

# Natural Sciences Module Based on Scientific Approaches to Improve Cognitive Accomplishment of 7<sup>th</sup> Graders Junior High School

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**Abstract:** This research is a development research (R&D) which aims at identifying the feasibility and effectiveness of Natural Sciences Module based on scientific approaches for Interaction of Living Things topic. It employed pre-experimental design with One-Shot Case Study. The module developed is a printed module employing Four-D model adapted from Thiagarajan (1974). The module consists of three learning activities and it is systematically presented using scientific approaches (observing, questioning, trying, associating, and communicating) to improve 7<sup>th</sup> Graders' cognitive accomplishment. The results show that students' cognitive accomplishment in Learning Activity I was 80%, Learning Activity II was 83.34%, and Learning Activity III was 96.64%. It means that students' have achieved Minimum Mastery Criteria. It can be concluded that the developed module is feasible to be used in learning to improve students' cognitive accomplishment.

**Key Words:** module, scientific, cognitive accomplishment, learning outcome, pre-experimental design

**Abstrak:** Penelitian ini merupakan penelitian pengembangan (R & D) yang bertujuan untuk mengidentifikasi kelayakan dan efektivitas Modul Ilmu Pengetahuan Alam berdasarkan pendekatan ilmiah untuk topik Interaksi Makhluk Hidup dengan lingkungannya. Penelitian ini menggunakan desain pra-eksperimental dengan *One-Shot Case Study*. Modul yang dikembangkan adalah modul cetak yang menggunakan model Four-D diadaptasi dari Thiagarajan (1974). Modul ini terdiri dari tiga kegiatan pembelajaran dan disajikan secara sistematis dengan menggunakan pendekatan ilmiah (mengamati, mempertanyakan, mencoba, mengasosiasi, dan mengkomunikasikan) untuk meningkatkan hasil belajar kognitif siswa kelas VII SMP. Hasil penelitian ini menunjukkan bahwa hasil belajar kognitif siswa dalam Aktivitas Pembelajaran I adalah 80%, Aktivitas Pembelajaran II adalah 83,34%, dan Aktivitas Pembelajaran III adalah 96,64%. Artinya, siswa telah mencapai Kriteria Ketuntasan Minimum. Dapat disimpulkan bahwa modul yang dikembangkan layak untuk digunakan dalam pembelajaran untuk meningkatkan hasil belajar kognitif siswa.

**Kata kunci:** modul, saintifik, capaian kognitif, hasil belajar, desain pre-experimental

Science learning by using scientific approach is a learning that provides experience directly using both observation and experiment, so that data obtained, in addition to valid, can also be accounted for (Sujarwanta, 2012). The nature of the Natural Sciences learning requires the use of a scientific approach in every stage of learning through the process of observing, asking, trying, associating and communicating. One of the goals of learning with the scientific approach is to increase the intellectual capability of students, particularly critical thinking skills as the character of the learning in the 21<sup>st</sup> era (Rosana, 2014).

One of the competencies that teacher needs to possess in implementing learning to students is to develop teaching materials. The development of teaching materials is important for teachers to make learning more effective, efficient, and in line with the competence intended to be achieved (Sungkono, 2003). It is in accordance with the Government Regulation No. 19 of 2005 Article 20, it is suggested that teachers are expected to develop learning materials, which require educators in educational units to develop lesson plans (RPPs). One of the elements in Lesson Plans is learning resources, thus teachers are expected to develop

teaching materials as one source of learning (MoNE, 2008).

Modul is one learning materials which are applicable to learning resource, particularly for Natural Sciences subject. Fundamentally, the module is a learning material arranged and designed systematically employing understandable and simple language based on students' knowledge understanding level and age in order to encourage independent learning with the minimum assistance of a teacher. Learning with module allows students to be able to measure their mastery of knowledge in a topic discussed within the module and if students have accomplished the learning objective of the previous topic, they can move to the next one. On the other hand, if students have not accomplished the objective or have not able to understand the topic, they need to repeat the materials (Prastowo, 2014). A good module is not only attractive in terms of design but also it should be able to encourage curiosity among students regarding the knowledge. When students possess high curiosity on the learning topic, students will be more motivated to learn and the cognitive achievement of students will be improved.

