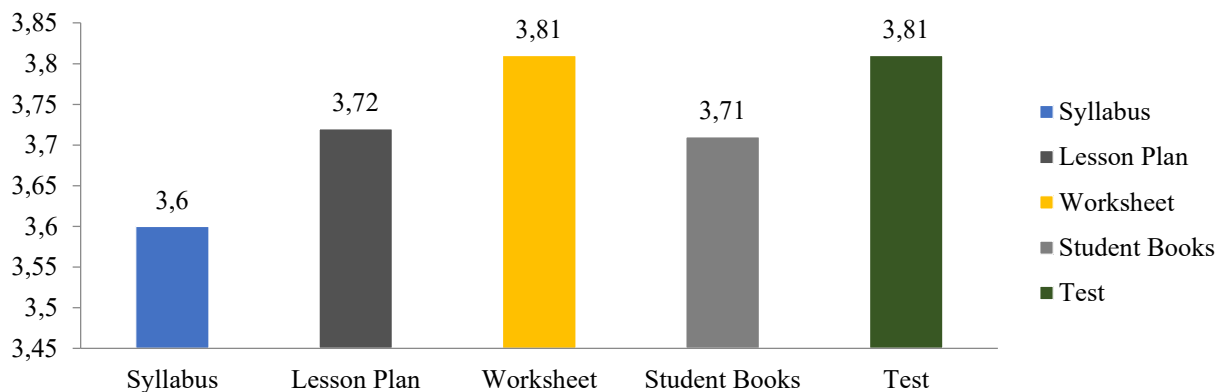
Figure 1. Validity of Teaching Material

Practicality Teaching Material

Practicality teaching material rated from implementation guided discovery when learning and student activity during the learning process using guided discovery.

Implementation of Learning Process

Observer used implementation sheet. Rate of learning implementation models adapted to the syntax of guided discovery consisting of motivation, data collection, data processing, closing, and assessment. Here are the results of learning implementation in the VIII C, D VIII, and VIII I.
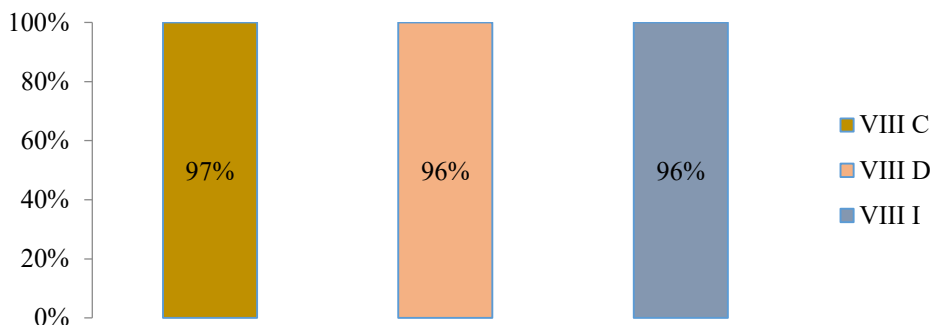

Figure 2. Learning Implementation

`

Based on the Figure 2 knowable average learning implementation in VIII C is 97 % with a very good category. Average learning implementation in VIII D at 96 % with very good category. Average learning implementation in VIII I is 96 % with a very good category. Based on the results of learning implementation in third class, it is known that the author have implemented a model with excellent guided discovery.

Student Activity

Student activity observed by the observer for each 5 minutes. The observed activity consists of observing, formulating research questions, measure, classify, deduce, communicate, and other activities. The observation of the activity of students in class VIII C show that 86 % of the activity has been demonstrated science process skills of students during the learning process. Activities VIII D shows that 85 % of the activity of science process skills. While in the VIII I shows that 85 % of science process skills activity has been demonstrated by the students during the learning process. From the observation of student activity in the third class, suggesting that the activity of science process skills of students performing well. Based on the results, excellent learning implementation

and activity science process skills that students have shown in learning, then teaching materials that was developed is practice to train science process skills of students.

Effectiveness Teaching Material

The effectiveness of teaching material rated from science process skills of students and student response during guided discovery learning.

