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Magazine Based On Guided Inquiry-An Innovation To Overcomes Natural Science Learning Difficulties In Elementary Schools

ABSTRACT

This study aims to: 1) developing a magazine based on guided inquiry for the 5th-grade elementary school, especially on the learning material of living things and its environment; 2) knowing the feasibility of the magazine based on guided inquiry; 3) knowing the potential of the magazine based on guided inquiry. The development procedure adopted the ADDIE model. Data collection techniques used questionnaires and students' understanding test. Data analysis techniques used descriptive statistics and interactive qualitative analysis. This research succeeded in developing Natural Science magazine based on guided inquiry which was feasible to be used as instructional media based on experts assessments. The media expert, the material expert, the learning expert, the students, and the teacher's assessment stated that the magazine was very feasible. The results of the implementation showed the magazine based on guided inquiry has a high potency to improve the students understanding.

Keywords: Magazine, Guided Inquiry, Natural Science, Elementary School

INTRODUCTION

Natural Science is one of the basic subjects in elementary school. Natural Science is a compulsory subject included in the national examination of the elementary school in Indonesia. Students at the elementary level, studying Natural Science from the 1st grade up to 6th grade. Therefore Natural Science subject has an important role in the success of students' learning. Factors affecting students' academic performance in Natural Science learning are learning motivation (Hossainy, Zare, Hormozi, Shaghaghi, & Kaveh, 2013; Perangin-angin & Effendy, 2016), learning facilities (Mushtaq & Khan, 2012), student engagement (Reyes, Brackett, Rivers, White, & Salovey, 2012), students' social and emotion (Durlak et al., 2011), teachers teaching methods (Devine, Fahie, & Deirdre, 2013), and the presence or absence of cognitive barriers such as learning difficulties (Maryani, Husna, Wangid, Mustadi, & Vahechart, 2018). The difficulty level of the learning material being studied in the lower grades (1st, 2nd, and 3rd grades) and upper grades (4st, 5nd, and 6th grades) is different.

Difficulties in Natural Science learning can be detected early, thus can be resolved in the right way. Various actions undertaken by the teachers in overcoming the problem ideally should be tailored to the students' needs, and in accordance with the characters of elementary school students. Elementary school-age group of children has different characteristics than younger children. Elementary school students tend to play, happy to move around, enjoy working in groups, and enjoy feeling or doing something directly (Koerber, Mayer, Osterhaus, Schwippert, & Sodian, 2015; Kunter et al., 2013). Teachers should take this as a consideration while preparing effective and meaningful learning process.

Based on previous researches on Natural Science learning, there are several problems that occur in the process of Natural Science learning in elementary schools in Indonesia, there are: 1) many teachers emphasizing learning on memory factor (Sinaga, Karniawati, & Setiawan, 2017), 2) lacking in the implementation of laboratory experiments that prioritizes thinking skills (Parmin, Sajidan, Ashadi, Sutikno, & Maretta, 2016), 3) focusing on lectures presentation, thus the activities are limited, no more than listening and copying (Zubaidah, Fuad, Mahanal, & Suarsini, 2017), and 4) decrease in teaching performance of Natural Science teachers such as during preparation, delivering materials, choosing learning methods, selecting learning media, managing students, and conducting learning evaluations (Dewi, Bundu, & Tahmir, 2016). Field observations showed that students' involvement is low (example: when the teacher explains about learning material, the students are silent); students are less interested in certain learning materials due to difficult and complex characteristics of learning materials.

Media has an important role in Natural Science learning in elementary schools. Media in learning is expected to improve the quality of the learning process (Livingstone & Bovill, 2013). Selection of learning media should consider the conformity with learning objectives, learning methods, students circumstances, availability, and efficiency. Good media is able to optimize the utilization of human senses in capturing various learning materials (Ramdhani & Muhammadiyah, 2015). In elementary school, media is expected to create meaningful learning. Through meaningful learning, students will be easier in constructing knowledge, because what they learn is already around them and relates to the cognitive structure they already possessed. Visualization of abstract concepts, such as too small, too large, or even harmful can be helped by the media, so that the learning materials are wider (Cohen, Ebeling, & Kulik, 1981; Korakakis, Georgios, Palyvos, & Spyrellis, 2009). Some types of media that can be used for teaching and learning process are; 1) graphic media, 2) photographic images, 3) projection media, 4) audio media, 5) three dimensional media and 6) the surrounding environment (Nurseto, 2011).

Learning media in teaching and learning method will give advantages, reminiscent of 1) learning media will clarify the presentation of messages and knowledge, thus on facilitate and improve the training process; 2) learning media will improve and direct the children's attention, therefore will generate learning motivation, direct interaction between students and their setting, and permit students to find out in accordance with their ability and interests; 3) learning media will overcome the constraints of the senses, space, and time; 4) learning media will give students with similar experiences regarding events in their setting, and permit for direct interaction with lecturers, communities, and also the setting eg through field visits, repository or facility visits (Nurseto, 2011).

Learning media in collaboration with appropriate learning strategies can be an effective way to help students to well understand the learning material. Interesting media when being delivered in the right way can make students more interested in learning. Students' interest in learning can make them actively involved during the learning process. This involvement is expected to lead to wider implications, such as increasing activeness, knowledge, curiosity, confidence, and so on (Sinatra, Heddy, & Lombardi, 2015).

In Natural Science learning, learning strategies must provide meaningful learning process for students. One of them is that the inquiry learning strategy. Inquiry strategy may be a series of learning activities that emphasize essential and analytical thinking method to seem and notice answers of the matter in question (Gillies & Nichols, 2015). Media that integrated with inquiry strategy can make students take direct action in learning, so that students engage in the entire learning process, and make them interact directly with all the learning components.

Inquiry on Natural Science learning (inquiry science) is a strategy that emphasizes the ability to think critically about the context in which the learning material is located. During the Natural Science learning with inquiry strategy, the students' skills in finding concepts will develop, such as distinctive queries and ideas regarding scientific phenomena throughout the investigation method. Students can also practice to investigate cases and explain it scientifically. Inquiry learning helps students understand that Natural Science can be implemented in real life. Collaborative inquiry science is able to train students to solve problems with peers, measure their ability, and help each other when there are peers who need help. This process is certainly easier than must be discussing with the teachers. These processes make science inquiry an important approach to use in meaningful learning (Grandy & Duschl, 2007).

