Unnes.J.Biol.Educ. 8 (3) (2019

Journal of Biology Education

http://journal.unnes.ac.id/sju/index.php/ujeb

The Effect Of Applying Guided Discovery Learning (GDL) Model on the Students' Critical Thinking Abilities In Budidaya Lele (BDL) Subject Grade 11 SMA N 10 Semarang

Devi Amalia[1]✉, Ari Yuniastuti[1], Wiwi Isnaeni[2]

Biology Department, FMIPA, Universitas Negeri Semarang, Indonesia

Info Article

History Article:
Received : September 2019
Accepted : October 2019
Published : December 2019

Keywords:
guided discovery learning (gdl) model; critical thinking ability; budidaya lele (bdl)

Abstract

SMA Negeri 10 Semarang is a school in Semarang which applies Budidaya Lele (BDL) subject. This subject is in accordance with the learning reference in the 2013 Curriculum. One of the goals to be achieved in the 2013 Curriculum is improving students' critical thinking abilities. However, the facts show that students' critical thinking abilities in SMA Negeri 10 Semarang are still low. One factor causing the low level of critical thinking abilities is conventional learning model implementation and teacher-centered. One of the learning models that can help improve students' critical thinking abilities is Guided Discovery Learning (GDL). This study aims to investigate the effect of GDL model on students' critical thinking abilities of grade 11 science in BDL subject. The sampling technique was purposive sampling. The research object was students in 11 science 4 class as the experimental class applying GDL model and students in 11 science 3 class as the control class applying conventional learning model. The aspects of critical thinking abilities measured were ability to provide simple explanation, ability to develop basic skills by using the indicators of considering trusted sources, ability to draw conclusion, ability to provide further explanation, and ability to manage strategies and tactics. The data was collected through tests and questionnaires. The data of test results was analyzed by using T test using SPSS and N-Gain test in Microsoft Excel 2010, while the questionnaire data was descriptively analyzed. The data analysis result of T test shows a mean difference in the experiment class and control class indicated by sig. value (2-tailed) as much as 0.000. The result of N-gain test, the experimental class has 0.43 value with medium criteria and the control class has 0.24 value with low criteria. The results of the two tests show that GDL model implementation affects students' critical thinking abilities in the experimental class in BDL lesson. Students in the experimental class applying GDL model have better critical thinking abilities compared to students in the control class which does not apply GDL model.

✉ Correspondence:
Building D6 Lt.1 Jl Raya Sekaran Gunungpati Semarang
E-mail: dwimuhar@gmail.com

p-ISSN 2252-6579
e-ISSN 2540-833X

INTRODUCTION

Thinking ability is a medium for students to be able to solve problems so that educational goals can be achieved. One of the thinking abilities that students should have is critical thinking ability. It aims to enable students to compete in the global competition era in the future (Quitadamo, *et al.*, 2008). Critical thinking ability is very important for students because through critical thinking ability, students are able to be rational and choose the best alternative option for themselves. In addition, developing the habits of mathematical critical thinking ability for students needs to be done so that they can look at various problems occurring in everyday life (Somakim, 2011). Critical thinking ability is also the reason for the development of the 2013 curriculum which is also included in the second future competency, which is the ability to think clearly and critically (Kemdikbud, 2016).

The facts show that the quality of education in Indonesia is still low. PISA, which is a comprehensive survey program at the international level, basically evaluates students' abilities which also include critical thinking ability (Rahayu, 2016). Lasmawan (2010) also said that one of the educational problems in Indonesia is that education does not provide the development of process skills, critical thinking ability, and creativity. It is shown by Santrock's (2011) explanation in his book entitled *Psikologi Pendidikan* (Psychology of Education), stating that only a few schools really teach students to develop critical thinking skills. Schools are accustomed to spending time teaching students by giving one correct answer so that learning activities in the classroom do not really encourage students to expand their thinking by creating new ideas in accordance with students' abilities.

One of the efforts which have been made by the Indonesian government to solve this problem is by gradually changing KTSP curriculum to 2013 Curriculum to catch up with lags from other countries. In the 2013 curriculum, one of the competencies which students should master in science learning is critical thinking ability (Kemdikbud, 2016). Ennis (2011) also stated that in the world of education, what can be done to improve human resources quality is by developing critical thinking habit for students during the learning process.