Students' Science Process Skills

Skills assessed process consists of observing, formulating research questions, measure (compare), classify, deduce, and communicate. Tests carried out 2 times that is pretest and posttest. Pretest was used to measure students' science process skills before learning. Posttest used to measure students' science process skills after learning. Here are the results of achievement of science process skills class VIII C, D VIII, and VIII I.
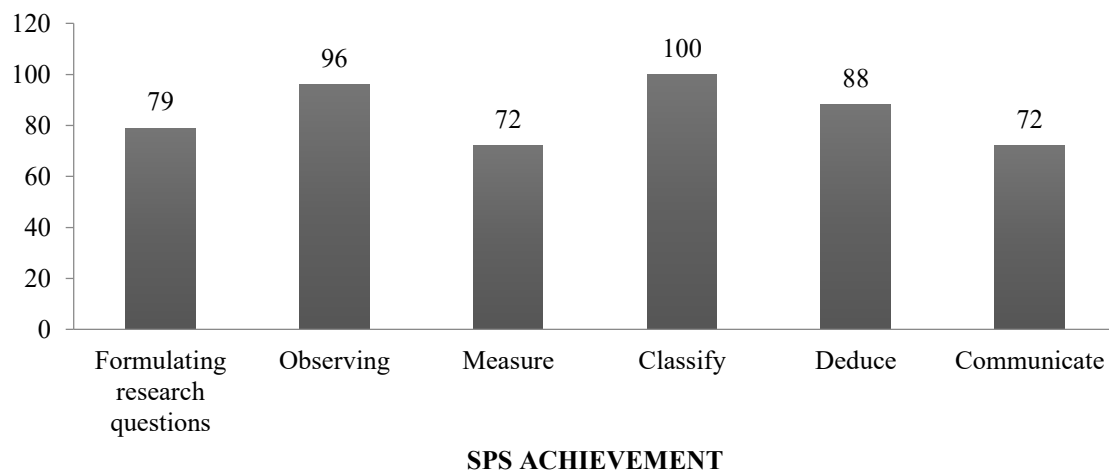
Figure 3. Science Process Skill Achievement in VIII C

Based on Figure 3 it can be seen that the achievement of science process skills in class VIII C for every aspect is, aspects of formulating research questions by 91 %, observed by 94 %, measure (compare) by 87 %, classified by 92 %, deduce by 78 %, and communicates by 78 %. Gain score of student in VIII C have been increase from pretest to posttest is 0.76 with very high category. Here is an achievement of science process skills in VIII D class.
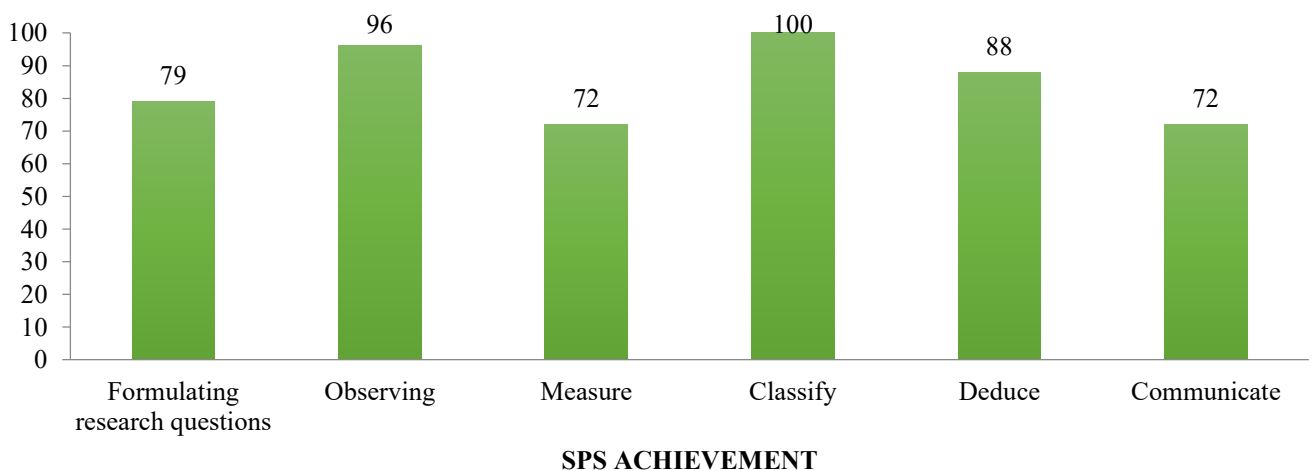
Figure 4. Science Process Skill Achievement in VIII D

