



Chemistry Laboratory Equipment Inventory Media: An Alternative Media for Students' in Learning of Laboratory Management

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Abstract. Chemistry laboratory management is an activity to organize all chemicals and equipment in the chemistry laboratory. The media that can be used to manage equipment in chemistry laboratory are computer software, log book, etc. This study is promoted a kind of MySQL-Android based media, called Chemistry Laboratory Equipment Inventory, as a media for students' in learning of chemistry laboratory management. The media used MySQL for laboratory equipment database. The information in database consists of the name of equipment, the specification of equipment, how to keep the equipment, how to use the equipment and also the picture of equipment. The android based smartphone is used as a reader of equipment barcode. The students fill out questionnaires about the learning process using this media in Laboratory Management learning. Based on this study, the students' of vocational school, especially department of analytical chemistry, are interested in using this media as a learning resource in chemistry laboratory management.

Keywords: chemistry laboratory equipment inventory, laboratory management

1. Introduction

The laboratory is a room or a place of experimentation and research. The laboratory is specially designed and equipped for science experiments, demonstrations and investigations in a safe environment^[1]. The laboratory in the learning process is used to achieve various goals, i.e. the cognitive objectives related to the concepts of scientific concepts, the process of developing skills and increasing understanding of the scientific method^[2]. Laboratory should not only be a place to demonstrate the phenomena described in the textbooks and to verify principles and laws, but it should also be a place where students are given the opportunities to go through the processes of scientific inquiry on their own^[1].

One of the common laboratories in school is chemistry laboratory. In the chemistry laboratory, students are able to see chemistry hands-on and they have the opportunity to act as scientists and observe chemical reactions taking place. It has long been a belief in chemistry education that the laboratory has the potential to be a place where theory and practice can coalesce for students^[3]. All the students' activities in chemistry laboratory always connected with chemical and also chemistry laboratory equipment.

Chemistry laboratory equipment means the various tools and equipment used by scientists in the chemistry laboratory. Both of experiment and research in chemistry are used the laboratory equipment. Kinds of chemistry laboratory equipment are laboratory glassware (such as beaker, reagent bottle, etc.) and analytical device (pH meter, spectrophotometer, etc.)

Managing laboratory equipment consists creating, editing, and organizing data on these equipment or laboratory tools, the actual, the specifications and the locations where they are stored^[4]. All of these activities are done by the head of laboratory. Laboratory equipment management is one of the essential elements of a quality management system in chemistry laboratory. Proper management of the equipment in the laboratory is necessary to ensure accurate, reliable, and timely testing. For a conventional system in laboratory equipment inventory, lots of forms and books were used to list out inventory and the data are written manually^[5]. The data can suddenly misplace or even lost. For future use, this conventional system should be replaced with a user friendly and more systematically system. It means that a computer software or application is important in managing the chemical and equipment in chemistry laboratory^[6].





One of the subject matter of analytical chemistry department in vocational school is laboratory management. The basic competence of this subject matter is students able to manage the chemical and laboratory equipment in the chemistry laboratory. One of the learning sources of this subject matter is a Chemistry Laboratory Equipment Inventory media. This media is a computer-based software application used in the laboratory to manage chemistry laboratory equipment. This application designed to manage the laboratory equipment, include the location, the specification, the instruction to keep and to use, etc. The design of this application is simple and easy to use. This application can be use in managing the laboratory equipment and also as a learning source for student in learning of laboratory management.

2. Methods

This study is a part of the research in developing a MySQL-Android based Chemical Inventory Management Systems (CIMS). In this study, the media, namely Chemistry Laboratory Equipment Inventory Media, is focussing on how to manage the chemistry laboratory equipment.



Figure 1. The icon of Chemistry Laboratory Equipment Inventory Media

The media consists of 2 software applications, which are the database and the reader. The database is installed on personal computer or laptop and the reader is installed on Android smartphone. The database includes of several things about the equipment, which are the name, the barcode, the specification, the amount, the location, etc.