Cognitive achievement of 8<sup>th</sup> graders in SMPN 1 Weru is still low. It showed the result of the daily test of Natural Sciences subject in 2<sup>nd</sup> Semester on the Interaction of Living Things topic academic year 2014/2015. The average results were lower than the other topic where VIIA Class obtained 54.03, VIIB Class obtained 62.80, VIIC Class obtained 57.57, VIID Class obtained 63.80, and VIIE Class obtained 58.62.

According to the final test score (UAS) and the description of knowledge aspect achievement on the Interaction of Living Things topic academic year 2014/2015, the results indicated low and need to be improved. It also proved that the final score of Interaction of Living Things topic was low. The average results of the final score were lower than the other topic where VIIA Class obtained 54, VIIB Class obtained 57.25, VIIC Class obtained 59, VIID Class obtained 58.25, and VIIE Class obtained 63.5.

The analysis result of material mastery achievement percentage showed that 89.33% Interaction of Living Things material mastery is still low and need to be improved. Meanwhile, 10.67% of the material accomplishment is considered sufficient. The result of National Examination followed by 284 students of SMPN 1 Weru in Academic Year 2014/2015 showed that the mastery of Natural Sciences subject is still low, it only achieved 52.61%. The following is the comparison of the Natural Science mastery on Interac-

tion of Living Things topic; in the school level is 66.14%, regional level is 67.29%, the provincial level is 61.99%, and national level is 65.29%.

The result of questionnaire analysis of student need indicates that all students have used Natural Science Handbook published by Education Ministry and Student's Worksheet, but not yet given a module. In addition, learning in the laboratory is still not optimized. A total of 86.66% or 26 students answered that often they conduct a practicum in science learning, whereas according to 100% students, practicum conducted by science teachers can help and facilitate students in learning science.

In fact, students were not invited to conduct learning outside the classroom to observe the existing phenomena in the environment, students were more often learning in the classroom with lecture and discussion approach. Students have been taught using a scientific approach in science teaching, but according to 83.33% or 25 students, it was still rarely done. According to 80% or 24 students, the way the science teachers teaching was interesting. However, the learning materials were unable to accommodate the learning process. It needs additional learning material to accommodate the learning process and also improve the reading interest of students which assists students in understanding topics in Natural Sciences subject. Thus, 100% or 30 students agreed on the development of Natural Sciences Module based on a scientific approach which is applicable to laboratory learning activity or out-of-class learning to improve students' cognitive accomplishment.

According to the questionnaire on the teacher's need analysis, it shows that predominantly teacher uses 2013 Curriculum Natural Sciences Handbook published by Education and Culture Ministry. The teacher does not use and have Natural Science Modul based on scientific approach. The handbook used by a teacher could not accommodate the learning process in Natural Science subject. There are some scientific approaches which are not presented in the handbook. School laboratory has provided sufficient facility for students in learning Natural Sciences, but unfortunately, school library has no adequate reference books and modules to support the learning. Further, it makes teacher become difficult to design an experiment and learning concept of Natural Science subject. Therefore, it can be concluded that teacher needs Natural Sciences Module based on a scientific approach to improve students' cognitive accomplishment.

Natural Science Modul based on a scientific approach for Interaction of Living Things is appropriate with the characteristics and needs of 8<sup>th</sup> graders on SMPN 1 Weru. The module developed in this study allows students to learn Natural Science subject through scientific processes which include observation, questioning, trying, associating, and communicating which assist them to obtain a comprehensive understanding of certain phenomena. Further, the development of this module can improve students' cognitive accomplishment.

This study aims at developing and examining the feasibility and effectiveness of Natural Sciences Module based on a scientific approach to Interaction of Living Things to improve 8<sup>th</sup> graders' cognitive accomplishment.

### METHOD

The research is a research and development (R & D) research that aims to know the characteristics, feasibility, and effectiveness of Natural Sciences Module based on a scientific approach to Interaction of Living Things. This study was using Four-D development developed by Thiagarajan (1974). Four-D development models consist of four stages, include: definition, designing, development, and dissemination

Assessment instruments used in this research were questionnaire of needs analysis, test result sheet in the form of multiple choice items, expert validation sheet, and module evaluation sheet for students and teachers.