Based on Figure 4 can be seen that the achievement of science process skills in grade VIII D for every aspect is, aspects of formulating research questions by 94 %, observed by 74 %, measure (compare) by 83 %, classified by 86 %, to conclude by 87 %, and communicates by 94 %. Gain score of students in VIII D have been increase from pretest to posttest is 0.76 with very high category. Here is an achievement of science process skills in VIII I.
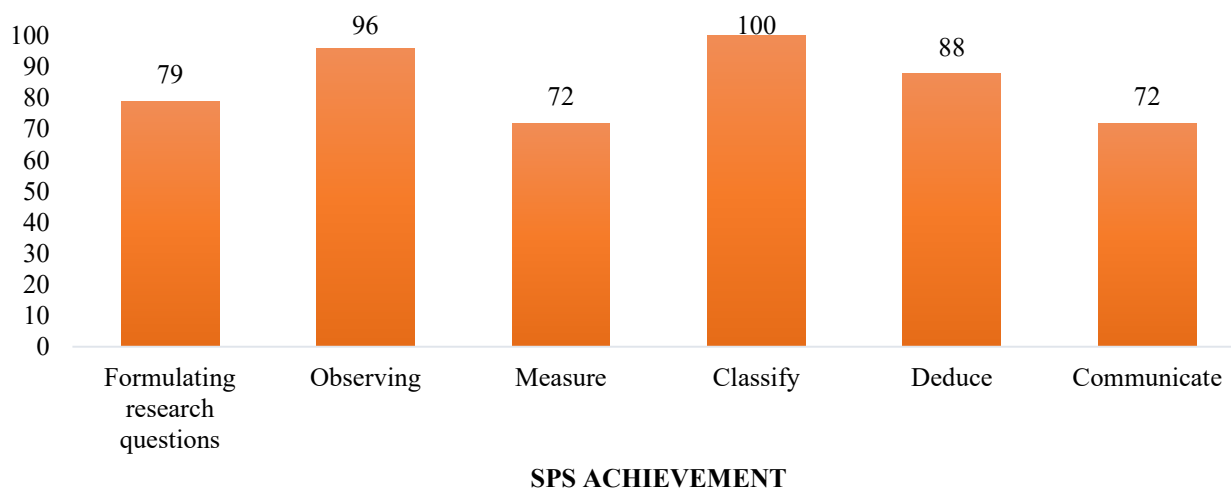

Figure 5. Science Process Skill Achievement in VIII I

Based Figure 5 it can be seen that the achievement of science process skills in class VIII I for every aspect is, aspects of formulating research questions by 79 %, observed by 96 %, measure (compare) by 72 %, classified by 100 %, deduce by 88 % and communicates by 72 %. Gain score of students in VIII I have been increase from pretest to posttest at 0.75 with very high category. Increased scores from pretest to posttest in VIII C, D VIII, and VIII I class because of the learning process that uses a guided discovery model. Carin (1993) said that guided discovery can provide a workout on students to learn to find a concept depend on the outcome of surveillance and experiments that have been done. So as to learn to find the concept it will be stronger students' memories. Analysis of the achievement of every aspect of science process skills in third class indicates that the measured science process skills such as formulating questions, observe, measure (compare), classify, deduce, and conclude has been reached. That's because the science process skills had been trained for three meetings in the learning process.

Student Response

Student response was measured using a sheet of student questionnaire responses. Student response sheet provided at the time after learning with guided discovery model. Based on the results of questionnaire responses of students who have been granted, 97 % of students VIII C class, 99 % of students VIII D class, and 92 % of students VIII I class have responded positively to the guided discovery learning model. This is according to research conducted by Qomariyah (2014) that guided discovery learning model received a positive response from students. Also according to Carin (1993) states that guided discovery learning model can increase student motivation because the model guided discovery can involve students in total in learning. From the results of high science process skills and positive response of students, the teaching materials that have been developed can be said to be effective to train science process skills of students. Based on the description of the discussions that have been associated with literature and relevant research results, it can be conclude that teaching materials can train science process skills of students as well as is feasible from the aspect of validity, practicality, and effectiveness.

