Journal of Physics: Conference Series

PAPER • OPEN ACCESS

Preface

To cite this article: 2020 *J. Phys.: Conf. Ser.* **1494** 011001

Soedirman's International Conference on Mathematics and Applied Sciences 2019

Java Heritage Hotel Purwokerto
October 23rd - 24th, 2019

Committees

Steering Committee/ Editorial Board

1. Prof. Abdellah Salhi, Ph.D. (University of Essex, UK)
2. Prof. Guiseppe Di Fazio, Ph.D. (University of Catania, Italy)
3. Prof. Hendra Gunawan, Ph.D. (Bandung Institute of Technology, Indonesia)
4. Prof. Dr.-Ing. R. Wahyu Widanarto (Jenderal Soedirman University, Indonesia)
5. Prof. Dr. Hadi Nur (University Teknologi Malaysia, Malaysia)
6. Dr. Hirokazu Saito (Tokyo University of Science, Japan)
7. Assoc. Prof. Dr. Imran Parvez (Hajee Mohammad Danesh Science and Technology University (HSTU), Bangladesh)
8. Dr. Jas Raj Subba (Royal University of Bhutan, Bhutan)
9. Dr. Saluma Samanman (Faculty of Science and Technology, Princess of Naradhiwas University, Narathiwas, Thailand)
10. Amin Fatoni, Ph. D. (Jenderal Soedirman University, Indonesia)
11. Dr. Eng. Mukhtar Effendi (Jenderal Soedirman University, Indonesia)
12. Drs. Wuryatmo A. Sidik, Dipl.Sc., M.Sc., Ph.D. (Jenderal Soedirman University, Indonesia)
13. Sri Maryani, Ph. D. (Jenderal Soedirman University, Indonesia)
14. Dadan Hermawan, Ph. D. (Jenderal Soedirman University, Indonesia)
15. Wahyu Tri Cahyanto, Ph. D. (Jenderal Soedirman University, Indonesia)
16. Dr. Abdullah Nur Aziz (Jenderal Soedirman University, Indonesia)
17. Dr. Jajang (Jenderal Soedirman University, Indonesia)
18. Dr. Hartiwi Diastuti (Jenderal Soedirman University, Indonesia)
19. Dr. Santi Nur Handayani (Jenderal Soedirman University, Indonesia)
20. Uyi Sulaeman, Ph. D. (Jenderal Soedirman University, Indonesia)
21. Bambang Hendriya G, Ph. D. (Jenderal Soedirman University, Indonesia)
22. R. Farzand Abdullatif, Ph. D. (Jenderal Soedirman University, Indonesia)

Conference Chair : Dr. Idha Sihwaningrum

Conference Co-chair :

Scienctific : Amin Fatoni, Ph.D.
Programs : Dr. Eng. Mukhtar Effendi

Journal of Physics: Conference Series **1494** (2020) 011001 doi:10.1088/1742-6596/1494/1/011001

Organizing Committee:

1. Dr. Nunung Nurhayati
2. Ari Asnani, Ph. D.
3. Dr. Zaroh Irayani
4. Rina Reorita, M. Si.
5. Dwi Kartika, M. Sc.
6. Wihantoro, M. Sc.
7. Abdul Naseh, A. Md.
8. Dr. Abdullah Nur Aziz, M. Si.
9. Frenky Oktavinanda
10. Kharis, S. Si.
11. Drs. Budi Pratikno, Ph. D.
12. Siti Muniroh, S. Si.
13. Andi Setiawan, A. Md.
14. Dena Martini, SE
15. Dr. Puji Lestari
16. Latief Nur Muhammad, ST
17. Listiyani Tri Hastuti, SE
18. Dian Riana Ningsih, M. Si.
19. Senny Widyaningsih, M. Si.
20. Siti Rahmah Nurshiami, M. Si.
21. Renny, M. Si.
22. Dr. Hartiwi Diastuti
23. Sukirlan ETR, MM
24. Rini Susanti, S. Si.
25. Sherly Arya Iskandar, SE
26. Eko Jatmiko, SH

Journal of Physics: Conference Series **1494** (2020) 011001 doi:10.1088/1742-6596/1494/1/011001

Report from The Organizing Committee

It is indeed my great pleasure and honor to welcome you all to Soedirman's International Conference on Mathematics and Applied Sciences (SICoMAS) 2019. The conference running this year is the first SICoMAS series hosted by Faculty of Mathematics and Natural Sciences Jenderal Soedirman University. As the development of technology and management of world resources for our future based on the innovation in Mathematics and Sciences, this conference takes issue "Innovation in Mathematics and Applied Sciences for better future".