In the initial stage, a questionnaire of needs analysis for teacher and students regarding Natural Sciences subject in SMPN 1 Weru was distributed. The questionnaire results prove that learning resources of Natural Sciences in SMPN 1 Weru is still limited. In addition, teacher encountered a difficulty in designing experiment since the resource is limited. During the learning process, students have never been used the module to support the learning, even students have not yet used the module based on scientific process. Thus, students and teacher need a module to support the learning process in improving students' cognitive accomplishment.

In the design stage, it dealt with the process of designing Natural Sciences Module based on a scientific approach for Interaction of Living Things topic. The phase of designing stage was: module formatting, initial design, and at the end, it generated the first draft of the module.

The development stage began with initial validation of product in the form of the first draft. It was assessed by the experts, educational practitioner, and fellow teacher. Then, the result of initial validation generated the second draft after first draft revision. This second draft revision was tested in a limited trial involving 9 students from VII-F class SMPN 1 Weru. The second draft of the module was revised and it generated the third draft of the module. The third draft of the module was field tested involving 30 students of VII-D SMPN1 Weru. The result of field testing generated the last revision of module; Natural Sciences Module based on a scientific approach for Interaction of Living Things topic.

Within dissemination stage, it was disseminated to three Natural Sciences teachers in SMPN 1 Weru. After the module was distributed, teachers provided an assessment on the final module to know the teachers' response regarding the module. The assessment included design and readability, material, and module development aspects.

### RESULTS

The result from the initial stage on the teacher and students' needs in SMPN 1 Weru indicates that the 8<sup>th</sup> Graders' cognitive accomplishment is still low and require more learning resources. In addition, the observation showed that scientific approach to learning process was still insignificant, thus students' cognitive accomplishment remain underdeveloped. The initial design of module was generating matrix and initial design of module with the format adapted from Daryanto (2013) consisted of Francis page, preface, table of contents, module positions map, module instruction guidelines, introduction, concept map, Core Competence (CC), Basic Competence (BC), learning activities (1,2,3), science info, summary, critical thinking exercise (1,2,3), competency test, glossary, answer keys, and references. The module developed is a printed Natural Sciences Module based on scientific approaches in every learning process which is integrated with critical thinking indicators employing Four-D model suggested by Thiagarajan.

During the development stage, it generated the second draft of the module which was assessed by the experts, educational practitioner, and fellow colleagues. the result of feasibility content validation by material experts obtained the score of 26 with the average score is 3.71 and considered very good. The result of critical thinking exercise obtained 35.2 with

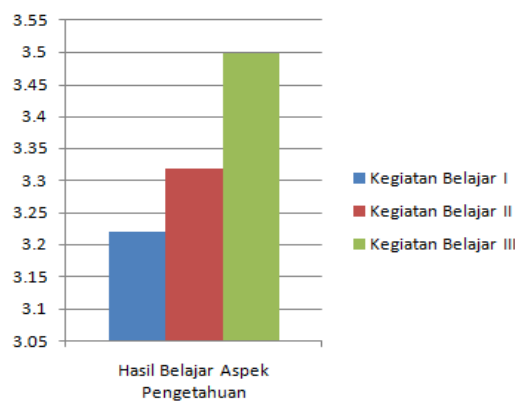
the average score is 3.91 and considered very good. The result of lesson plans validation obtained 20 with the average score is 4 and considered very good. The result of module development validation obtained 32.67 with the average score is 3.63 and considered very good. The result of language validation obtained 11 with the average score is 3.66 and considered very good. The result of module validation by educational practitioner obtained 62.12 with the average score is 3.26 and considered very good. Thus, the module developed in this study is considered feasible to be used as learning material.

During the limited trial, it involved nine students of VII-F SMPN 1 Weru to obtain the readability of Natural Sciences Module based on scientific approaches for Interaction of Living Things. During the limited trial, students were asked to do an exercise in the module. Then the answers of the students were analyzed to examine module's readability. Involving students in the limited trial with different level of ability aimed at obtaining the result which is representative of the entire students who possess the diverse ability.

The module's readability result can be seen from the students' achievement in answering exercises within Natural Sciences Module based on scientific approaches. The readability can be measured by the score achieved by students. To obtain the readability score, it involved three students in a limited trial. The average score of students' cognitive accomplishment on Learning Activity I was 83.33 with good criteria, Learning Activity II was 80 with good criteria, and Learning Activity III was 82.22 with good criteria. It proves that the module's readability is good.

