

BioPhy magazine based on a floating market for problem-solving skills and environmental awareness

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ABSTRACT

This study aimed to describe the validity and effectiveness of the floating market-based BioPhy magazine to improve problem-solving skills and encourage students to conduct environmental awareness campaigns. This research was development research with Tessmer formative evaluation model. The field test subjects were 24 students who studied fluids in the Fundamental Physics Course in the 2021/2022 academic year. Data were obtained through validation sheets and problem-solving questions. Data were analyzed quantitatively and qualitatively. The results showed that the developed magazine was valid and effective in improving students' problem-solving skills with an N-gain score in the field trial of 0.96 with a high category and an effect size of 12.61 with a strong influence category. In addition, based on the different tests, it was known that there is a significant difference between problem-solving abilities before and after learning. The magazine also succeeded in encouraging students to campaign on environmental awareness, as shown in the environmental-themed posters they made and shared on social media. Thus, the developed magazine was valid and effective to improve problem-solving skills and encourage environmental awareness campaigns on fluids in the Fundamental Physics Course.

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1. INTRODUCTION

South Kalimantan has unique local wisdom, namely the floating market. This market carries out trading activities on the river [1], [2]. In this market, sellers and buyers ride *Jukung*, which is a traditional means of transportation on the river [3], [4]. Another unique thing is that this market sells various agricultural products, plantations, and swamp fish [5]–[7], culinary [6], [8], and handicrafts typical of South Kalimantan [4], [6]. Even the floating market is nature-based, cultural, culinary, ecotourism, and edutourism [8]. Figure 1 shows the floating market and *Jukung*.

A floating market can be a source of learning physics. This is done by exploring the concepts and principles of the fluid that occurs there [9], [10]. This makes students learn physics as well as local wisdom [9] and make learning physics easy and fun [10].

Floating market as ecotourism can also be a source of learning biology. This market is associated with ecology, biodiversity, nature conservation, nature conservation and environmental awareness [11], [12]. Rivers as a means of trade need to be studied from an environmental perspective so that students realize the importance of preserving and maintaining the cleanliness of the river. This river environmental education needs to be done because community participation in maintaining the river is still low [12], [13]. People still throw garbage and waste in the river so that the river is polluted [14], disturbed river flow and abrasion [15], and decreased river water quality [14], [15]. Students need to be encouraged to maintain river ecosystems, including aquatic vegetation, because both affect the quality and flow of rivers and prevent flooding [16]. Moreover, there is a lot of environmental degradation, so that education needs to participate in discussing environmental issues [17].



Figure 1. Floating market is a market where sellers and buyers ride *Jukung*, a traditional means of transportation on the river

Floating market is used as a source of learning by pouring it into the media of magazines. The magazine is a mass media containing various articles with one particular theme and interesting pictures and designed in an innovative and communicative way [18]-[20]. The characteristics of the magazine are that the language is simple, contains interesting information related to life, contains fun games, and is colorfully designed [21]-[23].

Based on the results of an assessment of students from one of the physics education study programs in South Kalimantan, it is known that they have low fluid problem-solving abilities. This was also found by [24]. This is because they are not able to describe the problem [25], difficult to use mathematical procedures [26], difficult to connect various concepts and information [27], do not master the concept of physics [28], not analyze the problem in depth [29], and students do not study independently [30].

Problem-solving skills need to be improved. This is because good problem-solving skills are one of the objectives of learning physics [29], [30] and the needs of this century [31], [32]. With good problem-solving skills, students are able to face various problems and can think actively, creatively, and carefully [33] and adapt to the era of globalization [30], [34]. Observations also show that lecturers have not provided environmental education. Education needs to instill environmental awareness so that students maintain cleanliness and do not damage the environment [35]. Environmental awareness is influenced by their penchant for science [36]. So, physics material needs to be linked with biological sciences that discuss environmental issues and instill environmental awareness [37], [38].

The concept of physics in the floating market itself has been researched by [9]. In fact, there is a floating market-based physics module [10]. Actually, the development of the magazine has also been carried out by [21], [22], [39]. There have also been many studies on how to improve physics problem-solving skills, including the application of inquiry-based learning with PhET simulation [28], investigation-based-multiple representation (IBMR) learning model [30], problem-based learning that integrates scientific values and

Islamic values (PBL-ISI) [32], and problem based learning [34]. Likewise, with the cultivation of environmental awareness. Various studies have made efforts to inculcate environmental awareness, including the application of environmental education [40], [41]. However, there has been no research on the use of magazines containing physics and biology concepts in an integrated manner based on the floating market to improve problem-solving skills and encourage environmental awareness campaigns. Therefore, this study fills that void. This research is richer than the previous one because the magazine is presented in a varied and interesting manner based on the floating market, contains fluid concepts found in the floating market, contains biological sciences about the environment in the floating market, is published nationally, and is intended for students at the university level. The purpose of this article specifically is to describe the validity and effectiveness of BioPhy magazine in improving problem-solving skills and encouraging environmental awareness campaigns.