The educational problem, which is less attention to the development of critical thinking skills, also occurs in SMA Negeri 10 Semarang. Based on the results of tests, observations and interviews with the teacher of Budidaya Lele (BDL) subject and students at SMA Negeri 10 Semarang, the level of students' critical thinking skills was still low. Considering the test results, most of the students were under the minimum learning mastery criteria which has been determined at 75. Of the 30 students, only 30% (9 students) reached the minimum learning mastery criteria, while 70% (21 students) did not reach the minimum learning mastery criteria. Moreover, students do not do the feedback given by the teacher to students during the learning process, students do not answer teacher's question, do not argue and do not ask questions during the learning process.

An effort that can be made to develop students' critical thinking ability at SMA Negeri 10 Semarang is by applying appropriate and innovative learning models, so the learning process occurs optimally and is able to develop students' critical thinking ability. One of them is by applying Guided Discovery Learning (GDL) model (Purwanto, 2012). According to Nwagbo as cited by Akinbobola & Afolabi (2010) Guided Discovery Learning is a constructivist learning model, in which teachers provide illustrations of problems then pose questions to empower students' thinking skills in drawing conclusions as problem-solving. The characteristic of GDL learning model is a two-way system where the learning process involves

students and teachers. Students make discoveries, and the teacher plays a role in providing guidance by analyzing difficulties in solving the problems faced by students (Hamalik, 2013)

Based on the above explanation, it can be concluded that the solution to solve this problem is by applying Guided Discovery Learning (GDL) model. The research problem in this study is, "How is the effect of GDL model on critical thinking skills of grade 11 students in Budidaya Lele (BDL) subject at SMA Negeri 10 Semarang?" This study aims to investigate the effect of GDL model implementation on the critical thinking ability of grade 11 students in BDL subject at SMA Negeri 10 Semarang.

RESEARCH METHOD

The research method employed in this study is experimental method. The research design used in this study was the Pretest-posttest Control Group Design. This research was conducted at SMA Negeri 10 Semarang in the even semester of the academic year 2017/2018. The population used was 11 Science consisting of four classes. The sampling was done by purposive sampling method and obtained 11 Science 3 as the experimental class and 11 Science 4 as the control class. The research procedure was divided into three stages, they were preliminary study, implementation, and reporting. Preliminary study includes the preparation of research plans through observation and interviews as well as making learning media. The research implementation includes collecting data and research documentation activities. Reporting of the research results includes data processing and compiling research reports activities.

The collected data included main data and supporting data. The main data consisted of data on students' critical thinking skills and students' activities obtained from tests, observations and questionnaires. The indicators of students' critical thinking abilities measured in this study included: 1) ability to provide simple explanations, 2) ability to consider trusted sources, 3) ability to conclude, 4) ability to provide further explanations, and 5) ability to manage strategies and tactics. Whereas supporting data was in the form of data on students' and teachers' responses obtained from questionnaires and interviews. Statistical analysis of data was conducted using Anates program version 4 new and SPSS 16. The method of statistical analysis of data in this study included analysis of test questions (validity test, reliability test, distinguishing test, and difficulty level test), normality test, homogeneity test, T test and N-gain test. The data analysis of questionnaire results and observations was carried out by descriptive percentage method.

The learning steps taken in the experimental class were 1) pre-test, 2) stimulation - the teacher gave apperception and problems, 3) problem statements - students made hypothesis, 4) data collection - students collected information from books and the internet about BDL guided by the teacher, and students' worksheet through discussion, 5) data processing - students processed the information, 6) verification - presentation of hypotheses and discussion results, 7) generalization - conclusions, 8) post-test. Meanwhile, the learning steps in the control class were 1) pre-test, 2) explanation of BDL materials by the teacher, 3) discussion on doing students' worksheet, 4) students' worksheet presentation, and 5) post-test.

RESULT AND DISCUSSION

Based on the results of data analysis presented in Table 1 and Figure 1, it can be seen that the experimental class has a higher percentage level than the control class in all aspects of critical thinking abilities. It is because the experimental class applies GDL model, while the control class only uses conventional methods.

The results of data analysis of students' critical thinking abilities in the experimental class and control class are presented in Table 1 and Figure 1.