CONCLUSION

The teaching materials that have been developed is appropriate from the aspect of validity, practicality and effectiveness to train science process skills of students. Guided discovery can provide a workout on students to learn to find a concept depend on the outcome of surveillance and experiments that have been done. So as to learn to find the concept it will be stronger students' memories. Analysis of the achievement of every aspect of science process skills in third class indicates that the measured science process skills such as formulating questions, observe, measure (compare), classify, deduce, and conclude has been reached. That's because the science process skills had been trained for three meetings in the learning process. Implication of this research is science teaching materials based guided discovery for training science process skills in junior high school. Further research can be carried out for other levels of education (senior high school and university).

REFERENCES

Akinbobola, O., and Olufunminiyi, A. (2015). Enhancing transfer of knowledge in physics through effective teaching strategies. *Journal of Education and Practice*, **6**(16), 37-44.

Arabacioglu, S., & Unver, A.O. (2016). Supporting inquiry-based laboratory practices with mobile learning to enhance students' process skills in science education. *Journal of Baltic Science Education*, **15**(2), 216-230.

Carin, A. (1993). *Teaching science through discovery*. New York: Macmillan Publishing Company.

Dogan, I., & Kunt, H. (2016). Determination of prospective preschool teachers' science process skills. *Journal of European Education,* **6**(1), 32-42.

Gronlund, N.E. (1981). *Measurement and evaluation teaching*. London: Collier Macmillian.

Ibrahim, M. (2010). *Dasar-dasar proses belajar mengajar*. Surabaya: Unesa University Press.

Karsli, F., & Ayas, A. (2014). Developing a laboratory activity by using 5e learning model on student learning of factors affecting the reaction rate and improving scientific process skills. *Procedia-Social and Behavioral Sciences,* **143***,* 663-668.

Kementrian Pendidikan dan Kebudayaan. 2013. *Peraturan menteri pendidikan dan kebudayaan republik indonesia no. 68 tahun 2013 tentang kerangka dasar dan struktur kurikulum sekolah menengah pertama/madrasah tsanawiyah*. Jakarta: Badan Pengembangan Sumber Daya Manusia Pendidikan dan Kebudayaan dan Penjaminan Mutu.

Limatahu, I., & Mubarok, H. (2020). CCDSR learning model: Innovation in physics learning. *IJORER: International Journal of Recent Educational Research*, **1**(1), 19-29.

Limatahu, I., Wasis, Suyatno, S., & Prahani, B.K. (2018). Development of CCDSR teaching model to improve science process skills of pre-service physics teachers. *Journal of Baltic Science Education*, **17**(5), 812-827.

Mitarlis & Mulyaningsih, S. (2009). *Pembelajaran IPA terpadu*. Surabaya: Unesa University Press.

Qomariyah, N. (2014). Penerapan model pembelajaran guided discovery untuk meningkatkan keterampilan proses sains siswa SMP. *JPPS e-Pensa*, **2**(1), 68-74.

Ratumanan, T.G, & Laurens, T. (2011). *Penilaian hasil belajar pada tingkat satuan pendidikan*. Surabaya: Universitas Negeri Surabaya Press.

Sudiarman, Soegimin, W.W., & Susantini, E. (2015). Pengembangan perangkat pembelajaran fisika berbasis inkuiri terbimbing untuk melatihkan keterampilan proses sains dan meningkatkan hasil belajar pada topik suhu dan perubahannya. *Jurnal Penelitian Pendidikan Sains*, **4**(2), 658-671.

Susanti, R.L. (2016). Penerapan model pembelajaran guided discovery untuk meningkatkan keterampilan proses sains siswa pada materi kalor di kelas X SMAN 1 Nganjuk. *Jurnal Penelitian Pendidikan Fisika,* **5**(2), 2016.

Suyidno, Nur, M., Yuanita, L., Prahani, B.K., & Jatmiko, B. (2018). Effectiveness of creative responsibility based teaching (CRBT) model on basic physics learning to increase student's scientific creativity and responsibility. *Journal of Baltic Science Education*, **17**(1), 136-151.

Thiagarajan, S., Semmel, D.S., & Semmel, M.I. (1974). *Instructional development for training teachers of expectional children*. Minnesota: Leadership Training Institute, University of Minnecosta.

Yunita, Y., Poedjiastoeti, S., & Agustini, R. (2017). Pengembangan perangkat pembelajaran IPA model inkuiri terbimbing ditunjang media PhET untuk meningkatkan keterampilan proses sains siswa. *Jurnal Penelitian Pendidikan Sains,* **7**(1), 1407-1415.