Inquiry strategy with teachers' guidance (guided inquiry) can provide an opportunity for students to be directly involved in learning, so that the teacher will directly know the achievement of the learning objectives. Inquiry strategy can maximize students' development because students are required to develop and discover their own learning concepts (Koksal & Berberoglu, 2014). In an effort to maximize students' development, teachers are required to provide assistance in the form of; 1) creating peers environment that teaches physical skills; 2) implementing learning that gives opportunities for pupils to learn to interact and work with peers, so that their social personality can develop; 3) developing learning activities that provide concrete or immediate experiences in building concept; 4) implementing learning that can develop values, so that students are able to determine a stable choice, and also self-reliant.

The results of observations and interviews with the Principal of Semen Elementary School Temanggung showed that there are many problems such as lack of books availability or teaching materials for students. In addition, boredom in learning is caused by the uninteresting books display because the books are very limited. This makes students less motivated in learning. The condition of parents/guardians who are economically low, thus in meeting the learning facilities are very lacking. So in Natural Science learning, students only listen to what is being explained by the teachers, without any media in the learning process.

Based on the importance of the media based on guided inquiry and the explained problems, it is necessary to have media to support the students' learning process. One of the learning media that teachers can use for teaching and learning process is printed media. An educational magazine is one of the printed media that have many advantages compared to other media. Educational magazines have proven to be effective in learning because its easiness to access, flexibility, new information in them, including media in time publication, low cost, and lightweight content with easily understood languages (Rehman, Muhammad, Ashraf, & Hassan, 2011). Educational magazines can also improve students' vocabulary when presented in several languages (Daddi, 2014). This research aims to develop educational magazine based on guided inquiry, especially on Natural Science learning. Feasibility tests and magazine trials also become the main focus of this research. While the impact of media usage analysis are going to be mentioned in additional detail within the discussion section of this paper.

METHODOLOGY

a. Research Model

This research used research and development method adopting development model of teaching materials from Hannafin and Peck. The development steps were as follows.

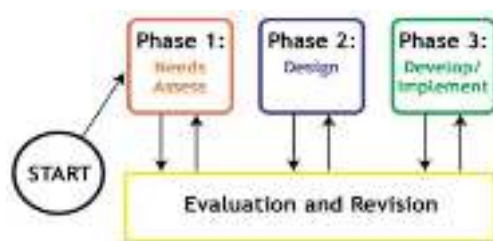


Figure 1. Hannafin and Peck Design Model (Reigeluth, 2013)

The product feasibility test was done through the validation of media expert, Natural Science materials expert, and elementary school learning expert. The product was then tested to users (teachers and students) for response and feedbacks. The quasi-experiment sought to determine the effectiveness of the science magazine based on guided inquiry on students' understanding.

b. Population

This study involved three lecturers as reviewers of science magazine based on guided inquiry, there are a learning media expert, a science learning expert, and an expert on learning in elementary school. The student's responses are given by 12 students and 2 teachers who used the magazine based on guided inquiry. Research trials were done to 12 of 5th grade students of Muhammadiyah Sangonan III Elementary School, Yogyakarta, Indonesia. The examination included a quasi-experiment with *One Group Pretest Posttest Design*. The experimental class consisted of 31 of 5th grade students of Semen Elementary School Temanggung, Central Java, Indonesia.

c. Data Collection Tools

Data collection tools were by questionnaires to experts and users, as well as tests of students' understanding within the fact of multiple choice test.

d. Data Analysis

The data consisted of quantitative and qualitative data. After the trials, then tested the impact of the use of educational magazine. The impact test analysis used paired sample t-tests because the samples come from a paired group.

FINDINGS AND DISCUSSION

The result of this research is teaching material in the form of Natural Science magazine based on guided inquiry. The development process of this teaching material was preceded by the need assessment stage. At this stage was done needs identify by finding information from multiple sources. From this stage is obtained the data that the school is in the need of interesting additional teaching materials which one of them is in the form of the educational magazine on Natural Science learning. The high requirement of this teaching material is caused by the

limitations of teaching materials used in the learning process, limitations of books circulating in schools, teachers who not yet teach with varied strategies, and teachers have not maximized the use of the surrounding environment as learning sources.

The next stage was the design, the components in the magazine that have been developed consist of Title or Cover, Magazine Description, Preface, Developer Profile, Menu or Table of Contents, Main Topics, Standards of Competency, Content Pages (learning zone, fact zone, tips zone, game zone), Bibliography, and Back Cover.

The next stage was development, at this stage, the researchers composed and developed teaching materials ranging from the arrangement of media, form, structure, and contents. The contents development flow using the syntax of guided inquiry that is integrated into some parts of the magazine. The syntax can be seen in table 1.

Table 1. The syntax of Guided Inquiry Model

Phase	Description
1. Planning	The teacher provides issues that area unit relating to the students' daily life. During this stage, the teacher guides the students in planning the strategy to solve the problem through an experiment
2. Retrieving	Students collect data to solve problems that teacher have provided with the help of various learning sources
3. Processing	Students testing and proving the hypothesis by doing an analysis to the experiment result data
4. Creating	Students make a conclusion on the results of the hypothesis testing
5. Sharing	Students present their findings to the class, the teacher corrects the concept of the students' findings
6. Evaluating	The teacher gives appreciation to every presentation group and corrects the students' findings.

(Espinosa Bueno, Labastida Piña, Padilla, & Garritz, 2011; Gyllenpalm, Wickman, & Holmgren, 2010; Pedaste et al., 2015; Putra, Widodo, & Jatmiko, 2016)

The fourth stage was implementation. This stage was done in Muhammadiyah Sangonan III Elementary School Sleman Yogyakarta as a limited trial, and in Semen Elementary School Temanggung as a large-scale trial. There were several stages done before performing the implementation. the first stage was done to determine the feasibility of teaching materials from

the side of the material, media, and learning. The learning materials expert advised and commented on the material developed. Media experts assessed existing designs in the developed media such as fonts, colors, animations, and layer designs. While the learning expert assessed the suitability of teaching material for elementary school students. After validation from the experts then the next step was a limited trial. The limited trial was conducted by implementing the product to some elementary school students, a limited trial was conducted to find out the impact of the teaching material that has been developed. The large-scale trial was done by implementing teaching material to all research subjects.

The last stage was the evaluation. This stage was done after the suggestion of improvement from the experts, Natural Science magazine based on guided inquiry is feasible because from experts assessment obtained suggestions: from the material expert in the form of material improvement that must be adapted to the surrounding environment, from learning expert to add games in the magazine because the games can be used as an evaluation instrument. While the advice from the media expert is some animation that should be removed, and there are some designs that must be adjusted to the existing script on the pages.

