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Research Artikel

BIOLOGI MODULE BASED ON COOPERATIVE PROBLEM-BASED LEARNING (CPBL) TO ENHANCE STUDENT'S PROBLEM SOLVING SKILLS AT MADRASAH ALIYAH NEGERI

MODUL BIOLOGI BERDASARKAN PEMBELAJARAN BERBASIS MASALAH KOOPERATIF (CPBL) UNTUK MENINGKATKAN KEMAMPUAN PEMECAHAN MASALAH SISWA DI MADRASAH ALIYAH NEGERI

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Abstrak

Model CPBL (Cooperative Problem-based Learning) memiliki beberapa keunggulan seperti siswa ditantang untuk menyelesaikan masalah yang ada, sehingga semua keterampilan kognitif, afektif, dan psikomotor siswa dapat berkembang. Penelitian ini bertujuan untuk menentukan kelayakan dan efektivitas modul biologi berdasarkan model CPBL untuk meningkatkan keterampilan pemecahan masalah siswa. Jenis penelitian ini adalah Penelitian dan Pengembangan (R&D). Model pengembangan penelitian ini menggunakan Borg dan Gall. Desain penelitian menggunakan metode desain eksperimen sejati dengan desain kelompok kontrol pretest posttest. Dua kelas dipilih oleh sampel acak sederhana. Penelitian ini melibatkan 171 siswa, 85 siswa di kelas kontrol dan 86 siswa di kelas eksperimen. Analisis data deskriptif digunakan untuk menganalisis kelayakan modul dan uji-t digunakan untuk menganalisis keterampilan pemecahan masalah. Hasil penelitian menunjukkan bahwa kelayakan pengembangan modul memiliki hasil yang baik berdasarkan penilaian para ahli dan praktisi. Berdasarkan hasil uji-t, terdapat perbedaan yang signifikan antara kelas kontrol dan kelas eksperimen (0,001), n-gain skor kontrol dan kelas eksperimen masing-masing 0,30 (rendah) dan 0,54 (rata-rata). Berdasarkan penelitian, modul ini lebih efektif daripada buku teks dan dapat meningkatkan keterampilan pemecahan masalah siswa.

Kata Kunci: *modul; Pembelajaran Berbasis Kooperatif; keterampilan pemecahan masalah*

Abstract

CPBL (Cooperative Problem-based Learning) model has several advantages such as students are challenged to solve existing problems, so that all students' cognitive, affective, and psychomotor skills can develop. This research aimed to determine feasibility and effectivity of biology module based on CPBL model to enhance students' problem solving skills. This type of research is Research and Development (R & D). The development model of this research uses Borg and Gall. The research design uses true experimental design method with pretest posttest control group design. Two classes were selected by simple random sample. The study involved 171 students, 85 students are in control class and 86 students are in experimental class. Descriptive data analysis was used to analyze the module feasibility and t-test was used to analyze the problem solving skills. The results showed that the feasibility of the module development have a good results based on assessment of the experts and practitioners. Based on the t-test results, there are significant difference between control class and experiment class (0.001), n-gain score of control and experiment class respectively 0.30 (low) and 0.54 (average). Based on the research, this module is more effective than the textbook and can improve students' problem solving skills.

Keywords: module; Cooperative Problem-based Learning; problem solving skills

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INTRODUCTION

Science is a knowledge that is broadly and systematically related to natural knowledge. Science is closely related to the scientific process. The result of the process is called the product. According to Gunawan (2015), the process is concerned with how learners discover concepts learned while products relate to process outcomes such as principles, laws, concepts, and equations. Science learning should give students the opportunity to collect data and make decisions related to their daily lives. Science will be difficult to learn if it does not meet the level of intellectual development and student characteristics.

The need of high school students to have high thinking ability, has been formulated explicitly in Permendikbud Number. 64, in 2013, on the competence of class XI in Curriculum 2013 for high school biology subjects (http://luk.staff.ugm.ac.id/atur/bsnp/Permendikbud64-2013StandarIsi.pdf diakses pada 2018). The Biology syllabus is tailored to cover 21st century skills such as scientific skills, creative and critical thinking skills, science process skills, problem solving, and scientific attitudes and moral values. Thus, according to the competency-based curriculum, biology not only focuses on the students 'cognitive development, but also the development of students' higher-order thinking skills.

