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Development of a Science Learning Module using the Guided Discovery Method to Increase Learning Independence and Scientific Literacy Ability

Mashudi[1]*, Tri Joko Raharjo[1], Udan Kusmawan[1]

[1]Pascasarjana Universitas Terbuka, Semarang, Indonesia.

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Corresponding Author:
Mashudi
mashudihudi64@gmail.com

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Abstract: Science and technology are developing very quickly in the 21st century, especially in the field of education. Students need to be prepared to face these changes by having independent scientific literacy skills and skills that help them use technology. The findings from the 2015 PISA test are proof of the importance of scientific literacy in science learning. This research aims to evaluate the feasibility of the module, the effectiveness of the module, the profile of students' scientific literacy skills and learning independence after using the module and the differences in learning independence and scientific literacy before and after using the guided discovery-based module. This research uses research and development (R&D) methods modified from Borg & Gall in Sugiyono. The N-gain test is used to determine the effectiveness of the product, and descriptive data analysis is used to assess the feasibility and profile of students' scientific literacy abilities and learning independence. Differences in students' independence and scientific literacy abilities were analyzed using Kruskal-Wallis H test. The research results show that (1) the guided discovery-based module developed meets the content, presentation and language criteria very well; (2) The N-gain value with the criteria is experiencing an increase, in accordance with the results of the assessment of scientific literacy and student learning independence; (3) The profile of students' scientific literacy abilities which includes science context, competence and knowledge has moderate/good criteria; (4) The level of learning independence after using the module is at high criteria; (5) Students who use guided discovery-based modules can increase their scientific literacy and learning independence, but not at the same level as students who use traditional learning methods. This shows that the use of guided discovery-based modules developed as an alternative learning resource for science lessons regarding the water cycle is feasible to use.

Keywords: Independent learning; Modules based on guided discovery; Scientific literacy.

Introduction

Creating individuals who are creative, critical, imaginative and productive who strengthen perspectives, abilities and have information in a coordinated manner are characteristics of 21st century learning which have been implemented in the 2013 curriculum. The 2013 curriculum uses a logical method or scientific approach. With the right methodology, learning can provide opportunities to increase students' scientific literacy. Scientific literacy means the ability to identify, interpret and explain in order to determine a decision/conclusion in accordance with logical evidence related to a particular issue (Kemdikbud, 2017).

The results of PISA test shows that students' science literacy abilities in Indonesia are low. Judging from the 2018 OECD survey, Indonesia is ranked 70th out of 78 countries (OECD, 2019). The rote memorization method

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for understanding each lesson applied to students is the cause of low scientific literacy abilities in Indonesia (Sanjaya et al., 2017). The results of observations at State Elementary Schools in Rowosari District, Kendal Regency, the science learning method during November 2021 still leads to teacher centered learning, causing students to be less active in the learning process so that students have only a small chance of developing scientific literacy independently. Learning using conventional methods that depend on textbooks and worksheets carried out at State Elementary Schools in Rowosari District, Kendal Regency causes students to not actively discover their own knowledge because discussion activities do not take place.

Students' science skills/scientific literacy abilities are influenced by their capacity to organize their learning properly and actually (Lestari et al., 2019). Students' ability to deal with their learning well and actually is related to learning independence. Learning independence is the ability of students to have the knowledge to master material independently or with their own awareness and be able to implement it in problem solving activities without having to depend on other people (Suhendri, 2012). Through good learning independence, students will have good behavior habits, be disciplined in the learning process and complete their assignments without depending on other people.

Achieving scientific literacy in science lessons includes three aspects, namely science content, process and product (Utami, 2018). The results of an interview with one of the teachers at a State Elementary School in Rowosari District, Kendal Regency regarding the role of science learning oriented towards scientific literacy to train students' independent learning, it turns out that several obstacles were found which included the learning process not being fully complete when viewed from the elements of scientific literacy, namely context. Science is still in the form of one-way learning from teacher to student and has not been connected to events in the surrounding environment. Aspects of the science process have also not been implemented optimally, with teachers still emphasizing students' mastery of the material through assignments. The lack of optimality in both aspects of scientific literacy is also reinforced in the context of science applications, which indicates that the learning process has not been implemented in an integrated manner. As a result, students have not been able to connect the knowledge gained with real events in the surrounding environment. Teachers provide learning facilities as supplementary materials in the form of text and images which cause students to become bored quickly because they are less interested.

There is no use of scientific literacy in science learning, both in the process and in the teaching materials used, so that learning independence is not achieved ideally. This has an impact on decreasing student motivation, powerlessness to decide and low learning outcomes, as well as hampering experiences to develop in the teaching and learning process.(Elfira, 2013). By using teaching materials that combine scientific content, scientific stages and application of science, it will make it easier for students to learn independently.