No	Barcode	Nama	Ukuran	Jenis Bahan	Jumlah	Kondisi	Sumber	Spesifikasi	Tahun Pembelian	Lokasi ...	Cara Penyimpanan	Cara Penggunaan	Foto
1	2.6.1.1	Alu dan Mortar	-	Porelin	20	Baik	FMIPA	Pyrex	2000	LA B 1	Cara penyimpanan.docx	cara penggunaan.docx	alu dan mortar.jpg
2	1.1.2.1	Beker Glas	50 ml	kaca	20	baik	FMIPA	Pyrex	2001	LA A1	Cara penyimpanan.docx	Cara penggunaan.do...	beker glass 50 ml.jpg
3	1.1.2.3	Beker Glas	250 ml	kaca	10	baik	FMIPA	Pyrex	2003	LA A1	Cara penyimpanan.docx	Cara penggunaan.do...	beker glass 250 ml.j...
4	1.1.2.2	Beker Glas	100 ml	Kaca	20	Baik	FMIPA	Pyrex	2011	LA A1	Cara penyimpanan.docx	Cara penggunaan.do...	beker glas 100 ml.j...
5	2.1.2.1	Botol Reagen Bening	50 ml	kaca	30	baik	FMIPA	lwaki	2000	LA D2	Cara penggunaan.docx	Cara penyimpanan...	botol bening.jpg
6	2.1.2.2	Botol Reagen Gelap	50 ml	kaca	30	baik	FMIPA	lwaki	2005	LA D2	Cara penyimpanan.docx	Cara penggunaan.do...	botol gelap.jpg
7	2.5.1.1	Botol Semprot	-	Plastik	15	Baik	FMIPA	Asistant cap	2016	LA A2	Cara penyimpanan.docx	Cara penggunaan.do...	botol fix.jpg
8	2.1.13.1	Bunsen	-	Kaca	20	baik	FMIPA	bahan gela...	2008	Rak A3	Cara penyimpanan.docx	Cara penggunaan.do...	bunsen.jpg
9	2.1.3.1	Corong	25 mm	kaca	4	baik	FMIPA	Herma	2009	LA B1	Cara penyimpanan.docx	Cara pengguaaan...	corong diameter ke...
10	2.1.4.1	Corong Pisah	500 ml	Kaca	8	Baik	FMIPA	Pyrex	2009	LA B2	Cara penyimpanan.docx	Cara penggunaan.do...	corong pisah.jpg
11	1.1.6.1	Erlenmeyer	100 ml	kaca	20	baik	FMIPA	Pyrex	2000	LA A1	Cara penyimpanan.docx	Cara penggunaan.do...	erlenmeyer 100 ml...

Figure 2. The database of Chemistry Laboratory Equipment Inventory Media

The reader is a kind of application which installed on Android smartphone. Using camera on the smartphone, the application will scan the QR code of the equipment. Smartphone must be connected with the server, personal computer or laptop where the database was installed, through wifi. Another word, the server can be connected with 2 or more Android smartphone.





The subject of this study is students of analytical chemistry department who learn laboratory management. The students fill out questionnaires about the learning process using this media. This questionnaire consists of three aspects, which are the depth of the laboratory equipment management contents, the performance of the program, and the display at screen of Android smartphone. For each aspect, there are consists of 5 – 6 statements. Students also fill out the open question, "Did you interested using this media in learning of laboratory management? Explain your answer!".

3. Results and Discussion

The Chemistry Laboratory Equipment Inventory has been validated by reviewers before it used as a learning source in laboratory management subject matter. The student activities using this media were:

a. Fill in the database

The students fill the Chemistry Laboratory Equipment Inventory database by clicking menu "Add Inventory".