Students of the 21st century face a more difficult challenge with what they got 20 years ago - the more problems they face open. Students must now solve problems they have never experienced before, providing solutions that often never happen before. Students are asked to think more efficiently and solve problems they face better. To achieve this, they need teaching and learning methods to be properly trained in efficient thinking and problem-solving tools. Current graduates need to become proficient in the workplace skills of the 21st century to meet the challenges of this era. Each skill is critical thinking and problem solving, communication, collaboration, creativity and innovation.

However, teaching and learning methods are not fully implemented and result in less integration of 21st century skills especially for science students. To obtain maximum results, teachers must observe and recognize the learning process because biological sciences must be developed through direct activity and thought (Ibrahim, 2004). Students today are active learners. They build their own knowledge structures and learning environments through interaction and collaboration. However, there are still problems with the application of contextual learning, such as the availability of lesson materials, school conditions, access to learning, student learning achievement, and teachers' skills are still low. Some schools have implemented contextual learning but in reality, teachers still use conventional learning systems. Because teachers do not fully use the system that has been planned for them, students tend to assume that science is a subject that is learned through rote. Until now, most of our schools focus on knowledge rather than skills, such as problem-solving skills.

Problems are understood as theoretical or practical difficulties that lead to questioning of the subject and directing it to the ability of knowledge (Kupisiewicz Cz, 1964) Fogler and Leblanc (1995) state that a problem does not have one solution and therefore different methods should be applied in problem solving. The problem itself does not indicate the direction of the solution and there is no barrier (Lerner, I. J., 1986). Organizations such as schools require students to learn about problem-solving skills because these skills will enable them to succeed in their later lives (Bellanca, J., & Brandt, R., 2010). Researchers and researchers need more information about the problem-solving process to help their students more efficiently. If problem-solving skills are cognitive activity then improving problem-solving skills through education should be a worthwhile goal (Seminara, 1996).

Problem solving is defined as the ability of individuals to understand a problem that does not have a clear solution method and overcome it in PISA 2012 (Bellanca, J. A. 2013). Problem solving is a process and not a result (Steve Kneeland, 2001). Troubleshooting is all processes during

troubleshooting attempts (Blum, B, & Niss ,M (1991). According to Tillery (2006) problem-solving skills are attempts to find solutions to difficult situations. Therefore, it is wrong to decide by only considering the last product (solution). The problem solver develops several hypotheses according to the data obtained; make the right choice between them and find the solution.

Problem solving skills are essential to human life. Humans solve problems all the time to achieve their goals. Students who have learned the problem solving process can succeed in all walks of life by using these skills and finding solutions to individual problems and difficulties. Problem solving skills will help us solve problems in not only in the academic field but also in all parts of life. The problem solving process involves the introduction of problems, using prior knowledge to create new concepts about the problem, and using effective strategies to solve problems (Sagir, 2011).

Studies have shown that many students have problems based on lack of information and skills in the problem-solving stage. Facts about students' problem-solving abilities by Ahghar (2012) in Tehran, Iran, and Kirmizi, Ceren Saygi & Ibrahim Halil Yurdakal (2015) in Turkey show that problem-solving abilities are still low. In Indonesia, based on the results of the problem solving skills report of TIMSS, Indonesia ranked 43 out of 45 countries and PISA results in 2009 show Indonesia ranked 61 out of 65 countries.

The problem solving process can be facilitated using open materials and group projects to provide integrated learning (http://www.ericdigests.org/1993/early.html diakses pada 2018) Problem solving requires patience, persistence, risk-taking, and cooperation, therefore a positive class climate must be provided. Problem solving can be defined as a series of focused cognitive operations that are used because they adapt to internal, external demands or challenges (Heppner, P.P., & Peterson, C.H, 1982). This process will improve students' lifelong learning ability. Thus, the learning process that allows students to have problem-solving skills is *Cooperative Problem-based Learning* or CPBL, a learning model based on the theory of Constructivism. In CPBL, students are given a phenomenon of problems in everyday life related to the subject matter, which is considered as a learning context to help students enhance problem-solving skills.