Supporting teaching materials that are helpful and in line with the demands of the 2013 curriculum, which mostly emphasizes students to further develop their capacities freely, as well as supporting experiences that continue to develop in the 21st century in accordance with current circumstances are modules. A module is a teaching material that can help students master lessons according to learning objectives and as a means of learning for students independently based on their individual abilities. Modules can be used as a learning resource in understanding the concepts of learning material (Sintawati, 2017).

In accordance with Jerrold et al, (2016)A module is characterized as an independent teaching package that contains points or units of learning material that students use to progress independently while minimizing receiving help from others. Some research that shows that increasing guided discovery-based modules can develop understanding of ideas is research from Nurhayati (2017), Sintawati (2017), and Melisa (2016). In Nurhayati's research (2017), completeness of learning using traditional modules is met and reactions to learning are positive. Based on Sintawati's exploration (2017), the modules created meet the principles of being substantial, reasonable, and suitable for use in learning. Furthermore, the consequences of Melisa's exploration (2016) directing that the revelation-based modules created have been truly utilized as teaching materials. Considering the issues above, researchers are very interested in developing science learning modules using the guided discovery method to increase learning independence and scientific literacy skills in class V elementary school water cycle material. Based on the description above, this research was conducted to evaluate the feasibility of the module, the effectiveness of the module, the profile of scientific literacy skills and student learning independence after using the module and the differences in learning independence and scientific literacy before and after using the guided discovery-based module.

Method

Type of research used research and development (R&D) methods with ADDIE model. The research subjects as a limited group were 23 fifth grade students at Rowosari State Elementary School, 25 students as the experimental group and 25 students as the control group. Both the experimental class and the control class have the same academic abilities as evidenced by the class average score in the final exam of the previous chapter.

The data collection instrument for the independence questionnaire is a closed questionnaire of 40 questions with a Likert model assessment scale providing four answer choices, namely strongly agree (SS), agree (S), disagree (ST) and strongly disagree (STS). The student learning independence questionnaire is prepared based on several indicators, namely learning independence including, having the ability to compete to advance, being able to make choices/decisions, being independent/taking initiative, having self-confidence, having responsibility, and being able to control oneself (Dahlan, 2017; Desmita, 2017; Febriastuti et al., 2013; Hidayati & Listyani, 2010; Mudjiman, 2011). The results of the validity and reliability tests state that this questionnaire has a good level of validity and reliability. Validity moves from 0.194-0.701 and reliability is 1.587. Scientific literacy ability data uses a scientific literacy ability test adapted from PISA 2009 questions in the form of multiple choices, complex choices and descriptions covering three domains of scientific literacy, namely context, competence and knowledge. The results of the validity and reliability tests state that this questionnaire has a good level of validity and reliability. Validity moves from 0.477-0.803 and reliability is 0.887.

Before analysis, the results were checked by an author. SPSS and Microsof Excel were used in the analysis. Based on the respondents' achievement scores, the average and standard deviation of the data for the research variables were calculated. The N-gain test is used to determine the effectiveness of the product, and descriptive data analysis is used to assess the feasibility and profile of students' scientific literacy abilities and learning independence.Differences in students' independence and scientific literacy abilities were analyzed usingKruskal-Wallis H test.

Results and Discussion

Through the validation stage, material experts, linguists, media experts and peer reviewers have tested the feasibility of the guided discovery-based science module. According to Poerwadarminta, (2003) feasibility is a prerequisite to be said to be worthy. The feasibility of the module being developed is determined by the results of material expert validation which includes: suitability of the material with Basic Competencies (known with KD), relevance and up-to-dateness, clarity of material in material descriptions, and depth of material; The use of language that is appropriate to EYD, communicative, appropriate to the developmental stage of elementary school students, punctuation, and consistent application of terms, symbols, and scientific names as well as foreign languages are examples of language expert validation; Peer reviewers validate the material, language, appearance and image components; media experts validate the color and size of letters, layout, presentation and image illustrations. After analyzing the cut-off score and validation results, the module was deemed feasible with an optimal percentage of 95.0%.