SICoMAS 2019 aims to provide a platform for researchers, lecturers, teachers, students, practitioners, and industrial professionals to share knowledge, exchange ideas, collaborate, and present research results in the fields of Mathematics, Chemistry, Physics, and their applications. Hence, my sincere gratitude goes to our four keynote speakers (Prof. Dr. Hadi Nur from University Teknologi Malaysia, Prof. Dr. Hirokazu Saito from Tokyo University of Science, Dr. Devi Putra , ST, M.Sc. from Pertamina Research and Tecnology, and Uyi Sulaeman, Ph.D. from Jenderal Soedirman University), and our six invited speakers (Prof. Dr. Youtoh Imai from Nishogakusha University, Prof. Riyanto, Ph.D. from Universitas Islam Indonesia, Dr. Moh. Adhib Ulil Absor from Gadjah Mada University, Bambang Hendriya Guswanto, Ph.D, Dadan Hermawan, Ph.D. and Dr. Eng. Mukhtar Effendi, M. Eng. from Jenderal Soedirman University) for sharing their expertise in this conference. My deepest appreciation also goes to our 80 presenters and 7 non presenters for their commitment to participate in this conference.

As the output of this conference, some selected papers in the field of chemistry will be published in Jurnal Molekul which is accredited Sinta 1; and other selected papers in the fields of Mathematics, Physics, Physical Chemistry, and Innovative Chemistry Education will be published in IOP Conference Series Journal. So, I greatly thank Jenderal Soedirman University, all our contributors, and all the members of the committee for the invaluable support that makes this conference a reality.
Finally, I would like to apologize for any short comings found in this conference; and hopefully this two-day conference will be engraved in your memory.

The chair of SICoMAS 2019

Table of contents

Volume 1494

2020

‹ Previous issue Next issue ›

Soedirman's International Conference on Mathematics and Applied Sciences (SICoMAS) 2019 23-24 October 2019, Purwokerto, Indonesia

Accepted papers received: 03 April 2020

Published online: 27 May 2020

Open all abstracts

Preface

PAPER • OPEN ACCESS

Introducing Iron Analysis with Smartphone Camera for High School Students

To cite this article: A Fatoni *et al* 2020 *J. Phys.: Conf. Ser.* **1494** 012030

Introducing Iron Analysis with Smartphone Camera for High School Students

A Fatoni[1*], Zusfahair[1], M D Anggraeni[2]

[1]Department of Chemistry, Faculty of Mathematics and Natural Sciences, Universitas Jenderal Soedirman, Purwokerto 53123, Indonesia
[2]Department of Nursing, Faculty of Health Sciences, Universitas Jenderal Soedirman, Purwokerto 53123, Indonesia

Abstract. Chemical analysis studies how to analyze both qualitative and quantitative materials. Analysis based on color differences, also known as colorimetry. The basic theory of the analysis is generally given to high school and university students. However, only a few schools practice the theory because of the limitations of expensive instruments. The limitations of expensive instruments have stimulated research to utilize simple daily life devices as alternative of analytical instruments, such as cameras on smartphones, pocket cameras, professional cameras (DSLRs) and scanners. This work reported the use of a smartphone camera (handphone) as a colorimetric iron analysis tool by comparing the color of the sample solution with the standard iron solution. The study starts with the explanation of basic theory of spectrometry and colorimetry, followed by experiments using smartphone cameras for iron analysis using an analysis kit containing o-phenanthroline. The results showed an increase in students and teachers high school knowledge.

1. Introduction

Quantitative analysis is one of the important methods in chemistry, which involves determining the concentration of a substance. Various methods of quantitative analysis have been developed, and one of the most widely used methods is colorimetry, which is a method of analysis based on the color changes that occur. The colorimetry method is based on Lambert-Beer law to determine the concentration of an analyte based on the light absorbed by the analyte. The theory of the analysis method has generally been introduced to high school and university students. Application of this method can be carried out using instruments that can measure the molar absorption of the solution at a certain concentration [1].

