Development of Google Form Based on Scientific Literacy Principles for Junior High School Students in Heat Material

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Abstract. The research aims to develop and find out the attractiveness and feasibility of Google Form based on scientific literacy questions for junior high school students on heat material. This study uses the Borg and Gall model. The steps used in this research are potential and problems, inFormation gathering, product design, design validation, design revision, product testing, and product revision. The results showed that the percentage of media, material, and language experts were 94.7%, 89%, and 80%, the teacher's response was 90.41% and students' interest with a percentage of 87%. The trial instrument of 25 items was declared valid, reliable, and functioning well. So, it can be concluded that the instrument of Google Form based on scientific literacy questions for junior high school students on heat material meets the requirements of very decent quality and is very interesting to be used by students.

1. Introduction
Development of 4.0 in education is marked by the use of media, digital, and the use of technology in the learning process [1]. With the integration of this technology, all human activities are converted from manual into digital [2]. The current reforms have paved the way for teachers and educational technology to examine problems that have arisen in education [3]. Facing these great challenges, education is demanded to be change as well through a cyber system making the learning process take place continuously without space and time restrictions [1], [4]. Challenges of the revolution era 4.0 in learning are that teachers must be creative in learning by applying models, strategies, approaches, and media [2], [5]. Students are required to have various abilities or skills to deal with the 4.0 revolution era. Students are required to have scientific literacy [6]. Scientific literacy is the ability to use scientific knowledge, identify questions, and draw conclusions based on available evidence to understand and make decisions regarding nature and its changes due to human activities [7]–[9].

Scientific literacy has been applied in the curriculum although the fact in the field indicates that the level of students' scientific literacy is still low. The average score by PISA shows that from 2000 to 2012, Indonesia's ranking has continued to decline [10]. In 2012 Indonesian students' scientific literacy was at level 64 out of 65 participating countries with a score of 382. this score is still far from the average PISA score of 500. Indonesia's average score which is still relatively low reflects that students in Indonesia have not been able to analyze and apply the problem-solving concept [10]. The vision adopted is that regardless of the individual differences, all the students should be educated as science and technology literate [11].
Efforts to overcome the low scientific literacy can be done using effective learning. Teachers, as facilitators, are required to master the skill and the ability to adapt new technologies, able to use media, learning models, and can develop the instrument to be used for evaluation after learning [1], [12]. Teachers are expected to develop assessment instruments and guidelines following the Form and techniques of assessment. However, the instrument that enables students to improve their scientific literacy has not been studied [13]–[15].

Following the development of the digital era, instrument evaluation is done by using the website. Website-based tests have the advantage of being easily accessible and can print test results automatically and the results can come out quickly [13], [15], [16]. One of the websites that can be used to provide tests to students is the Google Form. Google Form is an application or tool from the Google website that is useful to help plan events, send surveys, give students or other people a quiz, or collect information easily in an efficient way [13], [15]. Google Forms can be used easily and the results from tests can come out quickly [17].

Several studies have examined instruments on scientific literacy, namely (1) the development of scientific literacy-based test instruments assessing the understanding of scientific phenomena of energy [9]. (2) The development of a scientific literacy test instrument on heat material at SMAN 5 Surabaya [18]. (3) The development of physics Scientific literacy assessment instrument on sound waves at SMAN 1 Gedangan, Sidoarjo [18].

Online learning is one of the many innovations that have resulted from educational technology [3]. The novelty of the research developed by researchers lies on the instrument of scientific literacy constructed using Google Form on heat material for junior high school students.

2. Research Methods

The purpose of this research is to develop an instrument on the Form of scientific literacy based on Google Form and to know the responses of teachers and students toward the instrument and media developed. This research uses the Research and Development method, the steps include [19]:

![Figure 1. Steps of the R&D Method](image)

Based on the analysis of the needs and objectives of the research, this study looked at the feasibility and validity of the product without looking at the effectiveness of the product. The researcher limits the research steps and development from 10 steps to 7 steps. The seven stages of the research are described as follows:
1. Potential and Problems
The researchers define the problems to find out the basic problems faced by the need for the data as a source of research. This data was obtained from pre-field research and literature studies.

2. Data collection
After the problems had been found, the problems were then analyzed.

3. Product Design
After the data analysis had been done, the product design was made using the Google Form. The product design was then implemented into the initial product.

4. Design Validation
The next step after the initial product had been completed was the validation by the experts. A team of experts was needed consisting of material experts, media experts, and language experts. Material experts validated the suitability of scientific literacy instrument with the learning indicators. Media experts validated the Google Form product on the aspects of presentation, design, and ease of use. The language experts validated the grammar and punctuation used in making the instrument.