Table1. Module Validation Analysis Results

No	Validator	Ideal Percentage (%)
1.	Expert 1	89.0
2.	Expert 2	95.0
3.	Expert 3	88.0
4.	Peer Reviewers 1	88.0
5.	Peer Reviewer 2	92.0
6.	Limited Test Group Acceptance	87.5
7.	Acceptability of the Experimental Test Group	88.3
Maximum Value		95.0
Minimum Value		88.0
Natural cut off score		91.5
Average value		90.4
Information		Very Worth It

Student response questionnaires in limited trials at the module deployment stage, in addition to validation results, strengthen the feasibility of guided discovery-based science modules. The ideal percentage in limited trials is 87.5%, higher than the limit value of 86.4%. This shows that the module is considered suitable for use. Cut Off is used for additional calculations based on validation results from linguist experts, media experts, material experts and peer reviewers. The science module based on guided discovery on the water cycle material is suitable for use because the average assessment value is greater than the cut off value. According to Aryani et al., (2015), there is a real difference in students' physics learning outcomes before and after the PBL module is implemented. This is because students can better understand the concepts they have learned by building knowledge based on real experience through the use of the PBL model. The product developed received an assessment in good categories from material experts and media experts based on the results of the product validation that has been carried out, so it can be said that the product meets the validity requirements. This is in line with the statement put forward by Djamas & Tinedi, (2021) that a product has validity quality if material experts and media experts assess it in the minimum good category. According to Nieveen, (1999), a quality product must meet at least three requirements: validity, usability, and effectiveness. It can be concluded that the product developed meets the criteria for validity, usability and effectiveness based on the findings of product trials and final product reviews that have been described.

Table 2. Score ResultsLarge-Scale Group Student N-gain

Group	Aspect	Average Pre-Test Score	Average Post-test Score	Difference	*N-gain*	N-Gain Category
Experiment	Scientific literacy skills	36.4	77.0	40.6	0.6	Currently
	Learning independence	94.0	101.9	8.0	1.3	Tall
Control	Scientific literacy skills	35.7	60.4	24.7	0.4	Currently
	Learning independence	94.5	97.1	2.5	0.5	Currently

The initial assessment (pretest) of students' scientific literacy in the experimental group showed an average value of 36.4 (Min = 22.5; Max = 55.0) and in the control group the average value was 35.7 (Min = 20 .0; Max = 57.5). The pretest was carried out at the meeting before learning the water cycle material. Students have never used a module with a guided discovery approach in the learning process before. Teachers can use students' basic abilities as a link in providing the concepts taught so that there is continuity of concepts between teachers and students. Based on the assessment of Noviyanti et al, (2014) the pretest aims to determine students' basic abilities and determine the extent to which students can interpret material. Understanding ideas in new learning is greatly influenced by students' initial information (Norsanty & Chairani, 2016).

The process after the pretest is learning using a guided discovery module in the experimental group and using a conventional accompanying book in the control group. After the learning process is complete, students are given a posttest to measure students' scientific literacy abilities and learning independence on the water cycle material. Posttest assessment of students' scientific literacy in the experimental group showed an average score of 77.0 (Min = 65.0; Max = 92.5) and in the control group the average score was 60.4 (Min = 55.0 ; Max = 67.5). Pretest and posttest data show that the scientific literacy ability scores of experimental class students (using modules with the guided discovery method) are higher than those of students in the control group (conventional learning). The average post-test score obtained for the experimental class (77.0) was better than the control group class (60.4). This shows that students who learn using science learning modules with the guided discovery method are able to increase students' scientific literacy abilities in the good category.

Table 3. Normality Test Results

Learning methods		df	*W*	*p*
With Module	Independence	25	0.767	0.000
	Scientific literacy	25	0.915	0.040
Conventional	Independence	25	0.890	0.011
	Scientific literacy	25	0.898	0.016

The results of the Shapiro-Wilk test provide data on student learning independence in conventional classes [W(25) = 0.890, p = 0.011], classes with guided discovery modules [W(25) = 0.767, p = 0.001] distributed non-normally. The results of the Shapiro-Wilk test for scientific literacy data showed that the groups of students in conventional classes [W(25) = 0.898, p = 0.016], classes with guided discovery modules [W(25) = 0.915, p = 0.040] were distributed non-normally. In order to analyze the differences between learning independence and scientific literacy of students from different classes, the Kruskal-Wallis H test was used.

Table 4. Test Results of Differences in Scientific Literacy Ability and Learning Independence in Experimental Class and Control Class

	Independence	Scientific Literacy
Chi-square	9.916	31.694
df	1	1
p	0.002	0.000

The results of the analysis using the Kruskal-Wallis H test showed that there were significant differences in students' science iterations originating from different learning methods between conventional methods and methods using modules with a guided discovery approach [H(1) = 31.694, p < 0.001] and learning independence also showed significant difference [H(1) = 9.916, p < 0.002]. The final conclusion of this research is that the scientific literacy abilities and learning independence of students who use guided discovery-based modules can improve unlike students who use conventional learning methods.