Prior to being tested on users, the teaching material product was validated by media expert, Natural Science materials expert, and elementary school learning expert. Validation results indicate that teaching material is suitable for use in learning with a very good category. Although, before obtaining such an assessment, experts provided qualitative input to teaching material product. The input from the experts can be seen in table 2.

Table 2. Experts' Feedbacks toward Magazine Based on Guided Inquiry

Feedbacks on teaching materials	
Media Expert	<ul style="list-style-type: none"> – Some layers of the design of the contents need to be improved. – Some image illustrations need to be omitted. – Font type and color need to be adjusted. – Repair finishing or final stage of cutting in printing house; do not let the words cut off.
Natural Science Material Experts	<ul style="list-style-type: none"> – The materials in <i>Alit</i> magazine learning media should be adjusted to the local wisdom of the surrounding community – Guided Inquiry integration should be emphasized on important materials – The plot of materials presentation needs to be made more hierarchical, from easy to difficult and simple to complex.

Feedbacks on teaching materials	
Elementary School Learning Expert	<ul style="list-style-type: none"> – Games zone in the magazine needs to be added – Guided Inquiry integration should be the main spirit in the learning syntax with the teaching material of this magazine – Instructions for teachers should emphasize the steps with guided inquiry

Based on the experts' inputs in table 2, the final product of the Natural Science magazine based on guided inquiry teaching material has improved, among others on the cover as shown in Figure 1. briefly shown in Figures 2, 3, and 4.



Figure 2. The sample of product revision based on media expert's input

Improvements on the cover (figure 2) are: 1) improvements to the original sky and cloud layer being fixed to the forest, in order to better match the material characteristics available in the educational magazine; 2) font type, being fixed with the purpose of having uniformity and easier to read; 3) color, being improved to give the harmonious impression. Based on the input of learning material expert, educational magazine product has improved on the page of "fact zone" as shown in Figure 3.



Before revision



After revision

Figure 3. Example of product revision based on the input from Natural Science material expert

The improvements made as shown in Figure 3 are to change the original factual information about hummingbirds, replaced by factual information about one-horned rhinoceros. The improvement of this information is based on the fact that one-horned rhinoceros is a native Indonesian endangered animal, with this change information is expected to foster a sense of love for the flora and fauna, especially the native Indonesian. Based on the input of elementary school learning expert (table 2), the educational magazine performed improvements by adding Gamezone page as shown in Figure 4.



Figure 4. Example of product revision based on input from elementary school learning expert

The addition of GameZone as shown in Figure 4 can be used as a students evaluation. Gamezone is also a means of students' play zone so as to increase students enthusiasm in learning.

The final product of Natural Science magazine that has been validated by the experts was then tested on students and teachers. The trials were conducted in two stages, namely in the limited group and large group implementation. In the limited group, researchers requested responses from the teacher and 12 students from Muhammadiyah Sangonan III Elementary School Sleman, Yogyakarta. While in the large group trial, the researchers asked for responses from the teacher, and measured the understanding of 31 students of Semen Elementary School Temanggung, Central Java. The results of the assessment of experts, teachers, and students are presented in table 3.

Table 3. Results of product feasibility assessment by the material expert, media expert, learning expert, teachers' responses, students' responses questionnaire

Assessment	Score	Value	Category
Material Expert	34	85	Very feasible
Media Expert	37	92,5	Very feasible
Learning Expert	32	80	Very feasible
Limited Scale Trial			
Teacher Response	67	98,5	Very feasible
Students Response	119	89,0	Very feasible
Large Scale Trial			
Teacher Response	143	95,33	Very feasible
Students Response	97	97	Very feasible

Based on the pretest and posttest results from group trials, teaching material of Natural Science magazine based on guided inquiry greatly affect the level of students' understanding in the subjects of Natural Science, especially the material adjustment of living things with their environment. The results of descriptive analysis of pre-test and post-test presented in table 4.

Table 4. Descriptive Analysis Results of Students' Understanding before and after using media

	N	Minimum	Maximum	Mean	Std. Deviation
Pre Test	31	33,00	73,00	64,0000	10,29239
Post Test	31	53,00	100,00	78,3871	10,52514
Valid N (listwise)	31				

Based on table 4, it can be seen that there is an increase in value from pretest to posttest of 14.39 or 22.48%. This occurs to all students. Distribution of pretest and posttest values of all students can be seen in figure 5.

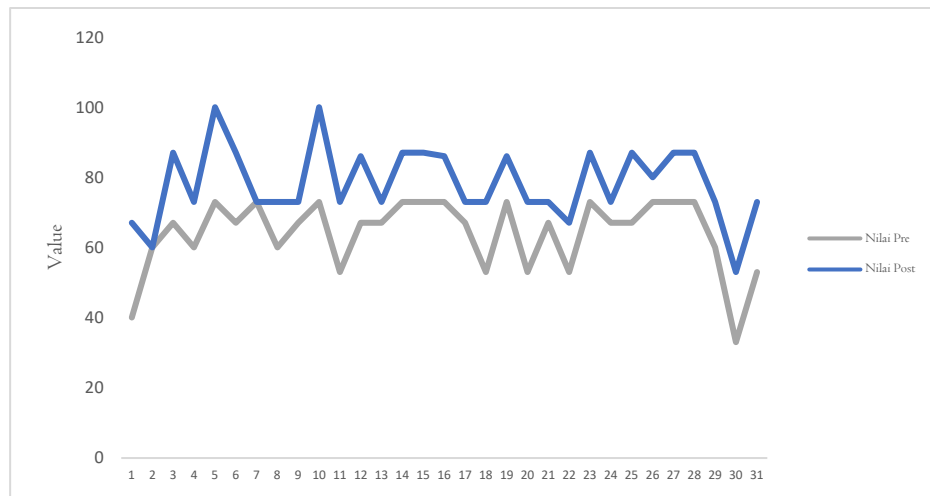


Figure 5. Value Distribution of students' Pretest and Posttest

Figure 4 shows a prevalent increase in each student's understanding. During the learning process using magazine based on guided inquiry, students were very enthusiastic. This enthusiasm was indicated by the positive response to the problems presented by the teacher and in the educational magazine which was used as the source to find the solution of the problem. Enthusiasm was also shown by the students that happy to do evaluation questions that exist in gamezone as a part of the magazine. When faced with difficulties, they asked teachers and peers and exchanged opinions with peers to find solutions.

In this section, researchers try to do a correlation analysis of students' understanding before and after using magazine based on guided inquiry. The result of correlation analysis can be seen in table 5.

