# Developing Manual Book of Household Wet Waste Composting Experiment by Using Decayed Pinneapple Essence Starter for Environment/Climate Changing and Waste Recycling Topic of X Graders Madrasah Aliyah

**Zerlinda Mara Ditta**
**Mimien Henie Irawati**
**Susilowati**
Universitas Negeri Malang
*zerlindaditta@gmail.com*

**Abstract:** Waste management by composting is an alternative way that is considered most appropriate to deal with the problems of wet domestic waste. The purpose of this study was to develop a user guide for the experiment of composting wet domestic waste for the subject Environmental Change/ Climate and Waste Recycling for 10th grade SMA/MA and to evaluate the effects of the use of rotten pineapple extract as the starter with the concentrations of 0%, 25%, 50 %, and 75% in the length of time of composting process. MAN 3 Malang was one of the schools in the city of Malang that had implemented Curriculum 2013, which contained the particular topic for the 10th grade. The results of the validation from materials experts, media specialists, and field experts resulted in the score of 94%, 93%, 99% respectively, and the test results from the students obtained the percentage of 91%. Based on the validation results it was concluded that the teaching materials were suitable as an alternative instructional materials in the teaching of Biology for class X IPA. The results of experimental studies indicated that the starter from the rotten pineapple extract in concentrations 75% was the most effective in speeding up the composting process.

**Keywords:** rotten pineapple extract, user guide experimental composting, wet domestic waste

**Abstrak:** Teknik pengelolaan sampah dengan pengomposan merupakan alternatif penanganan yang dianggap paling sesuai untuk menangani permasalahan sampah basah rumah tangga. Tujuan dari penelitian ini adalah (1) untuk mengembangkan buku petunjuk percobaan pengomposan sampah basah rumah tangga pada materi Perubahan Lingkungan/Iklim dan Daur Ulang Limbah untuk siswa kelas X SMA/MA; (2) untuk meneliti pengaruh pemberian starter sari nanas busuk dalam konsentrasi 0%, 25%, 50%, dan 75% terhadap lama waktu pengomposan. Hasil penilaian angket validasi ahli materi, ahli media, ahli lapangan terhadap bahan ajar berturut-turut memperoleh persentase skor sebesar 94%, 93%, 99% dan hasil uji coba pada siswa mendapatkan persentase sebesar 91%. Berdasarkan hasil validasi para ahli tersebut dapat dikatakan bahwa bahan ajar layak digunakan sebagai salah satu alternatif bahan ajar dalam pembelajaran Biologi kelas X IPA. Hasil penelitian eksperimen menunjukkan konsentrasi starter sari nanas busuk 75% efektif dalam mempercepat proses pengomposan.

**Kata kunci:** buku petunjuk percobaan pengomposan, sampah basah, sari nanas busuk

The problem of waste is a problem that is always discussed neither in Indonesia nor another cities in the world, because almost all cities face the similar problem regarding garbage and waste. Increased urban development, population increase, level of activity and socioeconomic community, along with the amount of waste piles from day to day will contribute to the negative impacts.

Garbage problems both in terms of environment and cleanliness will ultimately affect the public health. One way to help reduce waste problems is with the emphasis on the composting process (Sinaga, et al., 2010).

Waste management with composting is an alternative treatment that is considered as the most appropriate to handle the problem of household

wet waste. Compost is environmentally friendly. In addition, the compost can improve soil structure and texture, improve soil's ability to retain water and air, increase soil fertility and stimulate healthy root development in plants. Composting is very easy because we can start using only foliage and grass. Compost can also save on purchases of plant fertilizers so that composting has great benefits in both social, economic and health aspects (United States Environmental Protection Agency, 2009).

In the Curriculum 2013, it contains Environmental / Climate Change and Waste Recycling Topic for X graders of Natural Science Program students that demand their students a number of competencies, these competencies are analyzing the environmental change data and the impact of the change for life, solving environmental problems by making product design waste recycling and environmental conservation efforts as stated in Basic Competency 3.10 and 4.10 in the attachment to Regulation of the Minister of Education and Culture No. 59 of 2014.