The positive influence of learning using modules with a guided discovery approach on students' learning independence and scientific literacy abilities can be caused by several reinforcing factors in the learning process in this research. The strengthening factors are students' learning activities improving, students' thinking abilities developing and variations in the use of learning resources. Student activity has increased both in participating in learning, reciprocal relationships between teachers and students as well as student participation in making conclusions after learning. The high level of student learning activity explains that the elements of guided discovery learning were implemented well.

In line with the opinion expressed by Beamon in Lang, (2008) that interaction in guided discovery learning makes the teacher a facilitator at the stage of generating issues and connecting learning with the issues raised, while students effectively examine and investigate understanding of data or information. These actions aid in the mission to address issues through inspection cycles. Apart from that, there are additional assignments and idea support from educators to complete the illustrations. This is in accordance with research by Chase et al, (2013) that students in the guided discovery learning model show better activeness because they are the main learning subjects and can practice their interactive abilities through small conversations.

The second factor, students' scientific literacy abilities experience development. The experimental student group, through learning using the guided discovery module, was trained to be able to think analytically in solving problems at each meeting. The stages of formulating a problem, determining a hypothesis, collecting data, testing a hypothesis and determining conclusions are stages of guided discovery learning orientation so that it can develop students' thinking and analytical skills. The use of modules with a guided discovery approach is a varied learning source in this research. By using different learning resources, students can support each other and share significant data and address problems that are introduced. This can increase their insight. Meanwhile in the control class, progress only comes from the teacher and presentations distributed by the teacher, so that learning is only centered on the teacher or teacher.

The results of this study are in line with research (Putri et al., 2002) which states that the use of learning models in each class ultimately has an impact on student learning independence. The use of guided discovery learning models has a more important impact on expanding students' learning independence than the use of conventional learning models, and guided discovery learning is able to improve students' scientific literacy abilities.

Conclusion

Based on consideration of research results and discussions, it tends to be assumed that the use of guided discovery-based modules developed as an alternative learning resource for science lessons regarding the water cycle is suitable for use. There is a significant difference in students' learning independence and scientific literacy abilities after learning using the science learning module with the guided discovery method. Based on the research results, using guided discovery-based modules can help improve students' scientific literacy skills and learning independence, so it is hoped that teachers can use and develop this or similar learning modules in delivering material to students.

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Author Contributions

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Conflicts of Interest

The authors declare no conflict of interest

References

Aryani, I., Masykuri, M., & Maridi, M. (2015). Pengembangan Modul Problem Based Learning (PBL) pada Materi Populasi Hewan untuk Meningkatkan Kemampuan Berpikir Kreatif Mahasiswa Pendidikan Biologi Universitas Sebelas Maret. *Inkuiri*, *4*(3), 68–77. https://doi.org/10.20961/inkuiri.v4i3.9592

Chase, A., Pakhira, D., & Stains, M. (2013). Implementing process-oriented, guided-inquiry learning for the first time: Adaptations and short-term impacts on students' attitude and performance. *Journal of Chemical Education*, *90*(4), 409–416. http://dx.doi.org/10.1021/ed300181t

Dahlan, D. (2017). *Psikologi Perkembangan Anak & Remaja*. Rosdakarya Offset.

Desmita. (2017). *Psikologi Perkembangan Peserta Didik*. Remaja Rosdakarya.

Djamas, D., & Tinedi, V. (2021). Development of interactive multimedia learning materials for improving critical thinking skills. In *Research Anthology on Developing Critical Thinking Skills in Students* (pp. 507–525). IGI Global.

Elfira, N. (2013). Peningkatan kemandirian belajar siswa melalui layanan bimbingan kelompok. *Konselor*, *2*(1). https://doi.org/10.24036/0201321728-0-00

Febriastuti, Y. D., Linuwih, S., & Hartono. (2013). Peningkatan Kemandirian Belajar Siswa SMP Negeri 2 Geyer melalui Pembelajaran Inkuiri Berbasis Proyek. *Unnes Physics Education Journal*, *2*(1), 27–33. https://doi.org/10.15294/upej.v2i1.1617

Hidayati, K., & Listyani, E. (2010). Pengembangan Instrumen Kemandirian Belajar Mahasiswa. In *Jurnal Penelitian dan Evaluasi Pendidikan*. 14(1). https://doi.org/10.21831/pep.v14i1.1977

Kemdikbud. (2017). Konsep Literasi Sains dalam Kurikulum 2013. *Konsep Literasi Digital Dalam*

Kurikulum 2013, *November*, 1–28.

Lang, H. (2008). *Models Strategies and Methods For Effective Teaching*. Pearson Education.