2. RESEARCH METHOD

This research was development research which consists of two main stages, namely the preliminary stage and the formative evaluation stage [42]. Table 1 shows the stages of development research in this study. The research was conducted from June to November 2021 at the Tarbiyah and Teacher Training Faculty of State Islamic University (UIN) Antasari Banjarmasin, Indonesia. The subjects of the field trial were 24 students of the Biology Education Study Program who were studying fluids in the Fundamental Physics Course in the 2021/2022 academic year. The research instrument used were a validation sheet [43] and 10 problem-solving questions about four aspects of problem-solving, namely problem schema, analogy, argument, and causal [44], which was then checked using an assessment rubric [45]. The validity of the content, presentation, and language of the magazine was carried out by 12 material experts, 12 media experts, and 12 linguists.

The effectiveness of the magazine was determined by the formula N-Gain [46], Wilcoxon test, and effect size $[d]$ [47] with criteria [48]. The students' environmental awareness campaigns are judged by the posters they made [49]. Poster ratings were based on [50], [51].

Table 1. Research stages

Stages	Activities
Preliminary stage	<ol style="list-style-type: none"> 1. Researchers analyzed the problems of learning physics and its integration with biology learning based on the local wisdom of the floating market. 2. Researchers determined the place, subject, and research schedule. 3. Researchers thought about the initial draft of magazines and instruments and developed them.
Formative evaluation stage	
Self-evaluation	<ol style="list-style-type: none"> 1. Researchers examined various research articles related to the problem. 2. Prepared a list of validator names. 3. Evaluated the initial draft of the product that has been developed and revise the initial draft.
Expert review	<ol style="list-style-type: none"> 1. Validated magazines and research instruments. 2. Revised magazines and instruments based on input from experts [validator team].
One to one test	<ol style="list-style-type: none"> 1. Magazine trialed on 8 students in 1 meeting. 2. Revise the magazine based on the test results.
Small-group test	<ol style="list-style-type: none"> 1. Magazine trialed on 10 students in 5 meetings 2. Revised the magazine based on the test results.
Field test	<ol style="list-style-type: none"> 1. Magazine trialed on 24 students in 5 meetings. 2. Revised the magazine based on the test results and produced a magazine that is ready to be published.

3. RESULTS AND DISCUSSION

3.1. Validity of BioPhy magazine based on floating market

The developed BioPhy magazine was a print media. Magazine was presented in printed form because it was more practical and do not require assistance from other tools to use them [52]. Figure 2 shows the front cover of this magazine. The number of magazine pages was 168. The number of rubrics was 55 with various different topics but still based on the floating market. Based on the magazine validation sheet given to 12 experts, it was obtained as shown in Table 2.

Table 2 shows that the magazine is valid. This shows that the developed magazine met all the validity criteria [23], suitable for use in field tests [22], [52], [53], suitable for use in learning activities [21], [52], [54], worthy of being a learning media [39], the contents of the magazine were clear, complete, and relevant to the competency achievement to be achieved [23], met the appropriate validity criteria in terms of presentation aspects [18], [23], met all validity criteria in terms of language aspects [39], the language in the magazine was in accordance with the rules of good and correct Indonesian, communicative, and easy to understand [39], and in accordance with the character of the student [22], [52].