Then, the module developed was implemented on Natural Sciences learning in SMPN 1 Weru which consisted of 30 students of VIID Class. The implementation of module employed pre-experimental design with One-Shot Case Study. It means that there is one group which is given a treatment and the results will be observed afterward (Sugiyono, 2011). The results of the observation are presented in Figure 1

The effectiveness of module on the students' cognitive accomplishment within learning uses Minimum Mastery Criteria in each learning activity. The average of students' cognitive accomplishment on knowledge aspect in learning activity was 80.66 converted, according to Ministry of Education and Culture Regulation No. 104 of 2014, to 3.22 with good criteria. In learning activity II, the result increased by 83.00 and converted to 3.32 with good criteria. In learning activity III, the result increased by 87.66 and converted to



**Figure 1. Students' Cognitive Accomplishment Graphic**

3.50 with good criteria. The entire average was 83.77 and converted to 3.35 with good criteria. Students' cognitive accomplishment in field testing was improved compared to the limited trial. In the limited trial, the overall average was 82.22 and converted to 3.28 with good criteria. In the learning activity I, there was six students or 20% who have not reached Minimum Mastery Criteria and 24 students or 80% have reached Minimum Mastery Criteria. In learning activity II, there were five students or 16,66% who have not reached Minimum Mastery Criteria and 25 students or equal to 83,34% have reached Minimum Mastery Criteria. While, in the learning activity III, there was only one student or equal to 3.33% who have not reached Minimum Mastery Criteria and the rest of 29 students or equal to 96,64% have reached Minimum Mastery Criteria.

The feasibility of module can be seen from the students' teacher's response and assessment after using the module.

(1) Students' response regarding the module. Predominantly, students' response regarding Natural Sciences Module based on scientific approach is good. The questionnaires given to 30 students in VIID consisted of two options, negative and positive. It comprised of 11 items of the positive statement and 10 items of a negative statement. The student agreed on positive statements with the average score of 3.44. It means that the module is good. While on the negative statements, students gave disagree answer with the average score of 1.55. It also means that the module is good.

(2) Teachers' response regarding the module. In the dissemination stage, the module was distributed to three Natural Science subject teachers who teach different classes in SMPN 1 Weru. Then, the three

teachers were given a questionnaire containing teachers' response regarding the module. The results of the teachers' response obtained the average score of 3.88 and it is considered good.

### DISCUSSION

The implementation of Natural Sciences Module based on scientific approaches was done to identify the module's effectiveness and feasibility. Module's effectiveness can be seen from the students' learning outcome based on Minimum Mastery Criteria for each learning activity within the module. While the feasibility of the module can be seen from the responses given by teachers and students after using the module.

The result conducted by Dewanti (2011) concludes that through a problem-solving approach, students' cognitive accomplishment increases. On the first cycle, the result was less than 80% of the subject achieve the Minimum Mastery Criteria and increased more than 80% in the second cycle. According to the results (Setyowati, et al., 2013), it can be concluded that the developed Natural Sciences Module was considered feasible by the experts and it is effective to be implemented in the learning process for 10 Multimedia 2 Class with the students' accomplishment amounted to 86% and students' activity amounted to 91.4%.

### CONCLUSION

According to the results and discussion above, the developed Natural Sciences Module based on scientific approaches obtained a positive assessment from the material expert, module development expert, language expert, educational practitioner, fellow teachers, and students and it is considered as good and feasible.

The effectiveness of the modules in learning is seen from the students' learning accomplishment based on Minimum Mastery Criteria in each learning activity. In the learning activity I, there was six students or 20% who have not reached Minimum Mastery Criteria and 24 students or 80% have reached Minimum Mastery Criteria. In learning activity II, there were five students or 16,66% who have not reached Minimum Mastery Criteria and 25 students or equal to 83,34% have reached Minimum Mastery Criteria. While, in the learning activity III, there was only one student or equal to 3.33% who have not reached Minimum Mastery Criteria and the rest of 29 students or

equal to 96,64% have reached Minimum Mastery Criteria. It can be concluded that the developed Natural Science Module based on scientific approaches for Interaction of Living Things is effective to improve students' critical thinking skill and learning outcomes.