Lestari, H., Banila, L., & Siskandar, R. (2019). Improving Student's Science Literacy Competencies Based on Learning Independence with STEM Learning. *Biodidaktika: Jurnal Biologi Dan Pembelajarannya*, *14*(2). http://dx.doi.org/10.30870/biodidaktika.v14i2.6134

Melisa, M. (2016). Pengembangan Modul Berbasis Penemuan Terbimbing Yang Valid Pada Perkuliahan Kalkulus Peubah Banyak I. *Lemma*, *1*(2), 145466. https://dx.doi.org/10.22202/jl.2015.v1i2.533

Mudjiman, H. (2011). *Manajemen Pelatihan Berbasis Belajar Mandiri*. Pustaka Pelajar.

Nieveen, N. (1999). Prototyping to Reach Product Quality. *Design Approaches and Tools in Education and Training*, 125–135. https://doi.org/10.1007/978-94-011-4255-7_10

Norsanty, U. O., & Chairani, Z. (2016). Pengembangan lembar kerja siswa (LKS) materi lingkaran berbasis pembelajaran guided discovery untuk siswa SMP kelas VIII. *Math Didactic: Jurnal Pendidikan Matematika*, *2*(1), 12–23. https://doi.org/10.33654/math.v2i1.23

Noviyanti, L., Indriyanti, D. R., & Ngabekti, S. (2014). Pengembangan instrumen self dan peer assessment berbasis literasi sains di tingkat SMA. *Lembaran Ilmu Kependidikan*, *43*(1), 32–39. https://doi.org/10.15294/lik.v43i1.3165

Nurhayati, N. (2017). Pengembangan bahan ajar trigonometri berbasis kontekstual melalui metode guided discovery untuk meningkatkan pemahaman konsep mahasiswa. *FIBONACCI: Jurnal Pendidikan Matematika Dan Matematika*, *3*(1), 31–44. https://doi.org/10.24853/fbc.3.1.31-44

OECD. (2019). PISA 2018 Results. What school life means for students' lives. In *OECD Publishing: Vol. III*. Retrieved from https://www.oecd.org/pisa/publications/PISA2018_CN_IDN.pdf

Poerwadarminta, W. J. S., & (Indonesia), P. B. (2003). *Kamus umum Bahasa Indonesia*. Balai Pustaka. Retrieved from https://books.google.co.id/books?id=2L9kAAAAMAAJ

Putri, Novita Adiqka; Nurwidodo; Pantiwati, Y. (2002). Perbedaan Model Pembelajaran Open Inquiry Dan Guided Inquiry Berdasarkan Kemandirian Belajar Dan Berfikir Tingkat Tinggi Pada Mata Pelajaran Biologi Kelas 11 Man Tempursari ± Ngawi. *Jurnal Pendidikan Biologi Indonesia*, *1*(1), 27–34. https://doi.org/10.22219/jpbi.v1i1.2300

Rizta, A., Siroj, R. A., & Novaliana, R. (2016). Pengembangan Modul Materi Lingkaran Berbasis Discovery untuk Siswa SMP. *Jurnal Elemen*, *2*(1), 72–82. https://doi.org/10.29408/jel.v2i1.178

Sanjaya, R. W. K., Maridi, M., & Suciati, S. (2017). Pengembangan Modul Berbasis Bounded Inquiry Lab Untuk Meningkatkan Literasi Sains Dimensi Konten Pada Materi Sistem Pencernaan Kelas XI. *Didaktika Biologi: Jurnal Penelitian Pendidikan Biologi*, *1*(1), 19–32. https://doi.org/10.20961/inkuiri.v6i3.17828

Sintawati, M. (2017). Pengembangan Modul Berbasis Penemuan Terbimbing pada Materi Bangun Ruang Sisi Datar Bagi Mahasiswa PGSD UAD. *Jurnal Pendidikan Sekolah Dasar Ahmad Dahlan*, *4*(1), 24–33. http://dx.doi.org/10.26555/jpsd.v4i1.a7359

Suhendri, H. (2012). Pengaruh kecerdasan matematis-logis, rasa percaya diri, dan kemandirian belajar terhadap hasil belajar matematika. *Prosiding Seminar Nasional Matematika Dan Pendidikan Matematika UNY*, *10*. http://dx.doi.org/10.24127/ajpm.v9i2.2722

Utami, D. D. (2018). Upaya Peningkatan Literasi Sains Siswa dalam Pembelajaran IPA. *Prosding Seminar Nasional MIPA IV*, *2007*, 133–137. Retrieved from www.conference.unsyiah.ac.id/SN-MIPA