Table 5. Analysis of correlation between students' understanding and the use of magazine based on guided inquiry

Paired Samples Correlations				
		N	Correlation	Sig.
Pair 1	Pre Test & Post Test	31	0,757	0,000

Based on table 5, it can be seen that sig (0,000) < 0,05. It means that there is a correlation on students' understanding before and after using magazine based on guided inquiry. The table also gives R² value of 0,757² (0,5731 or 57,31%), which means that the contribution of Natural Science magazine based on guided inquiry is 57,31% while the rest is influenced by other

factors. Other factors can be academic levels (Poropat, 2009), achievement motivation (Shaharoun, Awaluddin Mohamed & Harun, 2012), self-efficacy (Turner, Chandler, & Heffer., 2009), and teachers teaching strategies (Ibrahim, Aulls, & Shore, 2017). In this research, it has been successful to test the impact of the Natural Science magazine based on guided inquiry with paired sample t-test analysis. The result of paired sample t-test is shown in table 6.

Table 6. Analysis of correlation between students' understanding and the use of magazine based on guided inquiry

		Paired Differences					t	Sig. (2-tailed)
		Mean	Std. Deviation	Std. Error	95% Confidence Interval of the Difference			
			n	Mean	Lower	Upper		
Pair 1	Pre Test - Post Test	-14,38710	7,26029	1,3039	-17,05019	-11,72400	-11,033	,000

Based on table 6, sig (0,000) < 0,05 means that there is a difference in students' understanding before and after learning using magazine based on guided inquiry. This difference is due to changes in students responses before and after the use of educational magazine. Positive responses appear as the effect of meaningful learning as a result of the inquiry approach. Students become easier in understanding the learning material because the learning material presented is closely related to their daily lives. Students' interest in Natural Science magazine based on guided inquiry has an impact on their interest in learning (Kang & Keinonen, 2017). Guidance that teachers do during the learning process makes students able to solve problems with reference to existing teaching materials. Attitude and self-efficacy of students are well formed throughout the learning process, due to the impact of collaborative learning used by teachers (Vishnumolakala, Treagust, Mocerino, & Qureshi, 2017). In addition to students 'understanding, the inquiry approach integrated into the educational magazine has the potential to increase students' literacy and confidence (Gormally, Brickman, Hallar, & Armstrong, 2009).

Conclusion

This research succeeded in developing Natural Science magazine based on guided inquiry which is feasible to be used as a learning media according to the assessment of experts. Media expert, Natural Science materials expert, and elementary school learning expert stated that this media is highly feasible for elementary Natural Science learning. The results of teachers and

students responses measurement are stated as very good. The potency of Natural Science magazine based on guided inquiry is big in helping students to understand the learning material, shown by the improvement of the measurements on students' understanding before and after media using this media.

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Submissions

Workflow **Publication**

BUKTI PROSES REVIEW

Submission Review Copyediting Production

Round 1

Round 1 Status
Submission accepted.

Notifications

[Pedagogika] Editor Decision	2019-10-07 12:18 AM
[Pedagogy] Editor Decision	2019-11-05 10:45 AM
[Pedagogy] Editor Decision	2019-12-14 07:23 PM

Reviewer's Attachments [Q Search](#)

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BUKTI HASIL REVIEW DARI REVIEWER 1

corrections needed

7. Accuracy, novelty, systematicness of the literature review

corrections needed

8. Presentation and reasoning of research methodology and methods

corrections needed

9. Completeness and reasoning of the presentation of research results

corrections needed

10. Compliance of illustrative material (tables, charts, graphs, etc.) in the text to the requirements of APA 6th edition.

corrections needed

11. Depth of scientific discussion, level of argumentation and value

inappropriate

12. The conclusions (generalizations) are related with the scientific problem, aim of the article as well as with given and grounded results of the research.

inappropriate

13. Compliance of references in the text and the list of references to the requirements of APA 6th edition.

compliant

14. Linguistic preparation of the article

appropriate

15. Notes and recommendations

1. It is advisable to formulate a clear purpose for the study. Creating a magazine for school students is a practical aim. What is the theoretical purpose of the study? How was it operationalized? Existing research aims are inconsistent with the findings.

This study aims to: 1) developing a magazine based on guided inquiry for the 5th-grade elementary school, especially on the learning material of living things and its environment; 2) knowing the feasibility of the magazine based on guided inquiry; 3) knowing the potential of the magazine based on guided inquiry.

Conclusions are: This research succeeded in developing Natural Science magazine based on guided inquiry which is feasible to be used as a learning media according to the assessment of experts. Media expert, Natural Science materials expert, and elementary school learning expert stated that this media is highly feasible for elementary Natural Science learning. The results of teachers and students responses measurement are stated as very good. The potency of Natural Science magazine based on guided inquiry is big in helping students to understand the learning material, shown by the improvement of the measurements on students' understanding before and after media using this media.

2. The concept of guided inquiry is unclear. The definition of guided inquiry under Banchi and Bell needs to be clarified.

Banchi, H. & Bell, R. (2008). The Many Levels of Inquiry. *Science and Children*, 46 (2), 26-29

3. The quantitative sample is too small (31 subjects). It is incorrect to apply mathematical statistics to such a small sample. There is a lack of explanation as to how the data meet the conditions of normality

4. Scientific problem is not undefined. There is a lack of discussion at its core.

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Notifications



[Pedagogy] Editor Decision

2019-11-05 10:45 AM

ika maryani, Nurul Wahyu Lestari, Much. Fuad Saifuddin Saifuddin:

We received the second review. Please also edit the article according to the second review. Maybe the comments are repetitive. Check out the article and upload again to the 'Revisions' section.

We have reached a decision regarding your submission to Pedagogy, "Magazine Based On Guided Inquiry-An Innovation To Overcomes Natural Science Learning Difficulties In Elementary Schools".

Our decision is: Revisions Required

Ona Monkevičienė
ona.monkeviciene@vdu.lt

Reviewer A:
Recommendation: Resubmit for Review

1. Title of the article

partly in line with the content

2. Comprehensiveness of information presented in the annotation

not enough comprehensive

3. Suitability of key words

corrections needed

4. Relevance and originality of manuscript

original in some respects

5. Compliance of the article structure to the requirements of scientific article (according to the nature of the research)

corrections needed

6. Formulation of problem, aim and objectives of scientific research

corrections needed

7. Accuracy, novelty, systematicness of the literature review

corrections needed

8. Presentation and reasoning of research methodology and methods

**[Pedagogy] Editor Decision**

2019-11-05 10:45 AM

**BUKTI HASIL REVIEW
DARI REVIEWER 2**

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ARTIKEL HASIL REVISI

Magazine Based On Guided Inquiry-An Innovation to Overcomes Natural Science Learning Difficulties in Elementary Schools

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ABSTRACT

This study aims to: 1) developing a magazine based on the guided inquiry for the 5th-grade elementary school; 2) measure the feasibility of this magazine, and 3) improve the student's understanding by using this magazine. The development procedure adopted the Hannafin and Peck model (needs assessment, design, develop/ implement, evaluation, and revision). Data collection techniques used open-close questionnaires and students' understanding test. Data analysis techniques used descriptive statistics and interactive qualitative analysis. This research succeeded in developing Science magazines based on guided inquiry, which was feasible to be used as instructional media based on expert assessments. It is feasible to be used as a learning media according to the evaluation of experts. Media experts, Natural Science materials experts, and elementary school learning experts stated that this media is highly feasible for elementary school students. Science magazine is essential to overcome the learning difficulties, shown by the improvement mean of the students' understanding before and after the intervention.

