Developing Save Your Food Kit *(Sayofu Kit)* to Support Inquiry, Improve Student Learning Outcomes at SMP Plus Hidayatul Mubtadiin and Public Awareness on Food Additives

J Astutik

Indonesian School of Kuala Lumpur, Lorong Tun Ismail No. 1, Kuala Lumpur 50480, Malaysia
E-mail: ummu.syauqee505@gmail.com

**Abstract.** Food additives are materials that cannot be separated from the lives of students and the community. Based on the preliminary questionnaire, it indicates the lack of kit supporting material additives in some schools and communities. The research objectives of this development are (1) to develop Kit experiment *(Sayofu Kit)* and supplementary books to improve student learning outcomes in the classroom and public awareness on food additives (2) to describe the feasibility and potential effectiveness of *Sayofu Kit* developed (3) to analyze the practice of *Sayofu Kit* and benefits for students and the community. This development study uses 4-D models Thiagarajan, et al (1974). through some stages, they are: defining, designing, developing and disseminating which involves the students and community. The developed SAYOFU KIT includes additives sample kit, borax test kit, curcumin test kit, formaldehyde test kit, modification heater to the identification of dyes and dye test paper. The study is conducted at SMP Plus Hidayatul Mubtadiin, and TKIT Al Uswah. The products are validated by experts and education practitioners. Qualitative data processing uses descriptive method, whereas quantitative data by using the *N-gain*. The average yield of expert validation of SAYOFU KIT with supplementary books 76.50% teacher’s book and 76.30% student’s book are eligible. The average yield of 96.81% validation of educational practitioners criteria, piloting a small group of 83.15%, and 82.89% field trials are very decent. The average yield on the student questionnaire responses SAYOFU kit and supplementary book is 87.6% with the criteria very well worth it. *N-Gain* 0.56 cognitive achievement with the criteria enough. The results of the public poll showed 95% feel the benefits SAYOFU kits for testing food. Based from description indicates that SAYOFU Kit developed feasible, practical, useful to support inquiry learning and improve student learning outcomes as well as public awareness of food additives.

1. Introduction

Material food additives can not be separated from everyday life is one of the materials science class VIII. Ideal learning science materials covers aspects of microscopic, macroscopic and symbolic [1]. If these aspects found, the science material will be easily learned and applied. Food additive teaching materials available today do not represent these three aspects much. Student activities on experiments in teaching materials are dominated by food composition analysis with many scientific terms so that these materials tend to be difficult to understand and apply because it reviews of symbolic aspect only.
Methods of learning and teaching materials of food additives should be investigated and developed more. This material is not separated from the daily life of current students, future and the impact on life in the community. According to Piaget in Olson & Hergenhahn, the optimal education requires a challenging experience for learners so that optimal process of assimilation and accommodation [2]. "Appropriate learning method, learning resources and learning experiences greatly affect the students 'competence' [3]. Method of inquiry is expected to accommodate and improve learning outcomes with real and meaningful experience. The availability of teaching materials are also expected to improve the reasoning ability of students in learning.

Teaching materials that support the process of inquiry are still limited. Activity is dominated by experimental analysis composition of food additives on food packaging. Curriculum resources VIII class 2013 contains experimental activities already [4]. However, experimental activities additives are only tested on dye textiles, while the issue of additives and other addictive are presented by information and analysis only. Grain material and concept maps are not much different from other books. Value divinity embedded in religious teaching students to associate with the material additives and addictive substances studied are still lacking.

Questionnaire preliminary study to parents and teachers from several areas indicate that the material teaching materials additives are needed. Respondents noted that variations have not done an experiment in learning the material additives yet. This material is dominated by the activities of the analysis of the composition of additives on food packaging. Exhaustiveness average grade of only 50-75% only. After studying this material, it showed no change in the attitude of the students in choosing the food consumed. The preliminary study questionnaire on 50 junior high school students of class IX Plus Hidayatul Mubtadiin showed that 65.22% of students did not like this material because a lot of memorizing the type and function of the term - a foreign term. Students who forgot the name of the food and non-food additives that need to watch reaches 40 to 71%, so they have not been able to apply the knowledge about additives in food consumption. The majority of parents also find it difficult to determine the safety and how to test food additives and feel uneasy with the widespread use of non-food additives on the market.