Table 1 Summary of data analysis comparison of students' critical thinking abilities in control class and experiment class

Class	Percentage of Critical Thinking Indicators				
	A	**B**	**C**	**D**	**E**
	Simple Explanation	Sources Consideration	Conclusion	Further explanation	Strategies & Tactics
Control	64.8%	67.1%	64.3%	59.9%	57.3%
Criteria	Good	Good	Good	Enough	Enough
Experiment	80.2%	78.7%	87.1%	75%	78.6%
Criteria	Good	Good	Very good	Good	Good

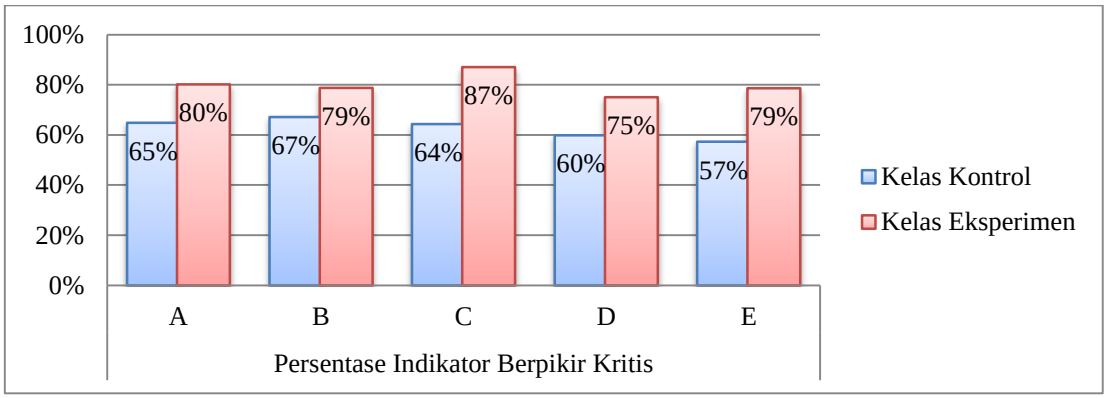

Figure 1. Graph of questionnaire and observation instrument analysis of students' critical thinking ability

To find out the difference in means of the test results between the experimental class and the control class, T test was conducted. Based on the data presented in Table 2, the sig. value (2-tailed) 0.000 is smaller than the α value (0.05), hence, it can be concluded that there is a difference in the test results between the experimental class and the control class, so it can be said that the implementation of GDL learning model affects students' critical thinking ability in the experimental class.

Table 2 Analysis result of T test between experimental class and control class

Data	Class	Number of Students	Mean	α	*Sig.(2-tailed)*	Description
Post test students' critical thinking abilities	Control	31	49.06	0.05	0.000	There is a significant difference
	Experiment	34	71.20			

To find out the criteria for students' critical thinking ability level of the experimental class and the control class after learning, N-Gain test was conducted. Based on the analysis result presented in Table 3, the value of N-Gain test in the control class is 0.24 with low criteria, while the experimental class is 0.43 with the medium criteria. Therefore, it can be concluded that the experimental class has higher criteria than the control class.

Table 3. Analysis result of data on students' critical thinking ability using N-Gain test

Class	N-Gain Value	Criteria
Control	0.24	Low
Experiment	0.43	Medium

Indicators for Students' Critical Thinking Ability

Ability to Provide Simple Explanation

The data on students' critical thinking ability with the ability to provide simple explanation was obtained from tests, questionnaires, student discussion sheet and students' worksheets. Based on Table 1, the results of data analysis show that most students in the experimental class experienced an increase in ability to provide a simple, significant explanation compared to the control class. This is because the experimental class applied GDL model starts with the teacher stimulating students in the form of simple questions then students answer according to the knowledge they know. Based on the students' answers, the teacher directs to the right answer, then the teacher asks the students to compile the answers into simple and unified sentences so that they are easily understood by students.

The above results are in line with the opinion of Hanafiah & Suhana (2010), that the GDL learning model is learning which starts from the teacher asking questions that track with the aim of directing students to the conclusion point then students conduct experiments to prove the opinions mentioned. The questions from the teacher are open, making students answer with different answers, so that from the different answers, students can develop into simple explanations. Hamalik (2013) also explained that GDL learning model involves students in answering teacher's questions. Students make discovery and the teacher guides students in the right direction.