Measurement of absorbance of a compound could be performed using visible spectrophotometer, UV-Visible spectrophotometer or colorimeter. However, this equipment may not available in high schools because of price is relatively expensive (the cheapest is about $ 4,000). On the other hand, there are some simple equipment commonly available at high schools that can be used to determine the concentration of analytes based on Lambert-Beer law with good precision and accuracy. Many studies have shown that daily life devices could be used as analytical instruments such as cameras on smartphones [2], pocket cameras [3], professional cameras (DSLRs) [4], webcam [5,6] and scanners [7,8].

The use of simple equipment for colorimetric analysis was initiated by Liebhafsky and Winslow in 1950 who used multilevel bulbs and cylindrical lamps to determine iron and copper content in water [9]. Furthermore, lately many have used simple equipment around us to be used as an analysis tool for determining the content of a compound. Among these studies such as determination of iron (III) levels using a scanner [10], measurement of the complex of starch-iodine use, the use of cameras on smartphones to measure biological markers (biomarkers) [11] and determination of chromium-iron content using a camera [3].

This study was performed in one of the favorite high schools in the Banyumas District. In general, high school students have received chemistry subject material since class X. Some chemistry subject matter will be easier for students to understand if conducted directly in laboratory experiments. Chemical experiments conducted so far are qualitative tests. Some recent research shows the daily tools could be used as a substitute for this experimental instrument, but limited teachers had this knowledge. This work was carried out to increase the knowledge of quantitative chemical analysis using daily life devices of smartphone cameras. Furthermore, this work would also improve the skills of students and teachers of using smartphone cameras as quantitative chemical analysis tools as an alternative to chemical analysis instruments

2. Methods

2.1. Materials and instruments

The material used to include iron (II) sulphate (Merck), iron test kit HI-3834 (Hanna Instrument) and distilled water. The instrument used were smartphone camera with Colorspot software (https://play.google.com/store/apps/details?id=com.colorspot), volume flash, beaker glass, test tube and micropipette.

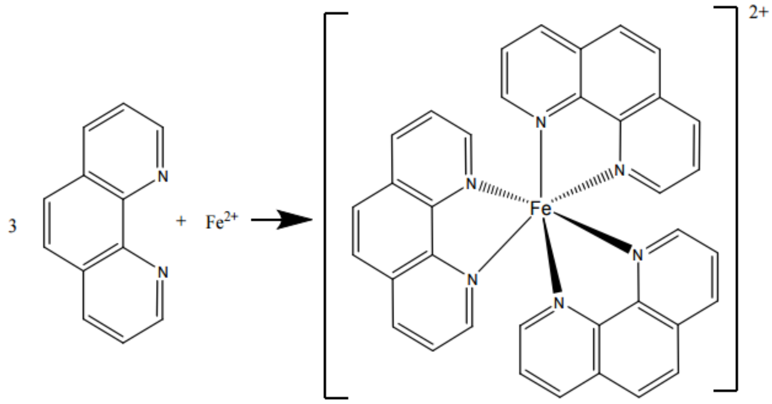
2.2. Experimental

The experiments were carried out as follows:
a. Pre-test to find out an initial knowledge of the use of a smartphone camera as an alternative instrument of chemical instruments for colorimetric analysis.
b. Class discussion of the principles of chemical analysis of colorimetric and spectrophotometric methods.
c. Laboratory explanation of the use of smartphone cameras, as an alternative chemical instrument for quantitative analysis of a material.
d. Training on the use a smartphone camera for quantitative analysis of iron levels using free ColorSpot software, with an analysis of the results.
e. Post-test to find out the increase of the knowledge on the use of a smartphone camera as an alternative tool for chemical instruments for quantitative analysis of iron content.

