

# Development of Chemical Learning Media in Reagent Bottle with QR-code

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**Abstract.** This study aims to develop learning media in the form of a reagent bottle with a label in the form of a QR code. This research is research and development with research stages namely analysis, design, development and evaluation. The data were obtained from the validity test and media readability test. The results of this study are the percentage of media validation tests from material experts, media experts, and student readability are 87.6%, 89.5%, and 90.5%, which means that the media is classified as very feasible and very good to use. It can be concluded that the learning media in the form of a reagent bottle with a QR code is declared feasible and very good for use in Basic Chemistry lectures. It is recommended to test the effectiveness and development of media on other materials.

**Keywords:** Reagent Bottle, Laboratory, QR-code, Basic Chemistry.

## 1 Introduction

Today's industrial revolution is characterized by the development of technology, information, and communication. This affects all aspects of life, including in the world of education [1]. The use of technology in the world of instruction can help implement the educational process to be better and modern [2]. An example of the use of technology in education is technology-based learning media [3].

Learning media is a tool used to help deliver materials and facilitate the learning process [4]. Learning media helps educators in channeling knowledge or material concepts to students in a more exciting way. Learning media is used in learning to students ranging from elementary education students to universities.

Natural Sciences (IPA) is a science learning about all aspects of life in nature [5]. In science, there is one family of science called chemistry. Chemistry learns about the nature of matter, material structure, material changes, and energy that accompanies energy that accompanies chemical reactions [6]. As prospective science educators, students of science education programs need to understand the basic chemistry concepts and their application in basic chemistry laboratories [7]. In a basic chemistry laboratory, the initial competency that students need to have is to know and understand chemical tools [8].

Chemicals in the laboratory are included in the learning medium. The chemicals in the laboratory circulating and available today are stored in reagent bottles with labels attached to the bottles. This is the same as the observation in the chemistry laboratory at the Natural

Sciences Study Program, State University of Malang, that the existing chemical bottles are equipped with labels attached to the bottles. It is still conventional and its use is the same since the old days.

The reagent bottles used in the science laboratory are still bottles with an information label attached to the surface of the bottle. Chemical reagent bottles with QR code labels have been successfully developed to increase innovation from existing reagent bottles. The reagent bottle developed was declared suitable for use from the results of the validation of material, media and readability experts to students. The use of reagent bottles with QR codes is more attractive to students than reagent bottles with conventional labels because of the influence of smartphone involvement in its use [9].

In today's technological development era, the quality of chemical learning media in reagent bottles can be improved by developing integrated technology. With the participation of technology in reagent bottles, it is also hoped that it can increase students' interest in learning [10]. One technology that can display information more uniquely and excitingly is QR Code.

QR Code is a quick response code in sending messages or information [11]. QR Code has been used in an institution for the presences process [12]. QR Codes can also be used to label school assets [13]. QR codes in the world of education can be an alternative learning medium that is easy, interesting, and easy to scan [14].

Many researches on QR codes have been carried out, both in the form of their development and their use and usefulness in the world of education. For example, the use of QR code learning media for periodic system chemistry does not produce higher student learning outcomes than conventional learning media. This is because students are more interested in learning to use the QR Code learning media. Here, students are able to use learning resources independently, not only making the teacher the only source of learning [15].

Based on the description that has been presented above, to improve the learning media of chemical bottles by utilizing technology, the development of chemical bottles with QR codes is carried out. This QR Code is scanned through an application installed on the smartphone to display information about the chemicals in the chemical bottle. It is expected that with this development, the learning media of chemical bottles can be used in lectures and can be mass-produced shortly so that it can be used in basic chemistry laboratories in Indonesia.

## 2 Research Methods

This research is research and development (R&D) with ADDIE research model by Lee and Owens [16]. The stages are:

- a. Analysis conducted initial needs analysis by looking at the condition of chemical bottles as a medium for Basic Chemical Practicum.
- b. Design, media design starting from the application storyboard and QR-code.
- c. Development, QR-code creation, Bottle Chem application development using Unity, and media validation test in terms of material, media, and readability to students of Science Study Program.
- d. Evaluation, determination of the feasibility level of the media based on validation and readability tests.

Data collection techniques using observation and literacy studies in the initial analysis, then questionnaires on validation and readability tests. Research data is qualitative data in the form of comments and suggestions from validators and students and quantitative data in the form of score results from validation and readability tests. The data analysis technique used is a descriptive analysis by changing the percentage result of validation score and readability to the media's level of feasibility and practicality. The eligibility level category of validation percentage can be seen in Table 1.