Keywords: Science Magazine, Guided Inquiry, learning difficulties, Elementary School

INTRODUCTION

Natural Science is one of the primary subjects in elementary school. Natural Science is a compulsory subject included in the national examination of the elementary school in Indonesia. Students at the elementary level, studying Natural Science from the 1st grade up to 6th grade. Therefore, Natural Science subject has an essential role in the success of students' learning. Factors affecting students' academic performance in Natural Science learning are learning motivation (Hossainy, Zare, Hormozi, Shaghaghi, & Kaveh, 2013; Perangin-angin & Effendy, 2016), teaching facilities (Mushtaq & Khan, 2012), student engagement (Reyes, Brackett, Rivers, White, & Salovey, 2012), students' social and emotion (Durlak et al., 2011), teachers teaching methods (Devine, Fahie, & Deirdre, 2013), and the presence or absence of cognitive barriers such as learning difficulties (Maryani, Husna, Wangid, Mustadi, & Vahechart, 2018). The difficulty level of the learning material being studied in the lower grades (1st, 2nd, and 3rd grades) and upper grades (4st, 5nd, and 6th grades) is different.

Difficulties in Natural Science learning can be detected early, thus can be resolved in the right way. Various actions undertaken by the teachers in overcoming the problem should be

tailored to the students' needs and following the characters of elementary school students. Elementary school-age group of children has different characteristics than the younger/ older. Elementary school students tend to play, happy to move around, enjoy working in groups, and enjoy feeling or doing something directly (Koerber, Mayer, Osterhaus, Schwippert, & Sodian, 2015; Kunter et al., 2013). Teachers should take this as a consideration while preparing an effective and meaningful learning process.

Based on previous researches on Natural Science learning, there are several problems that occur in the process of Natural Science learning in elementary schools in Indonesia, there are: many teachers emphasizing learning on memory factor (Sinaga, Karniawati, & Setiawan, 2017), lacking in the implementation of laboratory experiments that prioritizes thinking skills (Parmin, Sajidan, Ashadi, Sutikno, & Maretta, 2016), focusing on lectures presentation, thus the activities are limited, no more than listening and copying (Zubaidah, Fuad, Mahanal, & Suarsini, 2017), and decrease in teaching performance of Natural Science teachers such as during preparation, delivering materials, choosing learning methods, selecting learning media, managing students, and conducting learning evaluations (Dewi, Bundu, & Tahmir, 2016). Field observations showed that students' involvement is low (example: when the teacher explains about learning material, the students are silent); students are less interested in certain learning materials due to difficult and complex characteristics of learning materials.

Media has an important role in Natural Science learning in elementary schools. Media is expected to improve the quality of the learning process (Livingstone & Bovill, 2013). The selection of it should consider the conformity with learning objectives, learning methods, student's circumstances, availability, and efficiency. Appropriate media is able to optimize the utilization of human senses in capturing various learning materials (Ramdhani & Muhammadiyah, 2015). In elementary school, media is expected to create meaningful learning. Through meaningful learning, students will be more accessible in constructing knowledge, because what they learn is already around them and relates to the cognitive structure they already possessed. The media can help visualization of abstract concepts, such as too small, too large, or even harmful so that the learning materials are more comprehensive (Cohen, Ebeling, & Kulik, 1981; Korakakis, Georgios, Palyvos, & Spyrellis, 2009). Some types of media that can be used for the teaching and learning process are visual media, photographic images, projection media, audio media, three-dimensional media, and the surrounding environment (Nurseto, 2011).

Learning media in teaching and learning method will give advantages. First, reminiscent of learning media will clarify the presentation of messages and knowledge, thus facilitating and

improve the training process. Second, teaching media will enhance and direct the children's attention, therefore will generate learning motivation, direct interaction between students and their setting, and permit students to find out by their ability and interests. Third, learning media will overcome the constraints of the senses, space, and time. Lastly, teaching media will give students with similar experiences regarding events in their setting, and permit for direct interaction with lecturers, communities, and also the setting eg, through field visits, repository or facility visits (Clark, Yates, Early, & Moulton, 2008; Nurseto, 2011).

Learning Media, in collaboration with appropriate strategies, can be an effective way to improve the students' understand. Interesting media, when being delivered in the right way, can make students more interested and engaged in learning. Students' interests can make them actively involved during the learning process. This involvement is expected to lead to more full implications, such as increasing activeness, knowledge, curiosity, confidence, and so on (Sinatra, Heddy, & Lombardi, 2015).

In Natural Science learning, learning strategies must provide meaningful learning process for students. One of them is the inquiry learning strategy. Inquiry strategy may be a series of learning activities that emphasize the essential and analytical thinking method to seem and notice answers to the matter in question (Gillies & Nichols, 2015). Media that integrated with that can make students take direct action in learning so that students engage in the entire learning process and make them interact directly with all the learning components.

The inquiry is a strategy that emphasizes the ability to think critically about the context in which the learning material is located. During inquiry learning, the students' skills in finding concepts will develop, such as distinctive queries and ideas regarding scientific phenomena throughout the investigation method. Students can also practice to investigate cases and explain them scientifically. Inquiry learning helps students understand that Natural Science can be implemented in real life. Collaborative inquiry science can train students to solve problems with peers, measure their ability, and help each other when there are peers who need help. This process is undoubtedly more accessible than it must be discussed with the teachers. These processes make science inquiry an important approach to use in meaningful learning (Grandy & Duschl, 2007).