The existence of a kit to test food additives at this time is there but still need to be developed and disseminated in the learning material additives and in community life. The kits of non-food additives that are commercially available are relatively expensive and not so well known. Kit as a part of teaching materials will support the inquiry learning process. One characteristic of inquiry learning is to develop systematic thinking skills, logical, and critical [5]. They do demonstrate that the process of reasoning is needed in learning. So the inquiry teaching materials that support the process of reasoning is needed. Everyone should remember this sentence before eating or drinking "save your food, make sure before you consume it". The abbreviated sentence SAYOFU message is supported by experimental tools, named SAYOFU KIT.

Suwarni states that the inquiry teaching materials effectively increase the cognitive, psychomotor, and affective student [6]. The results of the other development is the interactive teaching materials with guided inquiry approach in chemical materials of foodstuffs are also feasible to use [7]. Other studies based learning inquiry is already quite a lot and give positive results in improving the quality of learning of them stated [8]. Sulistina et al, Juntunen and Aksela also stated approach of inquiry can be applied to materials chemistry at all levels of school [9],[10]. Use of research in various fields of connecting the world outside the school can prepare for study of scientific inquiry better to improve the concept and process skills using inquiry method [11]. Design of project-based activities to the development of creativity and knowledge of the inquiry-based learning is very effective at secondary school [12].

Based on the above explanation, the development of teaching materials in the form of SAYOFU KIT and supplementary to additives material is made which can be used by eighth grade students and the community. The proceedings are designed in view of material and design of experiments varied. The
objective research and development is to develop a proper and validated inquiry-based teaching material and determine the potential effectiveness in improving learning outcomes of student learning. Another goal is to increase public awareness of food additives and how to test using materials that are easy to obtain and inexpensive.

2. Model, analysis, design and implementation

2.1. Research and development model

The development model used in this study refers to the development of the research and development of 4D models of Thiagarajan et al which includes the step define, design, develop and disseminate [13]. In the define phase to do a needs analysis. These stages are complete made through a 5-step analysis: analysis front-end (front-end analysis), analysis of student (learner analysis), analysis of the task (task analysis), analyzes the concept (concept analysis), and goal setting (Specifying Instructional Objectives).

The front-end analysis aims in determining the problems encountered in learning based on the curriculum of 2013 and the facts on the ground so we need a material development material additives [14]. Analysis of students aims in determining the characteristics of the students to be adapted to the design of the development of teaching materials. Characteristics of students and the community analyzed will include background experience, the general attitude towards learning topics, as well as the media, formats and languages. Information about the characteristics of students and the public in accordance with the design development of teaching materials. The task analysis aims to identify the key skills that must be mastered and analyze it in order to be a skill that must be mastered. This analysis is done through a study of core competencies, basic competencies and learning indicators that are used to develop teaching materials additive material. Analysis of the concept aims to identify the main concepts in the material being taught additives which can not be separated from KI, KD and indicators of achievement of competencies. Formulation of learning objectives and task analysis is converting concepts into instructional objectives were developed from learning indicators.

Design stage is implemented by arranging story board that refers KD and indicators arranged on the define phase. This stage includes the preparation of materials, media selection, the selection of teaching materials floating format, the initial design. Penentukan early design phases covering material according to the material that has been determined, and the determination of the type KIT trial. Type kit is determined to make variations of the experiment could be done simply. The final outcome kit named SAYOFU KIT which consists of a kit of samples of additives, test of borax (paper, liquid and sticks), formalin (paper and liquid), for example paper test kit to test borax, formalin test kit, curcumin test kit, heater modifications and test paper dye.