Combining both CL and PBL produces Cooperative Problem-based Learning (CPBL). CPBL aims to emphasize cooperative learning and problem solving (Khairiyah, M.Y, Helmi, S.A., Jamaludin, M.Z, and Harun, N.F, 2010). CPBL is used to address current educational challenges. In Cooperative Learning, students work together in small groups to achieve shared learning goals and to maximize learning (Johnson, D.W., Johnson, R.T., and Smith, K.A, 2006). In Problem Based Learning, in addition to developing knowledge, students are also able to contribute to the development of skills and attitudes that are considered important in the learning process (Duderstadt J.J. 2008).

In this research, Cooperative Problem-based Learning is trained by using module. Lee, Fang, & Tsai (2001) state that problem-solving skills in biology learning can be improved by using modules Pradana (2016), state the use of modules can improve problem-solving skills. This module is a form of teaching material that is arranged systematically and attractively including content material, methods, and evaluation that can be used independently to achieve the expected competence (Anwar, I, 2010). The advantages gained from learning by applying the module according to Santyasa (2009) are as follows:

1) Improving student motivation because every time doing the lesson tasks clearly and in accordance with its ability
2) Evaluation, teachers and students are well aware of the modules in which students have succeeded and on the part of the modules they have not yet gained; 3) students achieve results according to their ability; 4) Education is more efficient because the subject matter is organized according to the academic level.

Based on the above background description, this research is conducted to know the module development and its effectiveness in improving problem solving ability. In recent years, one of the most important tasks of basic education is to provide students with the opportunity to learn effective problem-solving skills for the problems they face every day.

METHOD

Subjects and Study Sites

This research was conducted in State Senior High School, that is MAN Ngawi, MAN Paron & MAN Ngrambe in Ngawi Regency. The research design uses true experimental design method with pretest posttest control group design. The subjects of the study for large-scale trials were 85 students as control class (using BSE package book) and 86 students as experimental class (using biology module based on *Cooperative Problem-based Learning*). The sampling technique using *simple random sampling*.

Research Instruments

The instrument used in this study there are two kinds :

1) Questionnaire used to obtain expert response data, teachers and students about the effectiveness of modules developed. The scores were intepreted by using criterion in Table 1 (Sukiman, 2012).

Tabel 1. Criterion for product validation result

Prosentase (Ps)	Category
76% ≤ Ps ≤ 100%	Very Good
51% ≤ Ps ≤ 75%	Good
26% ≤ Ps ≤ 50%	Bad
0% ≤ Ps ≤ 25%	Very Bad

2) Test method used to determine the results of students' problem solving skills. The tests used in this study were pretest and posttest in the control and experimental class.

The data obtained were analyzed descriptively based on the results of validation of experts and educational practitioners as well as the responses of student and teacher questionnaires. The results of the problem solving test are analyzed by calculating the number of relevant student responses. Then the test results were tested with an *Independent sample t-test* to determine whether there were differences before and after treatment were given between the control class and the experimental class. Students' problem solving skills were analyzed with an *n-gain* score to determine an improvement in students' problem solving skills. Next, the scores were intepreted by using criterion in Table 2 (Hake R, Richard, 1999).