**Table 1.** Media percentage result category [17]

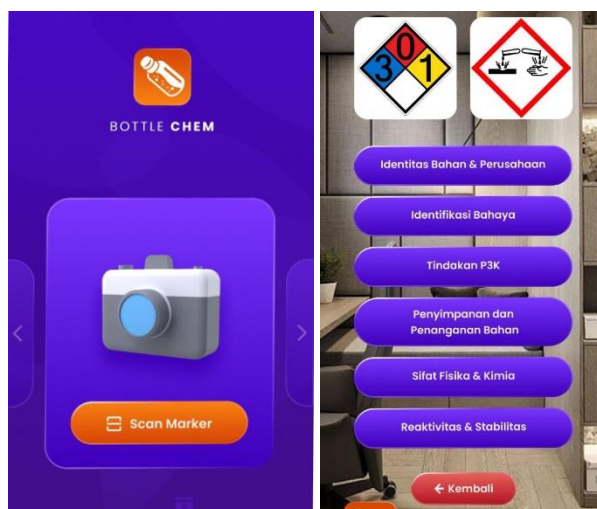
No	Percentage Result	Eligibility Category
1	81% - 100%	Very valid
2	61% - 80%	Valid
3	41% - 60%	Enough valid
4	21% - 40%	Invalid
5	0% - 39%	Very invalid

Based on Table 1, if the percentage result of the material and media expert validation test is above 60%, then the developed media is included in the valid category. Therefore, the minimum percentage of validation results that must be obtained is 61%.

### 3 Results and Discussion

It starts from the analysis of the need that results in the fact that the chemical bottle as a learning medium in the course Basic Chemistry I is still a chemical bottle affixed with a paper label/sticker on the bottle's surface. To further improve the quality and innovation of chemical bottles as a learning medium while utilizing technology, a chemical bottle development with a QR-code label was created on the bottle's surface that can be scanned and display chemical information on the smartphone.

The prototype resulting from this development has three main components: a chemical bottle containing chemicals, QR-code, and an application called Bottle Chem. The chemicals that have been developed prototypes are NaOH and H<sub>2</sub>SO<sub>4</sub>. If the QR-code is scanned using the Bottle Chem application, it will display information about chemicals in the form of; a) NFPI symbol, b) hazard symbol, c) identification of materials and company, d) hazard identification, e) first aid action, f) storage and handling of materials, g) physical and chemical properties, and h) reactivity and stability. The view of the Bottle Chem application can be seen in Figure 1.



**Fig. 1.** Architecture of a typical wireless sensor node.

Validation test results from material experts produced a percentage of 95.83%. It can be concluded that the media developed in terms of materials that belong to the category is very worth using. Details of the material expert validation test can be found in Table 2.

**Table 2.** Details of material validation test results

No	Material feasibility aspects	Percentage (%)
1	Grammar eligibility	91.67
2	Concept truth	100
	Average percentage	95.83

Validation test results from media experts produced a percentage of 96.5%. It can be concluded that media developed in terms of media belongs to the category is very worth using. Details of the media expert validation test can be found in Table 3.

**Table 3.** Media validation test result details

No	Percentage Result	Percentage (%)
1	App opener view	100
2	Main menu view	95
3	App button	100
4	Marker	87.5
5	Scan results	100
	Average percentage	96.5

The results of readability tests to students of the Science Study Program produced a percentage of 90.5%. It can be concluded that the media developed in terms of readability falls into the category of excellent. Based on comments and suggestions submitted by students of Prodi IPA as the subject of research, Bottle Chem media is exciting, mainly because of the

involvement of smartphones in the use of Bottle Chem. It can be known that a person at the age of students today more often uses smartphones in daily life [18].

The advantage of Bottle Chem media is that it can improve the habit of using technology in students, attractive look with various color combinations, and easy use. While the shortcomings of the Media Bottle Chem are the limitations of chemicals developed and the limitations of the information displayed. QR-code assistance in a learning medium can improve students' skills to be more technologically literate, literate [19] and add innovation in more modern learning media. In addition, the combination of technology with conventional chemical bottles can provide the latest ideas to the industry to develop learning media with integrated other technologies in the present.

## 4 Conclusion

The reagent bottles used in the science laboratory are still bottles with an information label attached to the surface of the bottle. Chemical reagent bottles with QR code labels have been successfully developed to increase innovation from existing reagent bottles. The reagent bottle developed was declared suitable for use from the results of the validation of material, media and readability experts to students. The use of reagent bottles with QR codes is more attractive to students than reagent bottles with conventional labels because of the influence of smartphone involvement in its use.

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