According to the results and discussion, several things are needed to be taken into account for further improvement: (1) learning using Natural Sciences Module based on scientific approaches to Interaction of Living Things topic for Junior High School students should have good preparation to obtain the desired outcome, (2) within the implementation of the module, it requires good cooperation among students in class during the learning in order to make students can understand the material comprehensively and conduct the learning activity based on scientific methods, (3) this development of module model can be used as a reference to develop and improve another module in the future, (4) empirical testing of exercise items with high, average, and low category should be conducted, (5) the developed module should be distributed and disseminated widely and did not only in one school.

### REFERENCES

- Prayitno, B. A., Sugiharto, B., & Suciati, S. (2013, October). Prototipe Model Pembelajaran Konstruktivis-Kolaboratif untuk Memberdayakan Kemampuan Berpikir Kritis dan Keterampilan Proses Sains Siswa Akademik Bawah. In *Prosiding Seminar Biologi* (Vol. 10, No. 1).
- Doabler, C., Cary, M. S., Clarke, B., Fien, H., Baker, S., & Jungjohann, K. (2011). Using a Scientific Process for Curriculum Development and Formative Evaluation: Project FUSION. *Society for Research on Educational Effectiveness*.
- Daryanto. (2013). *Menyusun Modul Bahan Ajar untuk Persiapan Guru Dalam Mengajar*. Yogyakarta: Gava Media.
- Departemen Pendidikan Nasional. (2008). *Panduan Pengembangan Bahan Ajar*. Direktorat Pembinaan Sekolah Menengah Atas.
- Dewanti, S. S. (2011, July). Mengembangkan kemampuan berpikir kritis mahasiswa Pendidikan Matematika sebagai calon pendidik karakter bangsa melalui pemecahan masalah. In *Prosiding Seminar Nasional Matematika*. Surakarta: UM Surakarta.
- Fascione, P.A. (2015). *Critical Thinking: What It Is and Why I Counts*. California: California Academic Press.
- Fisher, A. (2009). *Berpikir Kritis: Sebuah Pengantar*. Jakarta: Erlangga.

- Sudargo, F., & Asiah, S. (2010). Kemampuan pedagogik calon guru dalam meningkatkan kemampuan berpikir kritis dan keterampilan proses siswa melalui pembelajaran berbasis praktikum. *Jurnal Pengajaran MIPA*, 15(1), 4-12.
- Hasratuddin, H. (2013). Meningkatkan Kemampuan Berpikir Kritis Siswa SMP Melalui Pendekatan Matematika Realistik. *Jurnal Pendidikan Matematika*, 4(2).
- Prastowo, A. (2014). *Pengembangan Bahan Ajar Tematik Tinjauan Teoritis dan Praktik*. Jakarta: Kencana Pre-nadamedia Group.
- Purwanto. (2011). *Evaluasi Hasil Belajar*. Yogyakarta: Pustaka Pelajar.
- Rahmatiah. (2014). Mengasah Kreativitas dengan IPA Terpa-du. *EBuletin: Media Pendidikan LPMP Sulawesi Selatan*. Retrieved from <http://lpmpsulsel.kemdikbud.go.id>.
- Setyowati, R., Parmin, P., & Widiyatmoko, A. (2013). Pengembangan Modul IPA Berkarakter Peduli Lingkungan Tema Polusi Sebagai Bahan Ajar Siswa SMK N 11 Semarang. *Unnes Science Education Journal*, 2(2).
- Rosana, D. (2014). *Pendekatan Saintifik dalam Pembelajaran IPA Secara Terpadu*. Yogyakarta: Universitas Negeri Yogyakarta.
- Sugiyono. (2011). *Metode Penelitian Kuantitatif Kualitatif dan R&D*. Bandung: Alfabeta.
- Sujarwanta, A. (2012). Mengkondisikan Pembelajaran IPA dengan Pendekatan Saintifik. *Jurnal Nuansa Kependidikan*, 16(1), 75-83.
- Sungkono. (2003). *Pengembangan dan Pemanfaatan Bahan Ajar Modul Dalam Pembelajaran*. Yogyakarta: Universitas Negeri Yogyakarta.
- Yuli, D.P., Suparmi, Nonoh, S.A. (2015). *Pengembangan Modul Fisika Berbasis Scientific pada Materi Fluida Statis untuk Meningkatkan Keterampilan Berpikir Kritis* (Unpublished master's thesis). Universitas Sebelas Maret, Surakarta.