In MAN 3 Malang, waste recycling learning for X graders of Natural Science Program is still limited to a theoretical lecturing and assignment offering. There is no teaching material in the form of manual of composting experiment and the practice of composting of wet waste using experiment manual book.

Based on the terminology, the experiment can be interpreted as a series of activities that enable a person (student) to apply skills or practice certain knowledge. In other words, in the experimental activities, it is possible to apply a variety of science processing skills as well as the development of scientific attitudes that support the process of acquiring knowledge (products of science) in students (Subiantoro, 2010). Therefore, the experimental manual book takes a very important position in the natual science lesson, especially Biology subject on Environmental / Climate Change and Waste Recycling Topic for X Graders.

The arrangement of manuals of composting experiments was using 4D Thiagarajan model. In this study, the stage is only limited to the stage of developing. The teaching material was developed based on the results of experimental research on the effect of the utilization of various concentrations of rotten pineapple starter during the process of composting. The use of various concentrations with 0%, 25%, 50%, and 75% of rotten pineapple concentrations in this study refers to preliminary studies that have been successfully performed by Muarifah (2015).

The major reasoon of selection of starter made from rotten pineapple due to raw material of rotten pineapple which is easily found in Indonesia, especially in Malang city. During the harvest season, the production of pineapple is abundant. As a concequences, rotten pineapple that is not sold by traders were abundantly found. In addition, the use of rotten pineapple as a composting starter is because in the rotten pineapple there is a decaying microorganism produced during the process of decomposition of pineapple that has the potential to accelerate the destruction of household wet waste (Marwati, 2009)

## METHOD

This research employed research procedure of instructional materal development which is suggested by Thiagarajan or commonly known as 4D Model of Thiaragajan. The model consists of four major stages namely, Define, Design, Develop, and Disseminate. However, this research was only limited to the stage of development.

The goal at the define stage is to define and determine instructional requirements. Activities undertaken at the define stage for this study is to analyze the instructional needs of interviews to teachers Biology and interviews of students MAN 3 Malang. The need in this research is the selection of Environmental / Climate Change and Waste Recycling Topic for X Graders.

The stage of designing aims at creating a product design of instruction material. The design was based on the experiment result on the influence of various concentrations with 0%, 25%, 50%, and 75% of rotten pineapple concentrations towards the duration of composting process. The results of the research were then analyzed by employing One-way Anava and Duncan's Multiple Range Test.

Thiagarajan (1974) divides the development stage into two activities: expert appraisal and developmental testing. Expert appraisal is a technique to validate or assess the feasibility of product design. At this stage the validation by the material experts, and field experts on the materials are made. Developmental testing is conducted to test the product design on the subject's real target.

The subjects of this study were students of class X IPA-6 MAN 3 Malang with a total of 27 Students. The purpose of the test on the subject was to find the response data in the form of pre test and

post test which then analyzed using normalized gain score, reviews or comments from the target users of the product. The test results are used to improve the product. Reviews or comments from product target users were analyzed using student legibility questionnaire.

The types of data contained in this study were qualitative data and quantitative data. Qualitative data in the form of comments and suggestions from material experts, media experts, field experts and students of teaching materials. While the quantitative data obtained from the questionnaire scores distributed on the materials experts, media experts, field experts and students as the subjects. This quantitative data was analyzed by using the percentage formula.

## RESULTS AND DISCUSSION

### Results

#### *Define Stage*

The results of the define stage explain the problems faced by teachers in the Biology lesson of Environmental / Climate Change and Waste Recycling topic, and the characteristics of students in MAN 3 Malang. Based on the define stage, it was found that the material of Environmental Change / Climate and Waste Recycling is only taught with lectures and assignments for the manufacture of skills made from plastic waste. However, teachers have not yet directed to conduct composting experiments. So far, there is no instructional material in the form of a manual for the composting of waste recycling materials to help the learning process thus it needs to be compiled in the form of a manual for composting experiment to help the students in conducting the composting experiment. Based on the observations made to the students, it was found that the students liked the Environmental Change / Climate and Waste Recycling topic on Biology lesson, the students were happy to study the material of Environmental Change / Climate and Waste Recycling with the direct waste recycling experiment, the students will be easier to practice waste recycling with teaching materials in the form of practical waste recycling experiment. So it is concluded that it requires instructional materials in the form of manuals of composting experiments.