The above results are also supported because of the interaction of the teacher and students as well as students and students. This can stimulate students to think and then make simple arguments. Susanto's opinion as followed by Jumaisyaroh et.al. (2015) explained that in developing critical thinking abilities, one of them is the ability to provide a simple explanation, there is indeed a direct interaction between the teacher and students. There is interaction and active involvement of students in learning, as students are interested in the learning model. This proves that the implementation of learning models which develop critical thinking skills involve students as thinkers, not as someone taught.

Ability to Consider Trusted Sources

This data is obtained through tests, questionnaires, students' discussion sheet and students' worksheet. Based on Table 1, it can be seen that the average percentage of students' ability to consider sources in the experimental class is higher than the control class. This is because students in the experimental class are trained to consider relevant information by matching the facts that have been obtained from hypothesis testing. In addition, through open questions from the teacher to students, students answer with different answers, so students can consider the various information received.

. In the observation activities, students are also trained to test the data and consider various interpretations. Furthermore, by providing examples and experimental activities in groups, students can collect, observe and compare and test the data. By providing difficult examples at the beginning, students practice more to analyze data and arrange hypotheses and train students to consider appropriate sources. Haris et.al. (2015) also explained that in GDL learning, students were trained to consider relevant information by matching the facts obtained from hypothesis testing.

Ability to Draw Conclusion

The data of ability to draw conclusion are obtained through tests, observations and tests. The analysis results in Table 1 show that the average percentage of ability to draw conclusion in the experimental class is higher than the control class. The above result is because the experimental class applies GDL learning model, while the control class only applies conventional learning methods. The implementation of GDL model to the experimental class helps students during drawing conclusions process is students review the initial hypothesis by matching the facts that have been obtained through testing the hypothesis. Students decide the facts which agree with the predictions obtained from the hypothesis then present the conclusions, with which the experimental class students can get knowledge in exploring good conclusions. In addition, students are also trained to solve an alleged problem and consider relevant, so students can draw a conclusion with reasonable considerations. Whereas the control class applies the learning strategy which is daily implemented, namely lecture in which learning focuses on the teacher so that students are less helpful in the critical thinking process.

Haris, et. al. (2015) also stated that through learning process with GDL model in the experimental class, students are trained to solve problems or assumed problems, so they can draw a conclusion with reasonable considerations. The stage is trained in the drawing conclusions stage, where students review the initial hypothesis by matching the facts that have been obtained from hypothesis testing. Students decide facts that agree with predictions that have been obtained from the hypothesis then present conclusions. At this stage, students communicate among other, exchange ideas and knowledge to arrange the same concept.

Furthermore, according to Nur, as cited by Adelia & Surya (2017), in finding concepts, students conduct observations, classify, make assumptions, explain, draw conclusions and so on. The same thing was conveyed by Leonard & Irving (2014) that in the GDL learning model, teacher acts as a facilitator or non-dictatorial guide so that students are helped in explaining problems, finding facts and drawing conclusions.

Ability to Provide Further Explanation

This data is obtained through tests, questionnaires and students' worksheet. The data analysis results in Table 1 show that the average percentage of the experimental class is better than the control class. This is due to the implementation of GDL model in the experimental class which helps students to be active, understand and find themselves so that students can remember the materials studied longer. Moreover, students are also able to transfer knowledge to various contexts so that the experimental class students better master the aspect of providing further explanation. In the control class, the learning applies conventional model, hence, students are not actively involved in learning. This makes students easily forget the materials that the teacher delivers.

The above results are in line with Haris *et.al*. (2015) opinion mentioning that in the learning process using GDL model, students are trained to build concepts which have been obtained at each stage of learning through discovery and data collection which are then constructed into intact and meaningful knowledge. Furthermore, students are also trained to be able to present arguments about the problems discovered and their problem solving.

Ability to Manage Strategies and Tactics

Data on the ability to manage strategies and tactics is obtained through tests and observations. Based on the data analysis results presented in Table 1, the average percentage of ability to manage strategies and tactics in the experimental class is higher than the control class. This is due to the implementation of GDL model in the experimental class, while in the control class conventional model is applied. During the GDL learning process applied in the experimental class, students are trained to manage strategies and tactics in solving problems during discussions and practical learming. The practical learning stage is very helpful for students in improving aspects of managing strategies and tactics because students are given problems then students solve the problem individually or in groups. As for the control class, increasing the ability to manage strategies and tactics tends to be low because the learning methods used are one-way, so students do not have a wide space to improve the ability of these aspects.

