

# Analysis of Learning Media Needs in a QR-Code Assisted Chemistry Laboratory as an Innovation in the Use of Student Digital Technology

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**Abstract.** The industrial revolution 4.0 requires the younger generation to be proficient with technological developments. This study aims to describe the importance of providing technology-based learning media in the form of QR Code in the chemistry laboratory. This research is qualitative research. The research data is qualitative data which is analyzed descriptively. Data collection techniques by means of literature study, observation and interviews. The results showed that the learning media in the laboratory had not used elements of technology such as QR codes. QR code can be an innovation of learning media in the laboratory in the form of accessing chemical information in a more interesting and faster way. The conclusion of this study is that the innovation of learning media in the laboratory with the help of a QR code needs to be developed to improve students' skills in using technology while increasing interest in learning.

**Keywords:** Application, Laboratory, Learning media, QR Code, Technology.

## 1 Introduction

The development of the 21st century world has led to the flow of globalization throughout the world [1]. The rapid development of technology, information, communication to culture has led to the need for human resources that develop in accordance with the times [2]. In seeking to increase human resources, it is necessary to prepare a young generation who is capable of technology [3], [4].

To improve the skills of the younger generation in terms of technology, it can be done by habituation from an early age to use technology for various things, including in the world of education [5]. In the world of education, technology can be used in various activities ranging from the learning process with teaching materials or technology-based learning media and exam activities by utilizing technology [6]. The use of technology-based learning media can not only trigger technological skills, but also have a positive effect on learning processes and outcomes such as increasing learning motivation and improving student learning outcomes. This of course happens because now many young people are familiar with technology from an early age, such as smartphone technology [7], [8].

One of the technologies applied in learning media is a mobile application with the QR Code principle. QR Code stands for Quick Response. This means that the QR code can access information quickly [9]. In practice, QR codes can provide information to users through a fast-scanning process (within seconds). The use of this technology is mobile-based [9], [10] A smartphone application is required to start running the QR Code process. Currently, there are

many applications of QR Codes in the world of education [11], [12]. Examples are the QR code as an information display in the Green Technology module in Malaysia [9] and the QR code for learning media on the topic of table tennis [12].

Learning media is needed in lectures [13]. For students of the Science Education Study Program, as prospective science educators, students are needed who not only understand the material in terms of theory but also practice [14]. Therefore, practical activities are also carried out in the laboratory. In the laboratory, there are many learning resources that also act as learning media, one of the most basic of which is chemicals [15]. Chemicals are stored in containers in the form of bottles, commonly called chemical bottles. Chemicals have many varieties with different specifications. There are some chemicals that are dangerous. Therefore, information about chemicals is very important to be conveyed to students and included in the bottle itself.

Based on the description above, this study aims to reveal the use of learning media in the Chemistry laboratory and analyze the importance of developing chemical bottle learning media with a QR code label as a trigger for student digital literacy. It is hoped that this research can be the basis for research on the development of learning media with QR codes, so that it can be an innovation of learning media and improve students' digital technology skills.

## **2 Method**

This research is a type of qualitative research. Sources of data come from primary and secondary data. The primary data collected is the condition of the science laboratory in terms of learning media models, student responses to lectures and learning media in the laboratory and student characteristics. For secondary data, the data collected is the feasibility of QR Code technology for learning media. The primary data collection technique was by distributing questionnaires via Google Form to 34 students and 2 lecturers of Basic Chemistry I. Meanwhile, the secondary data collection technique was by conducting literature studies from journal article sources and scientific proceedings.

The research data analysis technique is descriptive analysis. The results of the data, both for primary or secondary data will be related to each other descriptively. Thus, it will produce scientific conclusions. The stages of the research carried out were the determination of the title, planning, implementation and evaluation. At the planning stage, research preparation is carried out in the form of determining the subject and making a questionnaire instrument. At the implementation stage, questionnaires were distributed to research subjects and literature studies. At the evaluation stage, the results of the questionnaire were analyzed using literacy, then the conclusions of the research were carried out.

## **3 Results and Discussion**

### **3.1 Chemical Bottles as Learning Media in the Laboratory with Conventional Labels**

Questionnaires containing questions have been distributed to 34 students of the Science Education Study Program semester 1 and 2 lecturers. Based on the questionnaire, the conditions of lectures at the Science Education Study Program in terms of laboratories are as follows:

- a. Practical activities in the laboratory are always carried out by students every semester such as practicum in Basic Chemistry I, Basic Chemistry II, Compound Elements and Physical Chemistry courses.
- b. In the laboratory, chemicals are stored in chemical bottles as learning media.