3. Results and discussion

3.1. Pre experiment

Preliminary experiments were conducted to review and practice the experiment that will be given to the target audience. The color change reaction that will be given training was the determination of iron concentration using iron test kit. The use of an iron test kit was based on the reaction of iron with o-phenanthroline. O phenanthroline ($C_{12}H_8N_2$) was a complex that can react with various types of metals to make colored complexes. O-phenanthroline could form a strong complex with iron (II) and form an orange red color, according to the following reaction:



$$Fe^{2+} + 3\ \text{o-Phen} \rightarrow [Fe(\text{o-Phen})_3]^{2+}$$

Orange-red solution

The iron determination assay produces a clear red color change, which was easy to use as an example in chemical analysis based on changes in color. The results of the experiments showed the the optimal concentration of standard iron solution at intervals of 2 to 10 ppm, with a volume of 5 mL solution will produce a linear standard curve.

3.2. Training of the use of smartphone cameras for analysis

The training was performed at the Chemistry Laboratory of SMA N 2 high school at Purwokerto, with a target audience of students and chemistry teachers. The training began with the explanation of on the basics of chemical analysis by spectrophotometry and chemical analysis by colorimetry. The next explanation as about the daily tools that can be used as an alternative analysis instrument as an alternative of a spectrophotometer or colorimeter which is usually used as an analysis tool based on color changes.

The next activity was training in the use of smartphone cameras as chemical analysis tools based on color changes. This training was assisted by chemistry undergraduate students using a guide book.

Standard iron solution was mixed with the reagent kit, resulting in a color change from clear to red, according to the concentration of iron content (**Fig. 1**).

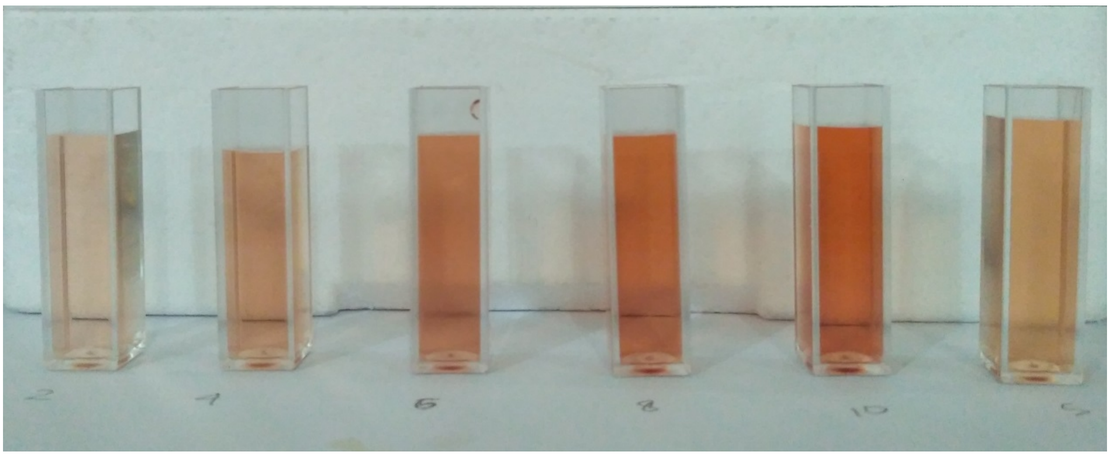


Figure 1. Color change of a standard iron solution with the addition of iron test kit at various concentration (2-10 ppm).

The solutions were then captured using a smartphone camera, and the image was analyzed using the "ColorSpot" software. This digital image processing would produce a color intensity (**Fig. 2A**) related to the concentration of standard iron solutions. The linear curve between intensity and concentration to calculate the sample concentration was then obtained (**Fig. 2B**). The results the calibration curve was resulted a regression equation of y = 0.04x + 203.5 r2 = 0.6465 for **Red**, y = -0.24x + 189.8 r2 = 0.9037 for **Green** and y = -0.30x + 207.1 r2 = 0.9265 for **Blue** color intensity. From these equations, the blue color intensity shows the best calibration curve, with the highest slope and the highest regression coefficient. Therefore, the blue line intensity equation was used to calculate the sample concentration. The results of the measurement of iron content in the sample solution is 5.54 ppm (**Fig. 2B**).