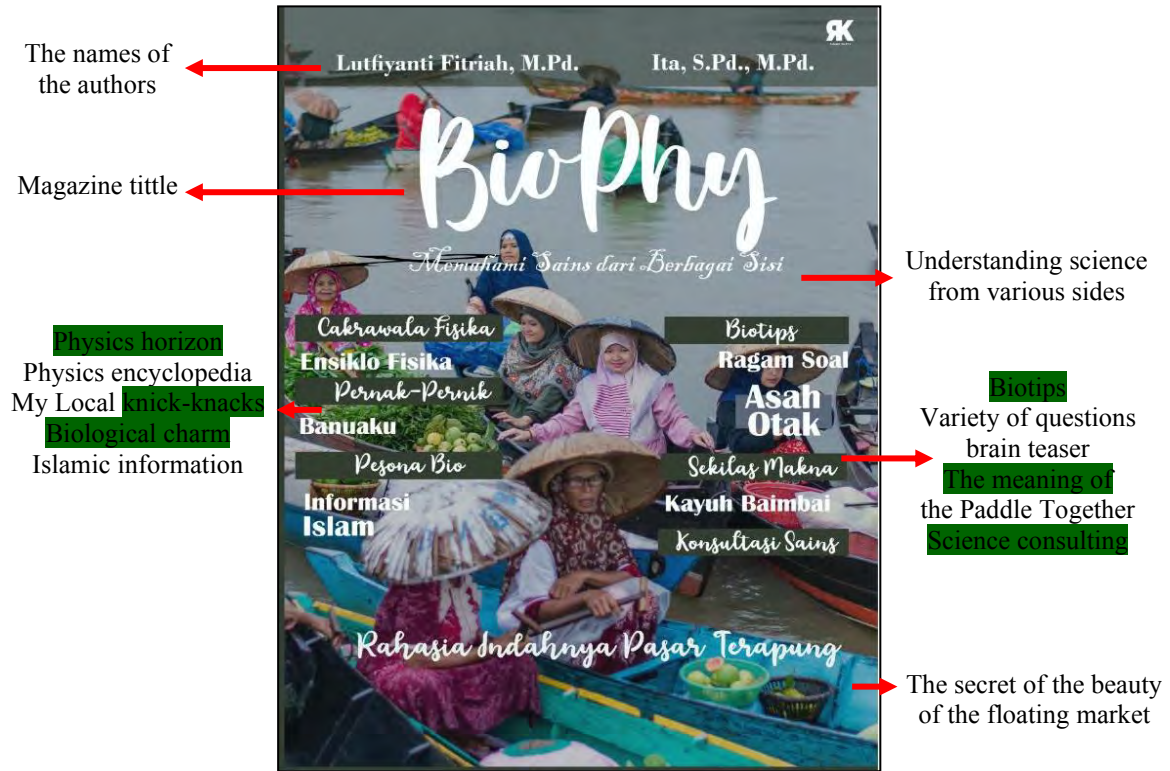


Figure 2. Front cover of BioPhy [53]

Table 2. Validity of magazines

Component validity	<i>V</i>	Category
Content validity	0.81-0.94	Valid
Construct validity	0.79-0.94	Valid
Language validity	0.81-0.92	Valid

3.2. Effectiveness of BioPhy magazine

Table 3 shows the students' abilities in field trials. This data shows that the problem-solving ability of students has increased. Magazine was effective in improving students' problem-solving skills for several reasons.

Table 3. Students' problem-solving abilities in field tests

Indicator	Sub-indicator	Means of pre-test	Means of post-test	N-Gain	<i>d</i>	Asymp. Sig. [2-tailed] Wilcoxon Test
Ability in every problem-solving process	Useful description	19.25	100.00	1.00	12.14	0.005
	Physics approach	14.25	100.00	1.00	13.79	0.005
	Specific application of physics	12.75	98.25	0.98	13.41	0.005
	Mathematical procedures	6.5	92.25	0.92	11.50	0.000
Ability in every aspect of problem solving	Logical progression	12.75	92.25	0.91	9.74	0.005
	Problem schema	10.75	95.50	0.95	10.86	0.008
	Analogy	9.25	100.00	1.00	20.90	0.005
	Argument	16.75	96.25	0.95	9.47	0.001
	Causal	18.00	96.25	0.95	10.40	0.001
	Average score	14.50	96.75	0.96	12.61	0.000

First, magazine helped students understand the material, fostered motivation, and made learning student-centered and strengthen memory [55] so that they successfully solved the problem [56], [57]. Second, the pictures presented in the magazine helped students to learn and understand the material and built meaning

[58]. Third, the magazine was designed to be colorful to attract students' interest [52]. If students are happy, they will be happy to solve problems [59] so that they try to solve problem solving problems well and tend to be successful in solving them [57]. Fourth, the magazine contained cognitive scaffolding, such as tables and graphs, to help students understand the material and solve problems [60]. Fifth, local wisdom, which was a source of student learning, made it easy for them to learn, attracted attention, and helped them to understand concepts [38], [61] and provided opportunities to construct meaningful learning experiences. In addition, local wisdom in magazine made the material relevant to life, made it easier for them to understand and solve problems [59]. Sixth, students were given the opportunity to solve problem-solving problems listed in BioPhy magazine in groups that made students interact socially with each other so that they were able to construct their own understanding according to Vygotsky's social constructivist learning approach [62], [63]. Group work facilitated students sharing ways to solve problems [62], [64] and reduced complexity in solving problems [62], [65]. Seventh, the problem-solving questions in the magazine were contextual in nature which stimulated students to actively explore and connected knowledge with various events in life so that students' solving abilities increase [66]. The questions in the magazine were also presented in the form of games that caused positive emotions, enjoy learning, do not get bored, and were motivated so that academic achievement increased [65].