Tabel 2. Criterion for n-gain result

Normalized Gain Score	Interpretation
-1.00 < g < 0.00	Decrease
g = 0.00	Stable
0.00 < g < 0.30	Low
0.30 < g < 0.70	Average
0.70 < g < 1.00	High

Research Procedures

This type of research is Research and Development (R & D). The development model of this research uses Borg & Gall (1983). Research procedures performed include :

1) Research and information collecting
2) Planning
3) Develop preliminary form of product
4) Preliminary field testing
5) Main product revision
6) Main field testing
7) Operational product revision
8) Operational field testing
9) Final product revision
10) Dissemination and implementation

RESULTS AND DISCUSSION

In the module development process, it starts with validation on material component by 2 lecturer of material expert, language component by 2 lecturer of languange expert, lesson plan component by 2 lecturer of lesson plan expert, and media component by 2 lecturer of media expert. In table 3 can be seen the results of material expert show average value 89.14% included in the category of very good, the results of languange expert show average value 92.19% included in the category of very good, the results of lesson plan expert show average value 85.94% included in the category of very good, and the results of media expert show average value 91.45% included in the category of very good. The result of all expert validation show average value is 89.68%. It was concluded that the biology module based on *Cooperative Problem-based Learning* falls into the very feasible category.

Table 3. The product validation result of the module based on *CPBL*

Validation	**N**	**Score**	**Max Score**	**Percentage (%)**	**Category**
Material Expert (Content Feasibility)	2	271	304	89.14	Very good
Language Expert (Language Eligibility)	2	59	64	92.19	Very good
Lesson Plan Expert	2	220	256	85.94	Very good
Media Expert (Feasibility of Graficity)	2	139	152	91.45	Very good
Average Value				**89.68**	**Very good**

Student response data is used to obtain students' opinions about the feasibility of the biology module based on *Cooperative Problem-based Learning.* Questionnaire given to 15 students which covers two statement that is positive and negative statement. The results of the assessment and response of the average students amounted to 87.88% included in the category of very good and feasible to use. In addition to students, 3 biology teachers also provide an assessment of the development of the biology module based on *Cooperative Problem-based Learning*. The results of the assessment and response of the average teachers amounted to 82.81% included in the category of very good and feasible to use.

To determine the effect of using biology module based on *Cooperative Problem-based Learning* to improve students' problem solving skills, the students' problem solving skill test scores in the control class were compared with the experimental class students. Table 4 shows the results of the two classes' pretest values. The mean of the pretest results is 41.17 for the control class and 44.41 for the experimental group. These results show no significant difference in the pretest value of the problem solving skills of both groups with *p-value* = 0.085 (p> 0.05), which shows that both classes of students have the same problem-solving skills before participating in the learning activity.

Table 4. Differences in the problem solving skills on pretest values of both groups

Groups	N	*Mean*	SD	*p-value*
Control class	85	41.17	12.7	
Experimental class	86	44.41	11.6	0.085*

After the learning activities, the final or posttest grade of students problem solving abilities in both classes is taken. Table 5 shows the t test of posttest values of two classes. It was found that group posttest values differ significantly with *p-value* = 0.001 (p <0.05). In addition, the mean posttest grade of the experimental class (74.70) was higher than the control class (59.08), indicating that the students in the experimental class showed much better problem solving skills than the control group. So it can be concluded that the biology module based on *Cooperative Problem-based Learning* can enhance students' problem solving skills.

Table 5. Differences in the problem solving skills on posttest values of both groups

Groups	N	*Mean*	SD	*p-value*	*n-gain*
Control class	85	59.08	11.2		0.30
Experimental class	86	74.70	9.07	0.001*	0.54

*Independent sample t-test

The analysis used to know the effectiveness of the learning module in the control class and the experimental class is the *n-gain*. The n-gain is a good indicator to show effectiveness in learning. Based on the calculation of value of n-gain control class obtained value 0.30 (low), while for the experimental class obtained a value of 0.54 (average).

Discussion

The first stage in this research is *research and information collecting*. These stages include literature study, field survey and needs analysis. The literature study was conducted to gather information on teaching modules, CPBL model, module based on CPBL, and students' problem solving skills. There are several goals of educational activities. Gagne (1980). states that the primary goal of education is to teach people to think, to use their rational power and be a good problem solver. The problem-solving ability as a result of learning is important for life because almost everyone in everyday life engages in solving problems (Jonassen, D. H, 2000). The field survey in this study were teachers and students. Information obtained from observation, questionnaires, and interviews. The information then analyzed and found alternative solution. The solution obtained is the development of module based on CPBL.