5. Design Revision
After product validation had been completed, the next step was to revise the parts that still needed to be improved. Revisions were made based on advice given by the validators.

6. Product Trial
In the next stage, after the product had been revised, the product was tested on the users. The product trials were intended to collect data used as the basis to verify the feasibility, attractiveness, and the validity of the instrument. Product trials in this study were carried out in three ways, namely experts review trials, small-group trials, and instrument trials.

7. Product Revision
After the product had been tested, the weaknesses of the product can be determined. The weaknesses of the product were then corrected to produce a quality product and ready to use.

The instrument used in data collection was a validation sheet in the Form of a questionnaire using a Likert scale. The validation sheet in this study consisted of a media validation sheet, a material validation sheet, and a language validation sheet. Data analysis techniques used were as follows:

a. Calculating the percentage of feasibility from each assessment indicator. The percentage was calculated using the following Formula: (Riduwan, 2013)

\[ P = \frac{\sum X}{\sum X_i} \times 100\% \]

Information:
P: Percentage
\( \sum X \): The score in one item
\( \sum X_i \): The ideal score of all items

| Interval    | Criteria       |
|-------------|----------------|
| 0% - 20%    | Poor           |
| 21% - 40%   | Inadequate     |
| 41% - 60%   | Quite Feasible |
| 61% - 80%   | Feasible       |
| 81% - 100%  | Highly Feasible|

b. Calculating teacher's responses assessments using the Formula:

\[ P = \frac{\sum X}{\sum X_i} \times 100\% \]
InFormation:
P: Percentage
∑𝑋: The score in one item
∑𝑋𝑖: The ideal score of all items

Table 2. Assessment Criteria (Asyhari & Silvia, 2017)

| Interval       | Criteria          |
|----------------|-------------------|
| 0% -20%        | Poor              |
| 21% - 40%      | Inadequate        |
| 41% - 60%      | Quite Feasible    |
| 61% - 80%      | Feasible          |
| 81% - 100%     | Highly Feasible   |

c. Calculating the students' response using the Formula: (Riduwan, 2011)

\[ P = \frac{\sum X}{\sum X_i} \times 100\% \]

InFormation:
P: Percentage
∑𝑋: The score in one item
∑𝑋𝑖: The ideal score of all items

Table 3. Assessment Criteria[21]

| Interval       | Criteria          |
|----------------|-------------------|
| 0% -20%        | Uninteresting     |
| 21% - 40%      | Less interesting  |
| 41% - 60%      | Quite interesting |
| 61% - 80%      | Interesting       |
| 81% - 100%     | Very interesting  |

3. Results And Discussion

Based on a series of steps that have been done, the resulting product is in the Form of an instrument based on scientific literacy using Google Forms for junior high school students on the heated material. The results and discussion of research and product development are described as follows:

3.1 Potential Issues and Data Collection

Based on the observations on SMPN 1 Talang Padang, there exist adequate devices to be used in the test using Google Form, yet, the teachers could not utilize them. So, students require an exciting, innovative, and easy to use evaluation media.

3.2 Problem-Based Scientific literacy using Google Form

Before developing the instrument, the researchers first seek references from PISA scientific literacy instruments and some textbooks (Serway, Giancoli, SMP / MTs modules) and the Internet as relevant sources. After all the instruments had been collected, they were adapted and added to Google Form. Here are some of the displays of the instrument.
Figure 2. Initial View of Google Form (Identity Page)

Figure 3. Article on Scientific Literacy Instrument
Figure 4. The Display of Incorrect Answer

Figure 5. End-of-Work Motivation
3.3 Results Validation
The product had been validated by the experts. The media experts were 2 physics learning material experts, the material experts were 2 physics professors, and the language experts were two linguists.

a. Media Experts Validation Results
Media experts validation was done by filling out the validation sheet which consisted of two aspects of evaluation. The table below illustrates the results of the media experts' validation.

| Aspect                                | Score (%) | Category         |
|---------------------------------------|-----------|------------------|
| Completeness of presentation and design | 93        | Highly Feasible  |
| Ease of use                           | 96        | Highly Feasible  |
| Average                               | 94.7      | Highly Feasible  |

b. Material Experts Validation Results
The validation was done by filling out the validation sheet consisted of three aspects of evaluation. The table below illustrates the results of material expert validation.

| Aspect | Score (%) | Category         |
|--------|-----------|------------------|
| Theory | 84        | Highly Feasible  |
| Question | 92.5    | Highly Feasible  |
| Language | 90      | Highly Feasible  |
| Average | 88.3      | Highly Feasible  |
c. Language Experts Validation Results
The validation was done by filling out the validation sheet consisted of two aspects of evaluation. The table below illustrates the results of the language experts’ validation.