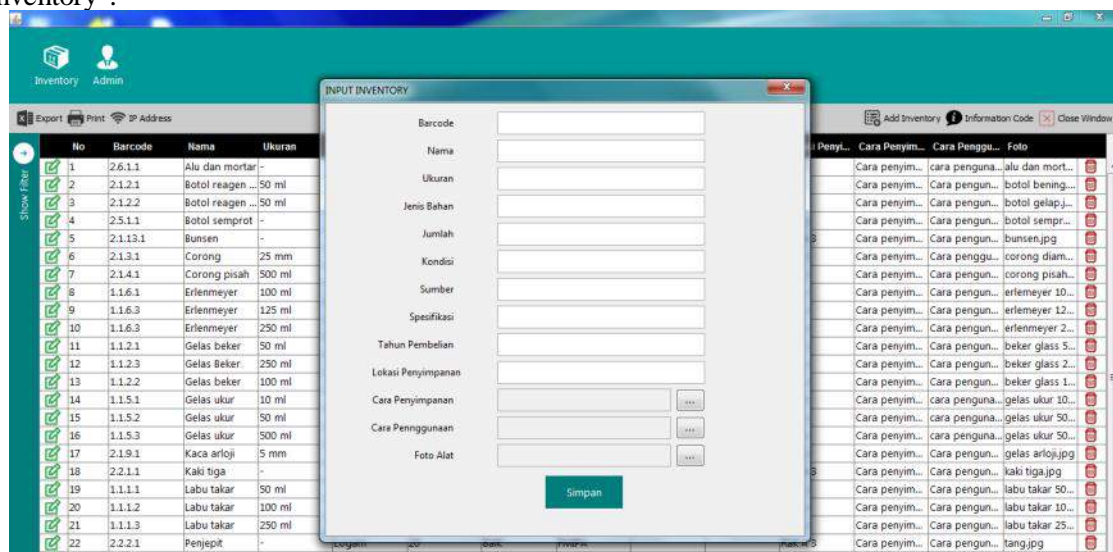


Figure 3. The process to fill in the database

b. Printing the QR code

The next process is printing the QR code of equipment. The QR code include of specific information of equipment.

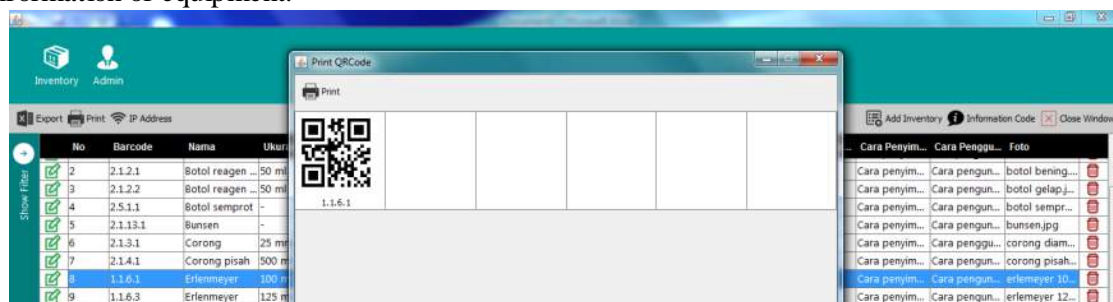
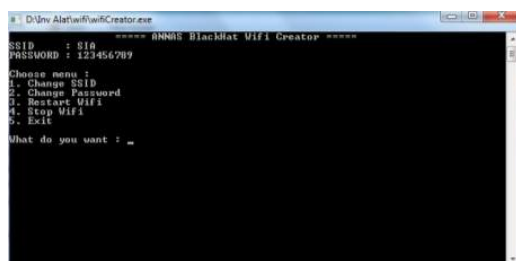


Figure 4. Printing the QR code

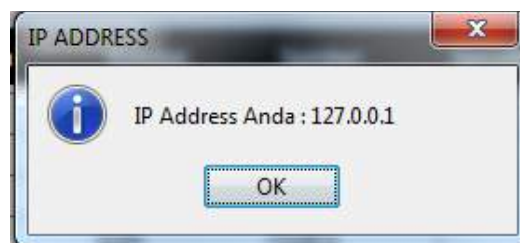




- c. Synchronizing Android smartphone and the database
Synchronizing means make connection between smartphone and laptop (the database server) using wifi.



(a)



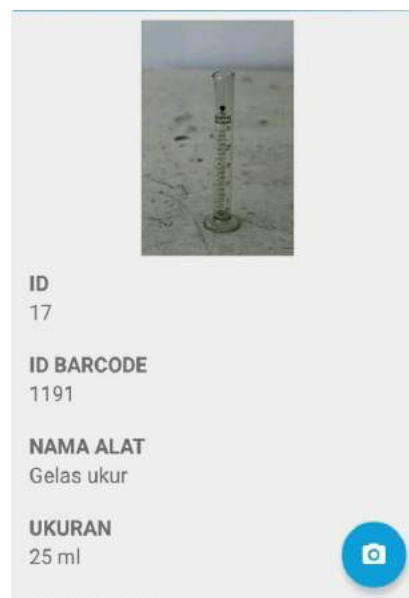
(b)

Figure 5. Synchronizing the smartphone and server,
(a) activating wifi creator, (b) IP address of the database

- d. Scanning the QR code by Android smartphone
The camera of Android smartphone is used to scan the QR code at the equipment. The result will appear at the screen of the smartphone after a few second.