#### *Design Stage Results and Discussion*

The design stage in this study aims at designing the appropriate alternative instructional materials to solve the problem. MAN 3 Malang has implemented the 2013 curriculum in its learning so that there are Environmental / Climate Change and Waste Recycling topic on Biology lesson. In the material there is no instructional materials in the form of a manual of composting experiment so that with the development of teaching materials in the form of a manual of composting experiments can overcome the problems and support the learning activities in the school.

In media selection process within the stage of designing, the aim of producing certain instructional media is to be utilized for students in learning. This stage focused on the arrangement of manual book for composting experiment in accordance with the experiment results regarding the influence of various concentrations with 0%, 25%, 50%, and 75% of rotten pineapple concentrations towards the duration of composting process.

Based on the results of experimental research, it obtained a significant results. The concentration of 75% starter of rotten pineapple juice is effective in accelerating the composting process for 10 days. Compost maturity data as a whole was then analyzed using One-way Anava and it is known that the probability value generated is greater than F Table that is equal to 0.64 indicating that the data obtained is significant. This can be interpreted that the starter of rotten pineapple concentration affect the composting process. To determine the concentration of starter extract of rotting pineapple is the most effective in accelerating the composting then it was tested further by using Duncan's Multiple Range Test.

According to Duncan's Multiple Range Test, it was obtained that the best rotten pineapple concentration in accelarating composting process is a rotten pineapple with 75% concentration which is able to accelarate the composting process up to 10 days.

#### *Develop Stage*

In the development stage, the researchers began to develop the product based on the design made. The result of the product development is manual book of composting experiment. Development stage consisted of two activities; expert apraisal and developmental testing. Expert appraisal is a phase to validate the feasibility of the developed product.

**Table 1. Results of Compost Maturity Observation**

| Repetition | 0 % | 25% | 50% | 75% |
|---|---|---|---|---|
| 1 | 42 days | 30 days | 20 days | 12 days |
| 2 | 40 days | 30 days | 20 days | 10 days |
| 3 | 42 days | 31 days | 21 days | 10 days |
| Avg | 41 days | 30 days | 20 days | 10 days |

**Tabel 2. Duncan's Multiple Range Test Results**

| Days | | | | | |
|---|---|---|---|---|---|
| Treatment | N | Subset | | | |
| | | 1 | 2 | 3 | 4 |
| Treatment 75% | 3 | 11.00a | | | |
| Treatment 50% | 3 | | 20.33b | | |
| Treatment 25% | 3 | | | 30.33c | |
| Treatment 0% | 3 | | | | 41.33d |
| Sig. | | 1.000 | 1.000 | 1.000 | 1.000 |

The validity of the developed product was evaluated by the experts who understand the instructional media development such as material expert, media expert, and field expert. The results of the validation from the experts obtained the average percentage of 94%. According to the results, it confirms that the product developed is valid and feasible without having a revision. The material expert evaluated the conformity of material with the basic competence in Biology subject lesson particularly on are Environmental / Climate Change and Waste Recycling topic.

## Discussion

The validation result by the material expert obtained an average of 93% and it affirms that the product is valid and feasible to be used without a revision required. The aspects assessed include aspects of graphic design and aspects of presentation of teaching materials, so that the instructional materials in the form of a manual for composting household wet waste that has been developed is valid and feasible to use without revision.

Validation of field experts was conducted to assess the effectiveness of the use of teaching materials for Environmental / Climate change and Waste Recycling topic in schools. The field expert validator was one of Biology subject teacher at MAN 3 Malang. Based on the results of validation by field experts, the developed product obtained an average score of 99% and the results stated that the product is in a category very efficient / valid and feasible to use without required revision. Field experts conducted assessments in terms of components of resource compilers, conformity of teaching materials with curriculum, significance of teaching materials, language, design and style and benefits of teaching materials in Biology lesson especially on Environmental / Climate Change and Waste Recycling topic.