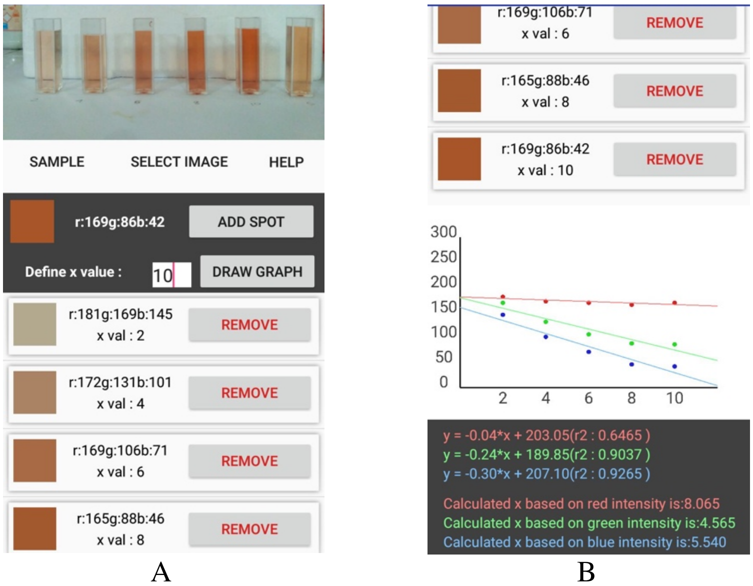
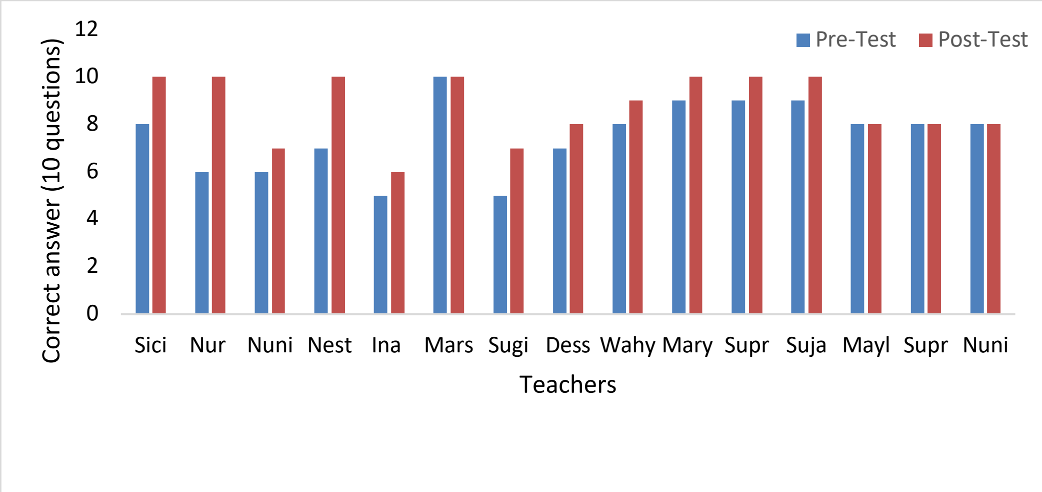
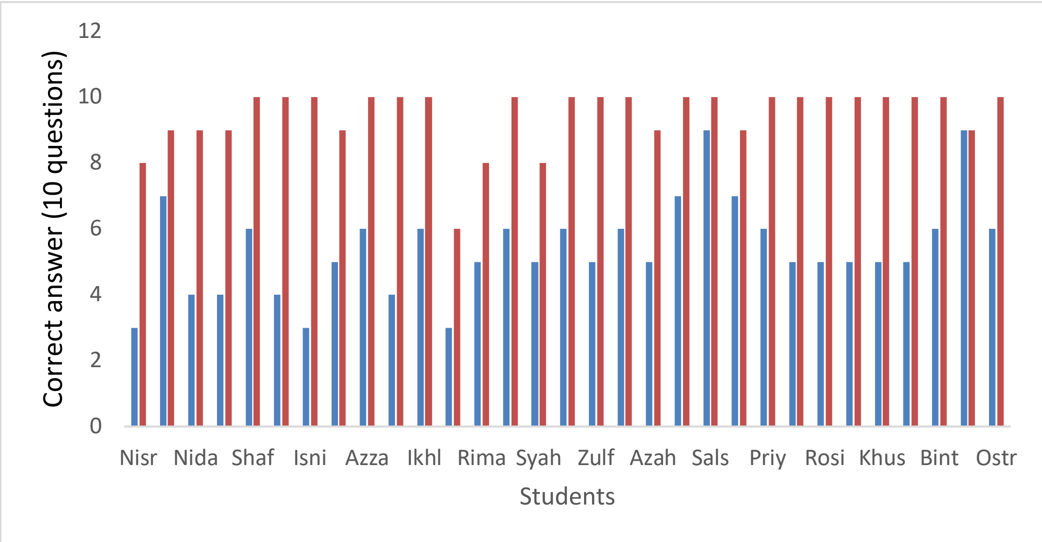


Figure 2. Color standard solution captured in the ColorSpot software. The color intensity (A) obtained and a calibration curve was made to calculate the sample concentration (B).