(a)



(b)

Figure 6. Scanning of QR code of the equipment
(a) The QR code, (b) the display at smartphone

The Chemistry Laboratory Equipment Inventory is not only focuses on the technical side but also refers to the way of managing laboratory equipment. Using this media, student slowly began to switch from conventional (conventional) method of managing laboratory equipment to digital method. The Chemistry Laboratory Equipment Inventory is easy application and practical to use because of the light program performance. Laptop used as database processing the data of equipment with wifi applications so that data transfer can cover a large area and faster.

The data analysis through student perception after using The Chemistry Laboratory Equipment Inventory media as learning source is viewed from 3 aspects, which are the depth of concept, program performance, and the display at screen of Android smartphone, shown at Figure 7 below.



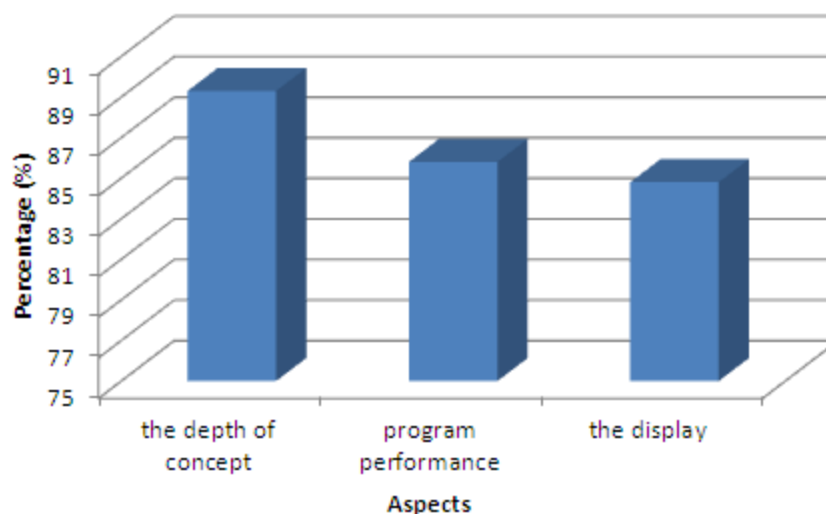


Figure 7. Student perception after using The Chemistry Laboratory Equipment Inventory media as learning source

The display aspect on the Android smartphone screen gets a value that tends to be lower than the other aspects. This is possible because the media display depends on the quality and resolution of each smartphone screen. In addition, the perception of each student on the display of computer based media is very subjective[7].

All students agree that Chemistry Laboratory Equipment Inventory media is very interesting and help them to learn the laboratory management. They say that this media is interesting because:

- Achieving deeper learning outcomes
- Improving the experience
- Applying technology in managing laboratory equipment.
- Easy to use
- Have a large capacity of database
- Updating the data is easy
- Using Android smartphone to read the QR code is fun.

4. Conclusion

Overall, the students respond positively to the implementation of Chemistry Laboratory Equipment Inventory as a media in learning of laboratory management. A more fine grained analysis shows they feel the media have encouraged them to achieve deeper learning outcomes, and have improved the overall educational experience.

References

- [1] P. W. Kwok, "Science laboratory learning environments in junior secondary school", *Asia-Pacific Forum on Science and Teaching* vol. 16, 2015, pp. 1-28.
- [2] M. I. H. Zuhdi, Subiyanto, S. Sukamta, "Management information systems of laboratory using laravel framework: Case study at electrical engineering of Universitas Negeri Semarang", *Jurnal Pendidikan Vokasi* vol. 7, 2017, pp. 158-167.
- [3] C. B. Russell and G. C. Weaver, "Student perceptions of the purpose and function of the laboratory in science: A grounded theory study", *International Journal for the Scholarship of Teaching and Learning* vol. 2, 2008, pp. 1-14.
- [4] S. A. Gupta and Z. Frutkoff, "Chemical inventory management solutions from CambridgeSoft", *Molecules* vol. 10, 2005, pp. 740-746.
- [5] N. M. Z. Hashim and N. A. M. M. Arifin, "Laboratory Inventory System", *International Journal of Science and Research* vol. 2, 2013, pp. 261-264.





- [6] G.Baysinger, R. Creed, and L. Gibbs, “Using a Chemical Inventory System to Optimize Safe Laboratory Research”, 2015, *ACS National Meeting*.
- [7] D. Tsovaltzi, N. Rummel, B.L. McLaren, N. Pinkwart, O. Scheuer, A. Harrer, and I. Braun, “Extending a virtual chemistry laboratory with a collaboration script to promote conceptual learning”, *International Journal Technology Enhanced Learning* vol. 2, 2010, pp. 91-109.