The above results are in line with the opinion conveyed by Bruner as cited by Arthur (2005) that GDL learning model has several advantages including an individual learn using his mind. Through GDL learning model, students slowly learn how to organize and carry out investigations or research independently. This learning model also helps students become more independent and responsible for their own learning. Nur (2011) also explained that discussion has an important role in students' concepts understanding. In addition, it helps students organize strategies in solving problems and understanding materials with friends in a group.

Students' Activities

Data on students' activities measured consists of two types, they are students' activities during discussions and students' activities in general. This data is obtained through observation. The data analysis results of students' activities are presented in Table 4.

Table 4 Data analysis of observation results of classical students' activities in control class and experiment class

Data	Students' Activities			
	General Learning (Likert Scale)	**Criteria**	**Discussion (Guttman Scale)**	**Criteria**
Control Class	93%	Very Active	69%	Medium
Experiment Class	95%	Very Active	81%	High

Based on the data analysis results presented in Table 4, the average percentage of students' activities in the experimental class is higher than the students' activities in the control class. This is due to differences in the learning model applied. The learning model applied to the experimental class is GDL, while in the control class conventional learning methods are applied including lectures, discussions, observations and presentation.

The above study results indicate that students' activities in guided discovery activities have reflected student activities that are in accordance with the GDL stages. Hosnan (2014) stated that discovery learning model is a learning model that emphasizes the importance of understanding the structure or important ideas of a scientific discipline through active involvement in the learning process. In line with this opinion, Sholeh (2014) also explained that the GDL model is one of the learning models that can guide students to think for themselves, actively investigate by themselves, and find out their own general concepts based on the materials provided by the teacher or the data they obtain through experiments. The extent to which the students are guided depends on students' abilities and the difficulty level of the materials studied.

Responses of Students and Teacher

Data on students' responses to the implementation of GDL learning model is obtained through questionnaires distributed to the experimental class students after a series of learning processes. Meanwhile, the data of teacher's response is obtained through interviews and responses to the implementation of GDL model obtained through questionnaires. The data recapitulation of student and teacher responses is presented in Table 5.

Table 5 Data recapitulation of student and teacher responses to GDL model implementation

No.	Types of Data	Percentage (%)	Criteria
1	Student Responses	99%	Very Good
2	Teacher Responses	87%	Very Good

Data recapitulation of student responses presented in Table 5 shows that the average percentage is 99% with very good criteria. It shows that students are very interested and happy with the learning atmosphere. To create an interesting and fun learning atmosphere is by inviting students to study outside the classroom, which is in the laboratory of BDL and around catfish ponds. This result is in line with the opinion conveyed by Bruner in Arthur (2005) that by using GDL learning model, the teacher is more likely to provide a pleasant learning atmosphere where students are involved in learning because it is fun, interesting, and useful for themselves. Moreover, students will have self-motivation when they learn through discovering something by themselves, not by listening. In addition, Eggen (2012) argued that GDL model is effective for increasing students' motivation in following learning and

understanding materials. Because of the high level of student involvement, this indicates the success of GDL model implementation in the learning process in the experimental class.

From the data on teacher responses, it can be seen that the teacher gives a positive response to GDL model implementation. The teacher also believes that GDL model implementation is an effective way of learning. The effectiveness of learning can be seen from the active role of students in learning activities. Students are not only actively listening to the teacher's explanation, but also constructing their ideas individually or in group. In this activity, the teacher only acts as a facilitator and motivator. Mulyasa (2006) also stated that learning is considered effective if it is able to provide new experiences and build students' competence, and deliver them to the goals to be achieved optimally

There is a teacher response stating that GDL learning model implementation has an obstacle related to time management during learning implementation. This affects the students' intensity in seeking information, communication during discussions and the lack of co-curricular assignments from teacher to students. Markaban (2006) explained that the guided discovery learning model has a weakness, *i.e.* it requires long time. Therefore, the teacher suggests that the learning implementation be more tightened, by adjusting the arranged lesson plan, and for practical learning which requires more time is by increasing the time outside of school hours or exchanging BDL lesson hour with another lesson hour.

CONCLUSION

Based on the data analysis results and discussions that have been conducted, it can be concluded that Guided Discovery Learning (GDL) model implementation affects students' critical thinking abilities in the Budidaya Lele (BDL) subject grade 11 SMA Negeri 10 Semarang. Students in the experimental class which applies GDL model have better critical thinking abilities than students in the control class that does not apply GDL model.