Develop stage aims to produce a final draft of the revised based on input from the experts. The activities of this stage is the assessment of the experts and product trials. Prior to validation by the validator, the product must be validated by supervisor first, further validated by educational experts, subject matter experts, and practitioners. Validation expert (expert appraisal) aims to determine the feasibility or validity of the product before the final product is produced. The revised products are used to test the product in small groups and field trials. The end product will be used for field trials in the experimental class to determine the potential effectiveness of teaching materials to improve student learning outcomes as on. Products are also tested in people from various circles in Figure 1.
2.2. Analysis
The type of data obtained in this research and development consists of quantitative and qualitative data from the questionnaires using Likert scale and column comments and suggestions. The qualitative data is obtained from the advice and input from education experts, subject matter experts, education professionals, students of class IX and class VIII Junior High School Plus Hidayatul Mu'tadhin Singosari Malang. The quantitative data is obtained from a questionnaire using Likert scale with a score of 1-5. Data obtained from expert validation is used to determine the feasibility and validity of teaching materials. The data from students, teachers and the community is used to determine the effectiveness, the attractiveness and teaching materials applicability.

Data collection instrument used in this study is in the form of questionnaire checklist and column suggestions and comments. The type of questionnaire used, namely the preliminary questionnaire (the needs of teachers and students), expert validation questionnaire, questionnaire testing small groups, and affective self-assessment questionnaire students. These preliminary questionnaire contains certain criteria of instructional materials needed by teachers and students. Questionnaire validation of experts comprising two types of assessment, namely the Likert scale and the truth of the concept of the material by subject matter experts using a questionnaire using yes and no options. Through this validation questionnaire can be used as teaching material improvement SAYOFU KIT developed.

Additive material cognitive matters are made according to the indicators achieved by competence, namely KD 3.7 and 4.7 grade VIII junior high school. Matters being used is validated by experts with the validity of 94.63% and a very decent criteria. The trials were conducted at about 44 students of class IX and continued with analysis using IBM SPSS statistics 21. The reliability obtained was 0.732 with the high category. The amount of cognitive questions are 30 questions that declared valid by modest and easy difficulty level.

Analytical techniques done is to calculate a score acquisition and converted in percentage form. The results of this quantitative data are used to get the conclusion of a pre-determined criteria. Data from preliminary study questionnaire is processed by the calculation of percentages for each item selection. As stated by Sudjana with the formula [15]: The determination of this percentage descriptive processed by counting the number of respondents divided by the total number of respondents and multiplied by 100 percent, Sudjana [15] as follows:

$$ P = \frac{f}{N} \times 100\% \quad (1) $$

P = the percentage of poll respondents
f = number of respondents who answered item
N = the total number of respondents
Criteria for eligibility qualifications percentage calculations with predetermined criteria [16]. The questionnaire results with the percentage of 81% - 100% criteria are very decent (not revised), 61% - 80% criteria are eligible (not revised), 41% - 60% criteria are quite decent (not revised), 41% - 60% criteria are less worthy (revision), and 0% - 20% criteria are not worth (revised).

Analysis of scientific reasoning ability and cognitive learning outcomes form of multiple choice questions are conducted to determine improved results pretest to posttest. The counting uses the formula N-gain. Analysis of scientific reasoning ability and cognitive learning outcomes form of multiple choice questions are conducted to determine improved results pretest to posttest. Perhitunganya using the formula N-gain as follows:

\[
N \text{gain} = \frac{\bar{O}_{\text{post}} - \bar{O}_{\text{pre}}}{\bar{O}_{\text{ideal}} - \bar{O}_{\text{pre}}} \quad (2)
\]

Furthermore, the N-gain obtained is interpreted based on predetermined criteria. A high N-gain criteria if > 0.70, middle criteria if 0.30 to 0.7, while the low criteria if the N-gain <0.3 [17].