The next stage is *planning.* Activities undertaken at the planning stage is the determination of learning objectives, core competencies, basic competencies that refer to the curriculum 2013. Next activity is the preparation of the matrix by including the stages of learning syntax CPBL. The last activity is to determine the format of the module that contains the problem solving indicators.

The third stage is *develop preliminary form of product*. At this stage, the initial design of CPBL-based module products is ready to be validated. The fourth stage is *preliminary field testing*. This stage begins with validation on material component by 2 lecturer of expert expert, component component by 2 lecturer of lesson plan expert, and media component by 2 lecturer of media expert. In table 3 can be seen the results that the biology module based on CPBL falls into the very feasible category. From the validation result, the module will be revised and has entered the *main product revision* stage.

Once revised then enter the next stage of *main field testing*. Student response data is used to obtain students' opinions about the feasibility of the biology module based on CPBL. Questionnaire given to 15 students and 3 biology teachers which covers two statements that is positive and negative statement. The results of the assessment and response of the students and teachers are included in the category of very good and feasible to use. The results of the response will be revised to refine the module product developed and have entered the *operational product revision* stage.

The eighth stage is an *operational field test*. Based on test result, hypothesis test using independent sample t-test, at p-value equal to 0,001, significance level $\alpha = 0{,}05$ ($p < 0{,}05$). The result of problem solving analysis on control class and experiment class was found to have significant difference. Significant differences in the use of modules based on CPBL in the experimental class present positive results. Pedrotti (1997) states that some elements of cooperation are learning in groups and communicating with each other. Milliken and Martins (1996) state that diversity (such as gender differences and different backgrounds) in group work leads to the influence of cohesion in reaching consensus on work. As a leader, the teacher plays a great role in forming the cooperation attitude among the group members and creating an active learning process which can then make the learning process more meaningful. This will also increase their level of achievement.

The effectiveness of this module can be seen from the n-gain results for the control class posttest and the experimental class, based on the n-gain results in table 5 it can be explained that the effectiveness of the experimental class (0.54) is higher than the control class (0.30). This proves that learning using modul based on CPBL is more effective for improving students' problem solving skills compared to conventional learning. This

result is in accordance with research conducted by Kurnia, Masykuri & Sarwanto (2015) obtained a significance level of 0.003 which means that the students' problem solving skills using PBL-oriented Modules increased significantly when compared with students who were given PBL learning without using modules (BSE). Phillips and Germann (2002) state that working in groups help student to be rational and respect the different opinions, try to find the right alternative and be more sensitive. Allen (2006) states that by working in groups, student can solve a problem by asking questions and communicating in meetings.

The *final product revision* was made to revise the module based on expert test validation test, education practitioner test, small group test, and operational test before the module product was distributed in several schools. *Dissemination and implementation*, at this stage is done the spread of modules in 5 high schools in the Ngawi region. Distribution is done to the biology teacher and then given a questionnaire containing the teacher's response to the module developed. The overall teacher response results are excellent and the modules are eligible for use. With students' interest in the material they have taught, students will be more motivated to achieve better problem solving skills and learning outcomes in biology. Teachers also provide a positive response because the module can be studied independently and anywhere.

Learning modules can help learners to build what they learn and understand in the learning process. Modules can be learned anywhere independently and also have a specific theme. This can facilitate students to obtain the information necessary to acquire the knowledge and skills specified. The module requires students to actively interact with learning materials, not just passively reading the material. Students are asked to do various things in the learning activities and get feedback about what they do. Evaluations prepared in the module can inform students whether they achieve full mastery of the material and what to do if they can not achieve the required mastery (Dick W, Carey L, and Carey J O, 2001).

CONCLUSION

Based on the results of the research, it can be concluded that the quality of biology module based on CPBL based on expert judgments including categorized very good, while for students and teacher response that states the module is very good and feasible to use. Biology module based on CPBL is effective to improve Madrasah Aliyah students' problem solving skill based on N-gain value 0.54 indicating average category.

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