Guided inquiry can provide an opportunity for students to be directly involved in learning so that the teacher will directly know the achievement of the learning objectives. Inquiry strategy can maximize students' development because students are required to develop and discover their own learning concepts (Koksal & Berberoglu, 2014). In an effort to maximize students' development, teachers are required to provide assistance in the form of; 1) creating

peers environment that teaches physical skills; 2) implementing learning that gives opportunities for pupils to learn to interact and work with peers, so that their social personality can develop; 3) developing learning activities that provide concrete or immediate experiences in building concept; 4) implementing learning that can develop values, so that students are able to determine a stable choice, and also self-reliant.

The results of observations and interviews with the Principal of Semen Elementary School Temanggung showed that there are many problems, such as lack of book availability or teaching materials for students. In addition, boredom in learning is caused by the uninteresting books display because the books are very limited. This makes students less motivated in learning. The condition of parents/guardians who are economically low, thus in meeting the learning facilities, is very lacking. So in Natural Science learning, students only listen to what is being explained by the teachers, without any media in the learning process.

Based on the importance of the media based on guided inquiry and the explained problems, it is necessary to have media to support the students' learning process. One of the learning media that teachers can use for teaching and learning process is printed media. An educational magazine is one of the printed media that have many advantages compared to other media. Educational magazines have proven to be effective in learning because of its easiness of access, flexibility, new information in them, including media in time publication, low cost, and lightweight content with easily understood languages (Rehman, Muhammad, Ashraf, & Hassan, 2011). Educational magazines can also improve students' vocabulary when presented in several languages (Daddi, 2014). This research aims to develop an educational magazine based on guided inquiry. Feasibility tests and magazine trials also become the main focus of this research, while the impact of media usage analysis is going to be mentioned in additional detail within the discussion section of this paper.

METHODOLOGY

a. Research Model

This research used a research and development method adopting the development model of teaching materials from Hannafin and Peck. The development steps were as follows.

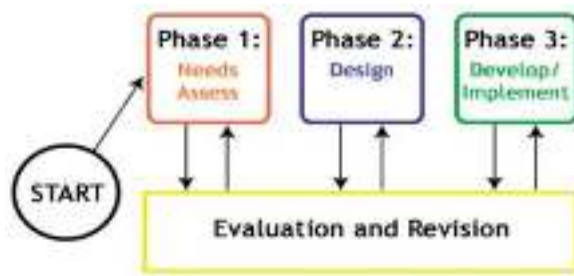


Figure 1. Hannafin and Peck Design Model (Reigeluth, 2013)

The product feasibility test was done through the validation of media experts, natural science materials experts, and elementary school learning experts. The product was then tested to users (teachers and students) for responses and feedbacks. The quasi-experiment sought to determine the effectiveness of the science magazine based on guided-inquiry on students' understanding.

b. Participants

This study involved three lecturers as reviewers of science magazine based on guided inquiry, and there are a learning media expert, a science learning expert, and an expert on learning in elementary school. The student's responses are given by 12 students and two teachers who used the magazine based on guided inquiry. Research trials were done to 12 of 5th grade students of Muhammadiyah Sangonan III Elementary School, Yogyakarta, Indonesia. The examination included Classroom Action Research. The group consisted of 31 of 5th grade students of Semen Elementary School Temanggung, Central Java, Indonesia.

c. Data Collection and Instruments

Data collection techniques using questionnaires, interviews, and tests. Questionnaires and interviews were used to determine the quality and feasibility of the magazine as a science teaching material. The questionnaire was used to retrieve data from media experts, material experts, learning experts, teacher responses, and student responses. While the interview is also used for the same interests but produces deeper qualitative data. The results of data retrieval with questionnaires and interviews are used to show the quality of teaching materials. The test is used to measure the effectiveness of the magazine in reducing learning difficulties. Teaching material is said to be effective in reducing learning difficulties if the posttest score is higher than the pretest score.

d. Procedures and Analysis

This research consists of two stages, namely research and development. The research phase consists of a preliminary study, a literature review, and an analysis of student learning difficulties. In this stage, a need assessment is carried out to determine the urgency of developing teaching materials. While the development phase consists of several steps, namely: 1) design, 2) development, 3) implementation, and 4) evaluation and revision. In the design stage, the storyboard is made as a representation of the design of teaching materials. This is then developed by adding content. The approach in teaching materials refers to the syntax of guided inquiry. The next step is the quality and feasibility test for experts and users. This stage determines whether quality teaching materials or not. If quality, the implementation phase can be carried out. In this stage, teaching materials are applied in science learning in class V. Students' understanding is measured to represent the learning difficulties they face. Teaching material is said to be feasible if it can reduce learning difficulties, as indicated by an increase in posttest scores.

Analysis of the data used in each of the above stages depends on the type of data and its purpose. In qualitative data, interactive model data analysis is applied. This technique includes data collection, data display, data reduction, and conclusion: drawing/verification. On quantitative data, descriptive statistics are applied.

FINDINGS AND DISCUSSION

The result is teaching the material in the form of a Science magazine based on guided inquiry. The development process of this teaching material was preceded by the need assessment stage. At this stage was done needs identify by finding information from multiple sources. From this stage is obtained the data that the school is in need of interesting additional teaching materials which one of them is in the form of the educational magazine on Natural Science learning. The high requirement of this teaching material is caused by the limitations of teaching materials used in the learning process, limitations of books circulating in schools, teachers who not yet teach with varied strategies, and teachers have not maximized the use of the surrounding environment as learning sources.

The next stage was the design, the components in the magazine that have been developed consist of Title or Cover, Magazine Description, Preface, Developer Profile, Menu or Table of Contents, Main Topics, Standards of Competency, Content Pages (learning zone, fact zone, tips zone, game zone), Bibliography, and Back Cover. At the development stage, the researchers composed and developed teaching materials ranging from the arrangement of media, form,

structure, and contents. The contents development flow using the syntax of guided inquiry that is integrated into some parts of the magazine. In the guided inquiry, the teacher provides students with only the research question, and students design the procedure to test their questions and the resulting explanations. In this method, students need guidance as to whether their investigation plans make sense (Banchi & Bell, 2008). The syntax of guided inquiry can be seen in Table 1.

Table 1. The syntax of Guided Inquiry Model

Phase	Description
1. Planning	The teacher provides issues that area unit relating to the students' daily life. During this stage, the teacher guides the students in planning the strategy to solve the problem through an experiment.
2. Retrieving	Students collect data to solve problems that teacher have provided with the help of various learning sources
3. Processing	Students testing and proving the hypothesis by doing an analysis of the experiment result data
4. Creating	Students make a conclusion on the results of the hypothesis testing
5. Sharing	Students present their findings to the class, and the teacher corrects the concept of the students' findings
6. Evaluating	The teacher gives appreciation to every presentation group and corrects the students' findings.