2.3. Design
Design of experiments performed in this study is at the stage of develop from the design of the 4-D, consisting of several stages: 1) validation expert (expert appraisal) by two lecturers, two science teachers JUNIOR HIGH SCHOOL, 2) pre-trials (initial testing) on at 8 junior high school students of class IX appointed, 3) field trials (quantitative testing), in class VIIIA SMP Plus Hidayatul Mubtadiin to test adherence and to get data from student questionnaire, continued to junior high school students grade VIIIB to test the potential effectiveness of teaching materials to improve student learning outcomes, 4) dissemination in the community involves teachers and parents of students kindergarten, elementary school, and junior high school. Research trial design in the classroom is one group pretest-posttest design as shown in Table 1 [13].

| Class | Pre test | treatment | posttest |
|-------|----------|-----------|----------|
| VIII  | O₁       | X         | O₂       |

Information:
O₁ = cognitive achievement test before treatment
O₂ = cognitive achievement test after treatment
X = learning inquiry-based teaching with SAYOFU KIT

2.4. Implementation
Research and development is done by 1) conducting a pretest about cognitive 2) implementing learning using teaching materials, 3) granting a matter posttest to measure whether there is an increase in cognitive achievement of students, 4) Socialising to the community through school kindergarten, elementary and junior high students. Quantitative data analysis of data is in the form of a percentage of student response to learning using teaching materials, the data pretest and posttest using cognitive tests. Furthermore, to determine student’s cognitive learning outcome is calculated by the formula N-gain. Public response is obtained through qualitative data from the questionnaires. Implementation of SAYOFU KIT in research can be seen in Figure 2.
3. Result and discussion

Prepared teaching materials are developed based on the Curriculum 2013 on the basis of competence 3.7 and 4.7 for teaching science to students of class VIII grade junior high school material additives and addictive substances in the form of books and SAYOFU KIT. The book consists of two kinds of books the teacher’s and student’s books. Teaching materials for teachers are not much different with the students teaching materials containing of four learnings, in each lesson there is an introduction, learning objectives, lesson inquiry, reflection, material comprehension, concept mapping, a summary of the material, tips, exercises. At the end of the book there is a summary of the material, concept mapping, a glossary and competency testing, concept maps, and a glossary. The difference between a teacher book and student book is at the teacher's guide, answer key, lesson plans and syllabi parts in the teacher’s book.

Sayofu kit consists of 1) additives sampel kits consisting of three colors (red, yellow, and green) of the label to depend on the risk, 2) heater modification kits to test natural dyes and artificial through heating, 3) curcumin test kit, made from alkaline solution that can be used to test food color yellow, 4) borax test kit (paper, liquid, spray and stick) 5) formalin-borax test kits contain active anthocyanins from the skin of dragon fruit, hibiscus, or use extract of sappan wood (Caesalpinia sappan L). 6) Dye paper test that works on the principle of paper chromatography. SAYOFU KIT and supplementary books developed can be seen in Figure 3.

![Figure 2. Impelentation SAYOFU Kit for Experiments. (a) SAYOFU KIT used for identify natural and artificial colouring agents, (b) dye paper test, (c) Borax test on cracker, (d) curcumin test on yellow cassava fried, (e) modification heater used to identify colouring agents, (f) and formaldehyde test on meat.]

![Figure 3. SAYOFU KIT and Supplementary Books. (a) SAYOFU KIT on box, (b) additives sampe kit, (c) Borax test kit, (d) curcumin test kit, (e) Formaldehyde test kit, and (f) Supplementary books for teacher and student.]