3.3. Environmental awareness campaign

The encouragement to carry out an environmental awareness campaign was carried out by including the task of making a poster in BioPhy magazine after the material on the river environment was presented in the magazine. Making this poster was an indicator that students had environmental awareness after studying with BioPhy magazine, as evidenced by their encouragement to carry out campaigns. Thus, the magazine not only provided an understanding of the importance of the river environment, but also made students participate in real environmental awareness campaigns. The content of the poster itself was an appeal to the public to preserve and maintained the cleanliness of the river. An example of this poster is shown in Figure 3.

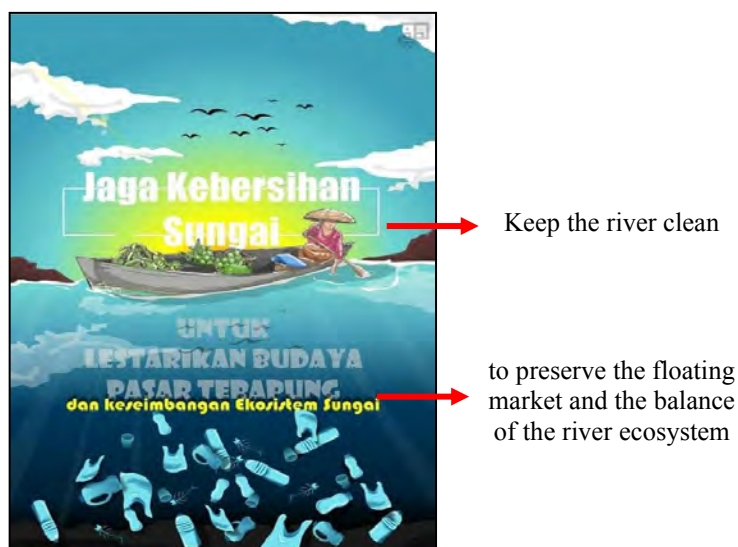


Figure 3. Example of a poster for an environmental awareness campaign

The poster was then distributed by students to the public on their respective Instagram accounts. The assessment of poster can be seen in Table 4. Posters of students judged by two lecturers. The validity of the assessment is calculated by product moment correlation with rough numbers [67]. Based on the calculation, it is known that the validity coefficient was 0.77, which means the results of both assessments were valid. As for the reliability of the assessment was determined based on the percentage of agreement [68]. Based on the calculation, it is known that the reliability percentage of agreement was 95%, which means the results of both assessments were reliable.

Table 4. Assessment of posters as media for environmental awareness campaigns in field tests

Aspect	Criteria	Means
Visible	Image display clarity	96
	Appropriateness of font size and type	97
Interesting	Image color compatibility, image layout, and background (background)	95
	The attractiveness of the image displayed on the poster	96
	The suitability of the image with the material on the poster	97
Structured	The suitability of the poster content with the objectives of the environmental awareness campaign	97
	Clarity of the material contained in the poster about the environment	95
Useful	Emphasis of message in the poster	94
	The information in the poster can be conveyed to the reader	96
Accurate	Completeness of presentation of information about the environment	96
Simple	The use of sentences does not lead to multiple interpretations and misunderstandings	95
	Use of language that is easy to understand	96
	The use of language on the poster is in accordance with the general guidelines for Indonesian spelling (PUEBI) rules	95
	Average of scores	95.77
Validity coefficient r_{xy}		0.77
The reliability percentage of agreement		95%

Based on Table 4 it is known that poster were suitable to be used as a medium to convey messages to the public and met the criteria as poster, namely combining visual aspects, colors, and messages so that it could attract the attention of many people [51]. In addition, this means that the poster was attractive, easy to understand, could be a medium of communication, and the content of the message was useful for readers [69]. So, the posters that have been prepared were good as media for environmental awareness campaigns.

One of the environmental education strategies is to combine the material being taught with various learning activities [41], [70]. The task of making posters in BioPhy magazine was an effort to instill environmental awareness and encouraged participation in environmental campaigns. This poster was also a source of information for other students about the environment so that it could increase environmental awareness [40]. So, this activity was part of environmental education. Environmental education was proven to increase students' understanding of environmental problems and increased environmental care attitudes [71].

Students were asked to share posters on Instagram. Instagram was used as a medium for delivering information because it is used by many people around the world [72], users are easy to interact and communicate [72], [73], users easily post interesting pictures to influence people [72], [73], and have visual appeal [73]. Instagram is a very powerful tool to attract people's attention to pay attention to the content of messages shared on the media [74]. The results also showed that Instagram was proven to increase environmental awareness so that it was effectively used as a media for environmental campaigns [72], [73], [75], [76].

4. CONCLUSION

The floating market-based BioPhy magazine was valid to be used as a medium for fundamental physics lectures on fluids. In addition, magazine was effectively used to improve problem-solving skills and encourage students to campaign on environmental awareness. For further research, it is possible to develop similar magazines based on other local wisdom for various physics teaching materials in universities.

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