References: (Espinosa Bueno, Labastida Piña, Padilla, & Garritz, 2011; Gyllenpalm, Wickman, & Holmgren, 2010; Pedaste et al., 2015; Putra, Widodo, & Jatmiko, 2016)

The fourth stage was the implementation. This stage was done in Muhammadiyah Sangonan III Elementary School Sleman Yogyakarta as a limited trial, and in Semen Elementary School Temanggung as a large-scale trial. There were several stages done before performing the implementation. The first stage was done to determine the feasibility of teaching materials from the side of the material, media, and learning. The learning materials expert advised and commented on the material developed. Media experts assessed existing designs in the developed media such as fonts, colors, animations, and layer designs. While the learning expert assessed the suitability of teaching material for elementary school students. After validation from the experts, then the next step was a limited trial. The limited trial was conducted by implementing the product to some elementary school students, and a limited trial was conducted

to find out the impact of the teaching material that has been developed. The large-scale trial was done by implementing teaching material for all research subjects.

The last stage was the evaluation. This stage was done after the suggestion of improvement from the experts, the product is feasible because from experts assessment obtained suggestions: from the material expert in the form of material improvement that must be adapted to the surrounding environment, from learning expert to add games in the magazine because the games can be used as an evaluation instrument. While the advice from the media expert is some animation that should be removed, and there are some designs that must be adjusted to the existing script on the pages.

Prior to being tested on users, the teaching material product was validated by media experts, Natural Science materials experts, and elementary school learning experts. Validation results indicate that teaching material is suitable for use in learning with a very good category. Although, before obtaining such an assessment, experts provided qualitative input to teaching material products. The input from the experts can be seen in Table 2.

Table 2. Experts' Feedbacks toward Magazine Based on Guided Inquiry

Feedbacks on teaching materials	
Media Expert	<ul style="list-style-type: none"> – Some layers of the design of the contents need to be improved. – Some image illustrations need to be omitted. – Font type and color need to be adjusted. – Repair finishing or final stage of cutting in a printing house; do not let the words cut off.
Natural Science Material Experts	<ul style="list-style-type: none"> – The materials in <i>Alit</i> magazine learning media should be adjusted to the local wisdom of the surrounding community – Guided Inquiry integration should be emphasized on important materials – The plot of materials presentation needs to be made more hierarchical, from easy to difficult and simple to complex.
Elementary School Learning Expert	<ul style="list-style-type: none"> – Games zone in the magazine needs to be added – Guided Inquiry integration should be the main spirit in the learning syntax with the teaching material of this magazine – Instructions for teachers should emphasize the steps with guided inquiry

Based on the experts' inputs in Table 2, the final product of the Natural Science magazine based on guided inquiry teaching material has improved, among others on the cover, as shown in Figure 1. briefly shown in Figures 2, 3, and 4.

Before Revision



After Revision



Figure 2. The sample of product revision based on media expert's input

Improvements on the cover (Figure 2) are: 1) improvements to the original sky and cloud layer being fixed to the forest, in order to better match the material characteristics available in the educational magazine; 2) font type, being fixed with the purpose of having uniformity and easier to read; 3) color, being improved to give the harmonious impression. Based on the input of learning material expert, educational magazine product has improved on the page of "fact zone" as shown in Figure 3.



Before revision



After revision

Figure 3. Example of product revision based on the input from Natural Science material expert

The improvements made, as shown in Figure 3, are to change the original factual information about hummingbirds, replaced by factual information about one-horned rhinoceros. The improvement of this information is based on the fact that one-horned rhinoceros is a native

Indonesian endangered animal, with this change information is expected to foster a sense of love for flora and fauna, especially the native Indonesian. Based on the input of elementary school learning experts (Table 2), the educational magazine performed improvements by adding the Gamezone page, as shown in Figure 4.



Figure 4. Example of product revision based on input from elementary school learning expert

The addition of GameZone, as shown in Figure 4, can be used as a student evaluation. Gamezone is also a means of students' play zone so as to increase student's enthusiasm in learning. The final product then tested on students and teachers. The trials were conducted in two stages, namely in the limited group and large group implementation. In the limited group, researchers requested responses from the teacher and 12 students from Muhammadiyah Sangonan III Elementary School Sleman, Yogyakarta. While in the large group trial, the researchers asked for responses from the teacher and measured the understanding of 31 students of Semen Elementary School Temanggung, Central Java. The results of the assessment of experts, teachers, and students are presented in Table 3.

Table 3. Results of product feasibility assessment

Assessment	Score	Value	Category
Material Expert	34	85	Very feasible
Media Expert	37	92,5	Very feasible
Learning Expert	32	80	Very feasible
Limited Scale Trial			
Teacher Response	67	98,5	Very feasible
Students Response	119	89,0	Very feasible
Large Scale Trial			

Teacher Response	143	95,33	Very feasible
Students Response	97	97	Very feasible

Based on the pretest and posttest s, the teaching material greatly affect the level of students' understanding in the subjects of Natural Science, especially the material adjustment of living things with their environment. The results of the descriptive analysis of the pre-test and post-test presented in table 4.

Table 4. Descriptive Analysis Results of Students' Understanding

	N	Minimum	Maximum	Mean	Std. Deviation
Pre Test	31	33,00	73,00	64,0000	10,29239
Post Test	31	53,00	100,00	78,3871	10,52514
Valid N (listwise)	31				

Based on Table 4, it can be seen that there is an increase in value from pretest to posttest of 14.39 or 22.48%. This occurs to all students. Distribution of pretest and posttest values of all students can be seen in figure 5.