REFERENCES

Adelia, W. S., & Surya. 2017. Resolution to Increase Capacity by Using Math Students Learning Guided Discovery Learning (GDL). *International Journal of Science: Basic and Applied Research (IJSBAR)*, 34(1).

Akinbobola, A.O. & Afolabi. (2010). Analysis of Science Process Skills in West African Senior Secondary School Certificate Physics Practical Examinations in Nigeria. *American-Eurasian Journal of Scientific Research*, 5 (4): 234-240. IDOSI Publications.

Arthur, E. 2005. Expanding The 5E Model. The Science Teacher. Reprented with Permission From the Science Teacher. *A Journal For High School Science Educators Published By The National Science Techers Association,* 70 (6): 56-59. Tersedia online di www.nsta.org.

Ennis, R. H. 2011. The nature of Critical Thinking: An Outline of Critical Thinking Dispositions and Abilities [Online]. *Prentice Hall*. Tersedia di http://faculty.ed.uiuc.edu/rhennis/documents/TheNatureofCriticalThinkin5171_000.pdf [diakses 15-3- 2017].

Eggen, P. D. K. 2012. *Strategi dan Model Pembelajaran*. Jakarta: PT. Indeks.

Hamalik, O. 2013. *Kurikulum dan Pembelajaran*. Jakarta: PT Bumi Aksara.

Hanafiah, N. & C. Suhana. 2010. *Konsep Srategi Pembelajaran*. Bandung: Refika Aditama.

Haris, F., Y. Rinanto & U. Fatmawati. 2015. Pengaruh Model GDL terhadap Kemampuan Berpikir Kritis Siswa Kelas X SMA Negeri Karangpandan Tahun Pelajaran 2013/2014. *Jurnal Pendidikan Biologi UNS*, 7(2): 114- 122.

Hosnan, M. 2014. *Pendekatan Saintifik dan Kontekstual dalam Pemnelajaran Abad 21*. Bogor: Ghalia Indonesia.

Organization for Economic Cooperation and Development (OECD). 2015. OECD Database. OECD. Online: http://www.oecd.org/pisa/pisaproducts/.

Jumaisyaroh, T. *et. al.* 2015. Peningkatan Kemampuan Berpikir Kritis Matematis dan Kemandirian Belajar Siswa SMP melalui Pembelajaran Berbasis Masalah. *Jurnal Kreano Jurusan Matematikan FMIPA Unnes*, 5(2). ISSN: 2086- 2334.

Kemdikbud. 2016. *Konsep dan Implementasi Kurikulum 2013.* Jakarta: Pusat Kurikulum dan Perbukuan, Balitbang.

Lasmawan. 2010. *Kinerja Ideal Praktisi dan Administrator Pendidikan dalam MBS dan Otonomi Sekolah*. Bandung: Remaja Rosda Karya.

Nur, A. S. 2011. *Modul Keterampilan-keterampilan Proses Sains.* Pusat sains dan Matematika: Universitas Negeri Surabaya.

Purwanto, S. Eko & Wiyanto. 2012. Penerapan model pembelajaran Guided Discovery pada materi pemantulan cahaya untuk meningkatkan berpikir kritis. *Unnes Physics Education Journal*, (1).

Rahayu, S. 2016. Mengembangkan Literasi Sains Anak Indonesia melalui Pembelajaran Berorientasi Nature of Sains. Pidato Pengukuhan Jabatan Guru Besar dalam Bidang Ilmu Pendidikan IPA FMIPA disampaikan pada Sidang Terbuka Senat Universitas Negeri Malang, 17 Maret.

Quitadamo, I. J., Celia, James & Marta. 2008. Community-based Inquiry Improves Critical Thinking in General Education Biology. *CBE-Life Science Education*, 7: 327-337.

Sanjaya, W. 2010. *Strategi Pembelajaran Berorientasi Standar Proses Pendidikan*. Jakarta: Prenada Media Grup.

Santrock. 2011. *Life-Span Development: Perkembangan Hidup*. Edisi 13, jilid 1. Alih Bahasa Widyasinta Benedictine. Jakarta: Erlangga.

Somakim, 2011. Peningkatan Kemampuan Berpikir Kritis Matematis Siswa Sekolah Menengah dengan Penggunaan Pendidikan Matematika Realistik. *Jurnal forum MIPA*, 14(1).