The average yield of expert validation of the teaching materials criteria that include SAYOFU KIT with 76.50% teacher’s book and 76.30% student’s book are eligible. The average yield of 96.81% validation of educational practitioners criteria, piloting a small group of 83.15%, and 82.89% field trials
are very decent. The average yield on the student questionnaire responses SAYOFU kit and supplementary book is 87.6% with the criteria very well worth it. From product testing, the highest scores obtained on the tips and reflection that is 97% and 93%. Results of the assessment cognitive learning outcomes N-gain of 0.56 with the medium category. Percentage outcomes 82.25 % of cognitive learning, 80% of learning outcomes affective, and psychomotor learning outcomes 85%. The results of the public poll showed 90% of respondents do not understand the additives and 95% feel the benefits SAYOFU kits for testing food, so they suggested to be produced, and developed further. The percentage of research result can be seen in Figure 4.

![Figure 4. Result data of the research.](image)

4. Conclusion

Based on the results of the validation and test of the product, it showed that the form of SAYOFU KIT teaching materials and supplementary developed are feasible to use for students and the community. Teaching material has the potential to improve student learning outcomes and increase public awareness as well as life skills to food additives. The results of research and development can be proceed in the final stage of testing is the use of packaging product by others and disseminating followed by a much larger scale. Teaching materials that have passed this phase will be determined its effectiveness, if proven effective, it can be used on a wider scale or distributed.

Further advice product development are (1) Developing kit other additives, such as test kits for MSG, cyclamate, and Rhodamine B because the current test kit price to test is still quite expensive; (2) developing supporting kits to another science materials or topics, because its existence is very helpful in the learning process; and (3) Using materials that are easy to obtain and use by the public.

5. References

[1] Chittleborough G and Treagust D F 2007 Chemistry Education Research and Practice 8 274-92
[2] Hergenhahn B R and Olson M H 2008 Theories of Learning (Teori Belajar) 7th Edition, Translate by Tribowo B S (Jakarta: Media Grafiya) pp 324-325
[3] Mulyasa 2014 Pengembangan dan Implementasi Kurikulum 2013 (Bandung: PT Remaja Rosdakarya) pp 5-6
[4] Zubaidah S, Mahanal S, Yuliani L and Sigit D 2014 Ilmu Pengetahuan Alam Kelas VIII (Jakarta: Kemdikbud) pp 175-7
[5] Hosman M 2014 Pendekatan saintifik dan Kontekstual dalam Pembelajaran Abad 21 (Bogor: Ghalia Indonesia)
[6] Suwarni E 2013 Pengembangan Bahan Ajar Kimia Materi dan Perubahannya Berdasarkan SMK Kelas X Program Keahlian Teknik Batu dan Beton (Malang: Thesis, Malang State University)
Acknowledgements

I would like to express my deepest appreciation to all those who provided me the possibility to complete this research. I would like to express my gratitude to Prof. Ir. Ari Purbayanto and Drs. H. Agustinus Suharto, M.Pd who allowed me to represent Indonesian School of Kuala Lumpur in Ki Hajar Dewantara Award. I would like to thank my advisors Dr. Munzil Arif, M.Si and Dr. Hadi Suwono, M.Pd for the useful comments, remarks, full effort in guiding me, and engagement through the learning process of this research. Furthermore I would like to thank Mr Muhamad Mustofa the headmaster of SMP Plus Hidayatul Mubtadiin and Mrs. Fitri the headmaster of TKIT Al Uswah Singosari for allowing research in their school also supporting on the way. Also, I like to thank the participants in my research, who have willingly shared their precious time during the process of research, their comment and advices. A special gratitude I give to Mrs. Astri Rahayu whose contribution in stimulating suggestions and encouragement, helped me to coordinate my research especially in writing this report. Furthermore, I would like to give my highest appreciation to the the staff of Indonesian school of Kuala Lumpur and SMP Plus Hidayatul Mubtadiin, who let me use all required equipment and the necessary materials to complete the research. A special thanks goes to all my friend, who help me to assemble the parts and gave suggestion about the SAYOFU KIT. I would like to thank my family and loved ones, Syaifudin Juri who have supported me throughout entire process, both by keeping me harmonious and helping me putting pieces together. I will be grateful forever for your love. Last but not least, many thanks go to anyone may I have forgotten. I do apologize and thank you as well.