- c. Information about chemicals in the form of acids or bases is included in the label affixed to the wall of the chemical bottle.

Based on the results of these answers, it can be stated that the Science Education Study Program, State University of Malang has implemented lectures that require students not only to understand theoretically but also practically. This is in accordance with Rumiya et al. (2017) with the nature of science learning, one of which is the science process [16]. Practical activities in the laboratory are important for science students to build a more meaningful understanding and improve science process skills such as calculating, designing and proving.

Data were also collected regarding student responses to lectures in the laboratory. The results are shown in Table 1.

**Table 1.** Student questionnaire results

No	Statements	Answers (%)	
		Yes	No
1	Students like activities in the laboratory	97.05	2.95
2	Chemistry practicums often involve chemicals in chemical bottles	100	0
3	Information about chemicals is very necessary to be included in learning media	100	0
4	Students are interested in learning media with QR code	100	0

Based on Table 1, it can be concluded that students like practicum activities in the laboratory. This is the same as the research conducted by Candra & Hidayati (2020), that students tend to prefer action activities rather than just hearing or learning about theory in regular classes [17]. Action activities such as practicum in the laboratory can provide a more pleasant atmosphere and stimulate students' motor skills.

Based on Table 1, it can be seen that the chemicals in the chemical bottle have become a familiar learning medium in the laboratory. Of course, the chemicals in the bottles are of various types with each specification such as the level of danger and storage methods that need to be considered. Through this questionnaire, it is also possible to find out information regarding the inclusion of chemical specifications contained in labels in the form of paper attached to the walls of chemical bottles. This is good for basic understanding and as providing information to students when they want to use the material.

However, there are times when there are small chemical bottles with labels containing full specifications of chemicals that are long and wide. This causes the writing of specifications in the label to be made small so that the label can contain all the information. This can cause user discomfort while reading. In addition, there are many unexpected events that can occur in the laboratory which can accidentally damage the written label such as getting wet with liquid. Therefore, here it would be very good if there was an innovation of chemical bottle learning media in terms of labeling.

### 3.2 The Importance of Learning Media Innovation in a QR Code Based Laboratory

Learning media is one of the learning tools available to support the implementation of learning activities [18]. The selection of the type of learning media is adjusted to the needs of the subject of study, namely students. The trend of learning media continues to change over time

and the development of the times. Technological developments now require the use of innovative technology in lectures [19].

It is known that the digital skills of the younger generation need to be improved, including in students of the Science Education Study Program. Therefore, the learning media used in lectures also need to include the application of forms of technology. Based on the research results, in the Chemistry laboratory in Science Education, the chemicals in bottles have become a learning medium that is often used. These learning media innovations can be improved with the help of technology that can display complete and interesting information about chemical specifications without being limited by the shape of the size of the chemical bottle. The technology that can be used is called QR code.

Based on the questionnaire filled out by the Science Study Program lecturers, it resulted that 2/2 lecturers stated that learning media needed to be designed in such a way as to improve students' technological skills. This is the same as the results of the study of Savitri et al. (2021) that the selection and design of learning media needs to be synergized with technology to get used to using technology as preparation for the industrial revolution 4.0 [20]. Then, 2/2 lecturers also agreed that the innovation of learning media in technology-based laboratories could be done by designing QR code-based chemical labeling.

In this case, the QR code is capable of displaying information regarding chemical specifications, such as the name of the chemical, chemical physics properties, hazard information, storage methods and efforts for accidents in the laboratory. More complete information about chemicals is usually contained in data called material safety data sheets (MSDS). The way this information is displayed is by scanning a QR code image in the form of an arrangement of black and white blocks using a scanner application [21].

Within a fraction of a second, various menus of chemical information options to choose from will appear. This is certainly more effective in displaying wider information than information on conventional paper labels that have limited space. Learning media such as QR Code need to collaborate with design and application developers. Design for designing QR Codes and applications for designing and creating applications that can later be installed on smartphones.

Based on the description that has been conveyed, it can be drawn an outline that labeling with a QR code is necessary and important to be developed for chemical learning media in bottles as an innovation of learning media and training digital technology skills. With this kind of learning media, it is also hoped that it can increase student learning motivation.

## 4 Conclusion

Based on the research that has been done, in the Chemistry laboratory there are chemicals in chemical bottles which are general learning media. The development of chemical learning media in chemical bottles needs to be done to improve students' digital technology skills as a provision for the industrial revolution. QR code technology can be an interesting development for chemical labeling that can display chemical specifications more completely and quickly.

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