| Aspect | Score (%) | category |
|--------|-----------|----------|
| Question | 80 | Feasible |
| Language | 80 | Feasible |
| **Average** | **80** | **Feasible** |

3.4 Results of Product Trials
There were three tests employed in this research, they are the expert's validation, the small-group trial, and test.

a. Experts Validation
The validation was done using an assessment sheet which consisted of four aspects of evaluation. The following table displays the results.

| Aspects      | Score (%) | category   |
|--------------|-----------|------------|
| Theory       | 86.67     | Highly Feasible |
| Presentation | 95.00     | Highly Feasible |
| Google Form  | 88.89     | Highly Feasible |
| Language     | 91.11     | Highly Feasible |
| **Average**  | **90.41** | **Highly Feasible** |

b. Small-Group Trial
The small group trial was conducted to 15 students who have studied science, especially the heat material in SMPN 1 Talang Padang. Here are the results of the small-group trial.

| Aspect      | Score (%) | category |
|-------------|-----------|----------|
| Theory      | 87.1      | Very interesting |
| Presentation| 85.9      | Very interesting |
| Google Form | 87.3      | Very interesting |
| Language    | 87.6      | Very interesting |
| **Average** | **87**    | **Very interesting** |

c. Field Test
The field test was conducted to 40 students from various junior high schools via the Google Form link. The results of the field test can be seen in the following table:
### Table 9. Field Test Results

| Aspect       | Score (%) | category   |
|--------------|-----------|------------|
| Theory       | 93.8      | Very interesting |
| Presentation | 91.6      | Very interesting |
| Google Form  | 90.3      | Very interesting |
| Language     | 92.0      | Very interesting |
| **Average**  | 91.9      | Very interesting |

The results of the overall assessment of the feasibility and attractiveness of test results can be seen in chart 7 below:

![Percentage Of Worthiness and Attractiveness](image)

**Figure 7. Feasibility and attractiveness Chart of the Developed Product**

d. The Test Instrument
1) Validity Test
After the trial test questions had been answered by the students, then the results were analyzed for its validity. Of the 30 questions, 25 items were declared valid with the value of $t_{table}$ of 0.3494.
2) Reliability Test
The results of the reliability test done using Microsoft Excel stated that the reliability ($r_{11}$) of 0.807 with a high-reliability level.
3) Discriminating Index Test
The discriminating index of the instrument was in the good and moderate categories.
4) The Level of Difficulty Test
The level of difficulty of the 25 items was in the moderate and easy categories. An instrument with moderate difficulty were 11 items and instrument with low difficulty were 14 items.
5) Humbug Test
Based on the Humbug test, the IP obtained was at a minimum of 5% which is moderately good.
4. Discussion
The presentation of the results of this development aims to answer the problem Formulation. The data presented is a description of the development process, the results of the feasibility validation, and test results. Based on the validation results, the media experts declared that the developed instrument as feasible with an average percentage of 94.7%. Thus, the developed instrument is suitable to be used.

The material experts declared the developed instrument as feasible with an average percentage of 88.3%. Thus, in terms of material, the developed instrument is highly feasible to be used. The assessment done by the language experts stated that the developed product is feasible with an average percentage of 80%. Thus, the language and phrases used by this product are feasible to be used by students.

Assessment test results done by the teachers of SMPN 1 Talang Padang stated that the developed instrument is highly feasible with an average percentage of 90.41%. The assessment of the attractiveness of the product through the small-group trial gained an average result of 87% with a very interesting category. The assessment was performed to 15 students. Based on the results, it can be said that the product is feasible to be used. Figure 7 shows that the instrument is categorized as highly feasible and appropriate to be used as a tool for evaluation after learning.

The advantages of the product developed, namely: (1) it is highly practical to be used because it is stored in the Form of soft-files. (2) Facilitate students in performing or working on scientific literacy. (3) Using a communicative language, so it can be easily understood by students. (4) Make it easy for teachers in correcting the problem because the scores are already listed after the students finish doing the test. (5) The preparation is easy, free, an unlimited number of respondents, the respondents’ answers automatically collected in Google spreadsheets. (6) Videos, pictures, and instrument dissemination can be done through links using social media.

5. Conclusion
Based on the research, it can be concluded that the quality of the developed instrument based on the media experts, material experts, and language experts, as well as the response of teachers respectively 94.7% with highly feasible criteria, 88.83% with feasible criteria, 80% with feasible criteria, and 90.7% with a highly feasible criteria. The attractiveness of the product obtained through the small-group trial is very attractive. The percentage derived from the small-group trial is 87% with very interesting criteria.

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