After the training was conducted, the target audience both teachers and students were again given an evaluation sheet (post-test) with the same questions as the pre-test. The results of the evaluation sheet processing, for the target audience of 15 teaching teachers (**Fig. 3A**) experienced an increase in knowledge of colorimetric chemical analysis using a smartphone camera with an increase from an average of 7.5 correct answers to 8.7 (10 questions). These results were analyzed with the Wilcoxon Signed-Rank test showing there were significant differences between before and after training.



A



B

Figure 3. Comparison of teacher (A) and students (B) knowledge before (blue) and after getting training (red).

The results of the other target audience of 31 high school students (**Fig. 3B**) also showed an increase in knowledge of colorimetric chemical analysis using a smartphone camera with an increase from an average of correct answers of 5.4 to 9.5 (10 questions). These results were analyzed with the Wilcoxon Signed-Rank test showing there were significant differences between before and after training.
If we compare, for the knowledge of the target audience of chemistry teachers (pre-test) the value was higher than students, because in general the chemistry teacher already has knowledge of chemistry analysis. However, from an increase in knowledge, then the target audience students showed higher improvement than that of teachers.

4. Conclusion
Students and Teachers of the targeted high school showed increased knowledge and skills in using smartphone cameras as an alternative tool of chemical instruments for colorimetric analysis of iron concentration. The students showed a higher increasing knowledge than that of teachers.

Acknowledgment
We would like to thank the Universitas Jenderal Soedirman with the "Penerapan IPTEKS" grant of 2017 for supporting this work.

References
1] Khopkar S M 1998 *Basic concepts of analytical chemistry* (New Age International)
[2] Anggraeni M D and Fatoni A 2017 Non-invasive Self-Care Anemia Detection during Pregnancy Using a Smartphone Camera *IOP Conference Series: Materials Science and Engineering* vol 172
[3] Firdaus M L, Alwi W, Trinoveldi F, Rahayu I, Rahmidar L and Warsito K 2014 Determination of Chromium and Iron Using Digital Image-based Colorimetry *Procedia Environ. Sci.*
[4] Choodum A, Boonsamran P, NicDaeid N and Wongniramaikul W 2015 On-site semi-quantitative analysis for ammonium nitrate detection using digital image colourimetry *Sci. Justice* **55** 437–45
[5] Fatoni A, Aziz A N and Anggraeni M D 2020 Low-cost and real-time color detector developments for glucose biosensor *Sens. Bio-Sensing Res.* 100325
[6] Wongwilai W, Lapanantnoppakhun S, Grudpan S and Grudpan K 2010 Webcam camera as a detector for a simple lab-on-chip time based approach *Talanta* **81** 1137–41
[7] Fatoni A, Anggraeni M D and Dwiasi D W 2019 Easy and Low-cost Chitosan Cryogel-based Colorimetric Biosensor for Detection of Glucose *J. Anal. Chem.* **74** 933–9
[8] Fatoni A, Anggraeni M D and Dwiasi D W 2016 Simple Colorimetric Glucose Biosensor using Chitosan Cryogel Supporting Material *AIP Conf. Proc.* **1746** 020029-020029–7
[9] Kehoe E and Penn R L 2013 Introducing colorimetric analysis with camera phones and digital cameras: an activity for high school or general chemistry *J. Chem. Educ.* **90** 1191–5
[10] Kompany-Zareh M, Mansourian M and Ravaee F 2002 Simple method for colorimetric spot-test quantitative analysis of Fe(III) using a computer controlled hand-scanner *Anal. Chim. Acta*
[11] Oncescu V, Mancuso M and Erickson D 2014 Cholesterol testing on a smartphone *Lab Chip* **14** 759–63