Developmental testing is a phase which aims to test the product design on the subject as real target. At this phase, the researchers attempted to collect response data in the form of pretest and posttest results, reviews or comments of the target users of the product. The test results are used to improve the product. Pretest and posttest scores were used to determine whether there was a significant difference between the students' ability before and after using the instructional materials in the form of a manual for composting experiment on Environmental / Climate Change and Waste Recycling topic. Product effectiveness in field trials can be determined using a normalized gain score formula on the pretest and postes score calculations.

The result of the normalized gain score calculation obtained the value of 0.79, where the value indicates that (g)> 0.7 which means that the value of gain score is in the high category. So it can be concluded that the material is effective to use, and there is a very significant difference between the ability of students before and after using the instructional materials in the form of a manual book of composting experiments. The students'

assessment of the use of the trial manual obtained an assessment score of 91%. This means that the instructional materials developed are very efficient or valid. The components in the experiment book are written clearly and understandable so that the students can carry out all the activities contained in the experimental manual easily. In addition, the experimental manual can be used as a learning medium for students in studying waste recycling materials in a scientific approach.

## CONCLUSION

According to the explanation of the research findings and discussion, there are several things that can be concluded as follows. The instructional materials in the form of experimental manual was arranged and developed to support Biology subject lesson particularly on Environmental / Climate Change and Waste Recycling topic. Instructional materials in the form of developed experimental manual was made as attractive as possible, with full color design in order to attract students' attention.

The components of manual book are the identity of the book, the table of contents, work instruction of doing experiment, experimental work and practical purposes, theoretical basis, tools and materials, work procedures, observation data columns, questions to analyze practicum data, reference lists and lists of scientific terms (glossary).

The validation results of instructional material has been declared feasible and appropriate. The feasibility of instructional materials in the form of manual book of household wet waste composting experiment was evaluated from the validation result from 3 validators i.e. material expert, instructional expert, and field experts and students.

The results indicated the percentage the instructional material product in the form of manual book for composting material of Environmental / Climate Change and Waste Recycling validity level. The average percentage of media expert assessment on instructional materials in this experimental manual is 93% which achieved the valid criteria. The average percentage of expert material assessment on instructional materials in the form of this experiment manual is 94% that achieved the valid criteri. Therefore, the developed instructional material does not need to be revised. The average percentage of the field expert's assessment by Biology teacher at MAN 3 Malang on the instructional material in the form of manual book is 99% that achieved the valid criteria. The average percentage of students assessment on instructional materials is 91% that achieved very valid criteria.

The result of the normalized gain score calculation obtained the value of 0.79, where the value indicates that (g)> 0.7 which means that the value of gain score is in the high category. Further, it can be concluded that the material is effective to use, and there is a very significant difference between the ability of students before and after using the instructional materials in the form of a manual book of composting experiments. Overall, the instructional material in the form of manual book for composting experiment of household wet waste for Environmental / Climate Change and Waste Recycling topic within Biology subject lesson is valid and efficient.

## SUGGESTIONS

According to the conclusion above, there are several important points of suggestion with regard to the development of the instructional material. The instructional material in the form of manual book for composting experiment of household wet waste for Environmental / Climate Change and Waste Recycling topic within Biology subject lesson is feasible to be used, however, it requires to be improved and tested on wider subject. The instructional material in the form of manual book for composting experiment of household wet waste using rotten pineapple concentration for Environmental / Climate Change and Waste Recycling topic within Biology subject lesson is only a supplementary material. It still need a teacher as a facilitator to guide and direct students. This product is recommended to be maximally utilized, both for students and teachers, so that every student and teacher obtain an information about the composting experiment of household wet waste.

Furthermore, its is suggested to to a dissemination of product by indtroducing the developed instructional material on Biology teachers through Subject Teacher Organization activity. In addition, the developed instructional material can be disseminated through national and international conreferences. For the future development of product, it is suggested to make product for other subject or other material. Moreover, the future development of the material can take into account other approach and media for composting experiment to increase students' knowledge.

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