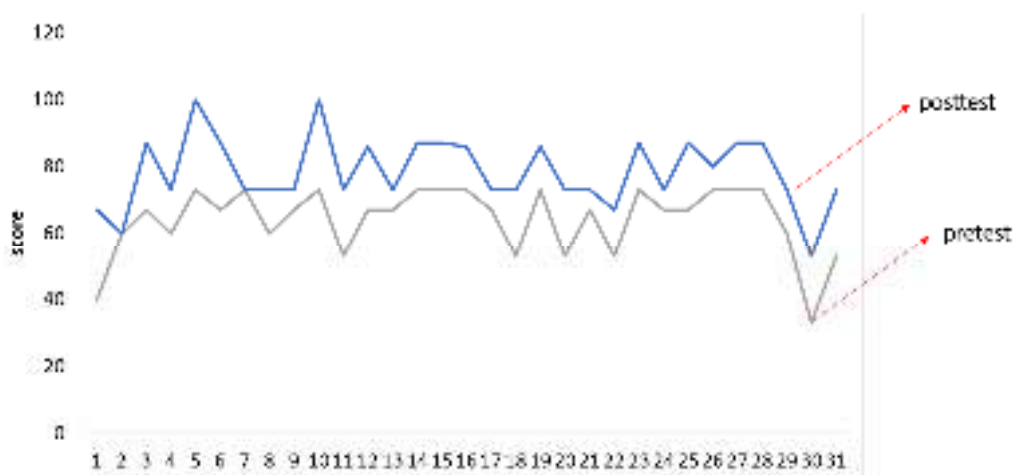


Figure 5. Score Distribution of students' Pretest and Posttest

Figure 5 shows a prevalent increase in each student's understanding. During the learning process using magazines, students were very enthusiastic. This enthusiasm was indicated by the positive response to the problems presented by the teacher and in the educational magazine, which was used as the source to find the solution to the problem. Enthusiasm was also shown by the students that happy to do evaluation questions that exist in The Gamezone as a part of the magazine. When faced with difficulties, they asked teachers and peers and exchanged opinions with peers to find solutions.

In this research, it has been successful to test the impact of the magazine with compared mean between pretest and posttest. Post-test scores increased by 14.3871 compared to the pretest shown in Table 4. This difference means it is due to changes in student's responses before and after the use of the educational magazines. Positive responses appear like the effect of meaningful learning as a result of the inquiry approach. Students become easier to construct the learning material because it is closely related to their daily lives. Students' interest in Science magazine has an impact on their interest in learning (Kang & Keinonen, 2017). Teacher's guidance makes students able to solve problems with reference to existing teaching materials. Attitude and self-efficacy of students are well-formed throughout the learning process, due to the impact of collaborative learning used by teachers (Vishnumolakala, Treagust, Mocerino, & Qureshi, 2017). In addition to the student's understanding, the inquiry approach integrated into the educational magazine has the potential to increase students' literacy and confidence (Gormally, Brickman, Hallar, & Armstrong, 2009).

Guided Inquiry Design to guide elementary students through the flow of discovery in the learning process from various sources of information through collaborative learning and inquiry (Maniotes, 2018). This model requires teachers involvement in preparing the lesson planning, material development, and monitoring of group discussion. Teachers organize more discussion and motivate students to ask more questions in their classrooms (Banerjee, 2010). Pupils practiced constructing inquiry-guided learning activities suitable for a range of different courses taught throughout the curriculum. Guided inquiry gives the privileges students to increasingly independent questioning and constructing knowledge. This learning accommodates students who learn independently to overcome problems and produce artifacts in their projects (Atkinson & Hunt, 2008).

Constructing scientific knowledge in inquiry-based science classes is a challenging task for students and requires skillful teachers to support the learning process (Harris & Rooks, 2010; Wu & Hsieh, 2006). Cognitive and metacognitive have strong links with students' inquiry processes, especially their planning and analysis skills. The science magazine, as an integrated learning resource of inquiry, is able to train students in the planning process to the evaluation of learning outcomes (Zhang, Hsu, Wang, & Ho, 2015). In inquiry learning, a teacher must possess more than teaching skills through investigation (Bryce, Wilmes, & Bellino, 2015). Science participation through inquiry influences students' positive attitudes and increases their

understanding of science inquiry (Schmidt & Ketler, 2017). In the inquiry, visual media such as digital images, teaching materials, storybooks, magazines, modules play an important role in inquiry instruction. Therefore, it is necessary for the teacher's responsibility to be able to facilitate the transition to student-centered instruction (Maeng, Mulvey, Smetana, & Bell, 2013). The science magazine in this study is the students' starting point to construct science concepts. The teacher guides them in developing concepts through the practice of reading and investigating scientific phenomena (Bencze, 2009). Other factors can be academic levels (Poropat, 2009), achievement motivation (Shaharoun, Awaluddin Mohamed & Harun, 2012), self-efficacy (Turner, Chandler, & Heffer., 2009), and teachers teaching strategies (Ibrahim, Aulls, & Shore, 2017).

Conclusion

This research successfully developed a guided inquiry-based magazine using Hannafin and Peck's design (Needs assessment, design, development/implementation, evaluation, and revision). Media experts, natural science material experts, and elementary school learning experts state that this media has good quality as science teaching materials for elementary school students. The science magazine is important in helping students to understand the learning material. It is indicated by an increase in the common understanding of students before and after the intervention. These results also show a decrease in student learning difficulties. Content and approaches used in magazines can create meaningful learning processes and help students construct knowledge more efficiently. Therefore, it can be concluded that the guided inquiry-based science magazine is appropriate to be used as teaching material that can reduce student learning difficulties.

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[Pedagogy] Editor Decision

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We have reached a decision regarding your submission to Pedagogy, "Magazine Based On Guided Inquiry-An Innovation To Overcomes Natural Science Learning Difficulties In Elementary Schools".

Our decision is to: Accept Submission

Ona Monkevičienė
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Magazine Based On Guided Inquiry-An Innovation to Overcome Natural Science Learning Difficulties in Elementary Schools

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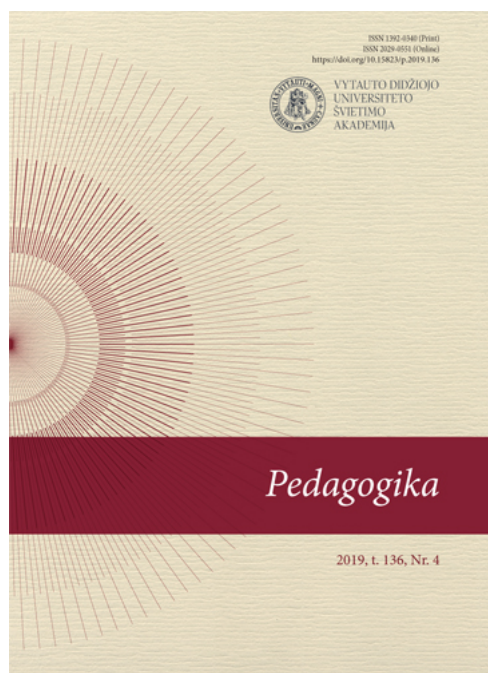
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Abstract

This study was aimed at developing a feasible magazine based on the guided inquiry for 5th-grade elementary schools. The development procedure adopted was the Hannafin and Peck model which involves needs assessment, design, development, evaluation, and revision. Data were collected through the use of questionnaires and tests. It analyzed using descriptive statistics and interactive qualitative analysis. This research produced science magazines which are feasible to be used as instructional media towards overcoming learning difficulties and enhancing students' understanding.



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