

## Design and Implementation of Sorting Waste Bins as an Integrated Waste Management System in the School Environment

Hisyam Ihsan<sup>1</sup>, Fajar Arwadi<sup>2</sup>, Muhammad Ammar Naufal<sup>3\*</sup>, Riswansyah<sup>4</sup>, Ahmad Israk<sup>5</sup>, Lutfiah<sup>6</sup>

<sup>1</sup>Actuarial Science Program, Faculty of Mathematics and Natural Sciences, Universitas Negeri Makassar, Makassar, Indonesia

<sup>2,3</sup>Mathematics Education, Faculty of Mathematics and Natural Sciences, Universitas Negeri Makassar, Makassar, Indonesia

<sup>4,5</sup>German Language Education, Language and Literature Faculty, Universitas Negeri Makassar, Makassar, Indonesia

<sup>6</sup>Accounting Education, Faculty of Economics and Business, Universitas Negeri Makassar, Makassar, Indonesia

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### ABSTRACT

This program aims to develop an effective waste management system in schools to increase environmental awareness. A segregated waste bin system with color categorization (green, yellow, nir, red) is implemented to make it easier to sort waste, especially organic and inorganic waste. This program is carried out based on needs analysis, system design, implementation and effectiveness evaluation. The results show an increase in students' waste sorting accuracy of 75% and increased awareness of the environment. However, challenges such as consistency of sorting, maintenance and changing habits still need to be addressed. This program recommends ongoing maintenance and education to increase the effectiveness of waste management systems in schools. In this way, it is hoped that environmental awareness and the quality of the school environment can be improved. This program contributes to the development of waste management systems in schools.

## 1. INTRODUCTION

Schools face big challenges in managing waste generated from learning activities which increase every year due to the increasing number of students [1]. According to data from the Ministry of the Environment, an average student produces 2 to 3 kilograms of waste every month, with a composition of 60% organic waste and 40% inorganic waste [2]. Apart from that, there is also additional waste from teachers and staff, such as paper, which also increases the volume of school waste. The lack of a good waste sorting system results in increased negative impacts on the environment.

Based on observations at SMK Negeri 2 Maros, it was found that students' low awareness of environmental cleanliness was the main problem. Waste such as plastic, Styrofoam, and paper scraps from food are often mixed together in the trash [3]. As a result, the pile of rubbish creates an unpleasant odor which can disrupt the comfort of the teaching and learning process. To overcome this problem, an effective waste management system is needed.

The main solution proposed is the implementation of segregated waste bins as a first step towards sustainable waste management in schools [4]. This system not only makes it easier to sort waste, but also provides education to students about the importance of proper waste management [5]. This program aims to develop segregated waste bins according to school needs, equipped with technical guidance, and evaluate their effectiveness in supporting comprehensive waste management.

## 2. METHOD

The design stage for sorting waste bins or Waste Banks begins with a thorough needs analysis through observation. Next, the UNM SMKN 2 Maros KKN-PPL Team carried out a comprehensive mapping of the type and volume of waste produced in the school environment and continued with identifying strategic points for placing rubbish bins. User preference surveys and ergonomic studies were also carried out to ensure that the designed system could be used easily by all school components.

#### \* Corresponding Author

Muhammad Ammar Naufal (Email: ammar.naufal@unm.ac.id)

Mathematics Education, Faculty of Mathematics and Natural Sciences, Universitas Negeri Makassar, Makassar, Indonesia

Menara MIPA Lantai 4, Jalan Mallengkeri, Parangtambung 90221, Makassar, Indonesia



Figure 1. Observation and cleaning photos with students

Next, the process of making waste sorting bins was carried out using used materials available at the school, thus saving the budget. The stages of making it are as follows:

1. Tools and Materials
  - Used Paint Bucket
  - Paint
  - Paintbrush
  - Paper with writing to be installed in the bucket
  - Razor blades
  - White pilox
2. Manufacturing Process
  - First collect the tools and materials needed.
  - Clean the bucket that will be used as a trash can. Make sure the bucket used still has a lid.
  - Paint the bucket and its lid based on the specified colour
  - Razor the paper to form letter holes
  - After the paint in the bucket is dry, attach the paper that has been razored neatly.
  - Pilox then wait until it dries.
  - Remove the Paper and the sorting bin is ready for use



Figure 2. Process of making waste sorting bins

In the process of making the trash bins, the team divided the waste categorization into four which were differentiated based on color: Green for organic waste (wood, tree branches, dry leaves, etc.), Yellow for inorganic waste (plastic, drink cans, plastic bags, etc.) , Blue for paper and cardboard waste, and red for B3 waste (hazardous and toxic materials). Each trash can is made from used paint buckets at school. With a capacity of 30 liters. This trash can is equipped with a lid, a clear information label on the lid, a drainage system for wet waste, and a trash stand that accommodates four trash cans per stand, in accordance with the waste categorization which is divided into four.

Implementation begins with the procurement and installation process according to predetermined specifications. Placement is carried out at predetermined strategic points. Furthermore, the socialization and education process will continue intensively, such as waste sorting and recycling workshops, as well as comprehensive distribution of written guidelines.

### 3. RESULTS AND DISCUSSION

This program was welcomed by the school, as this program can help solve one of the main problems at the school, namely waste. With the presence of this program, the teacher council, especially the school principal, hopes that the waste problem in the school can be resolved soon. Various methods have been implemented at the school, such as reducing the use of single-use plastic at school, especially in school canteens. However, this problem has not yet been resolved.

Prohibition of the use of single-use items in schools without any education being provided, so that students cannot directly understand the meaning of the prohibition. So, there are still many students who violate these rules and still throw rubbish inappropriately. So, we from the UNM KKN-PPL Team at SMKN 2 Maros, starting from the needs analysis and observation results, agreed to implement this program.

Approximately 32 trash bins that have been created will be distributed to 8 predetermined points. At each point there are four rubbish bins based on waste categories. Then the program was tested within one week. And then, regular monitoring will be carried out to determine the level of effectiveness of the program.



Figure 3. Trash cans ready to be distributed

The results of the implementation of waste sorting bins show a gradual increase in the effectiveness of waste sorting in the school environment. The team estimated that students were approximately 50% accurate in sorting in the first week of testing the sorting bin system at school. In the second week, students' level of accuracy in sorting increased by 25%. Comprehensive education and outreach shows that students' understanding of the waste sorting system is starting to increase and some students are starting to realize the importance of waste sorting in keeping the environment comfortable during the learning process.

In its implementation, this sorting system faces various challenges such as students' lack of consistency in sorting, regular maintenance, and student resistance to changes in habits. However, these challenges can be overcome with various solutions. such as, a daily monitoring system, implementing a fine system for students who do not throw rubbish in the places provided and do not throw rubbish based on category, regular maintenance schedules, as well as intensive and continuous education and socialization



Figure 4. Initial socialization regarding waste sorting bins by the school principal during morning assembly

#### 4. CONCLUSIONS

The implementation of a waste sorting system has proven to be effective as a basic foundation in developing a good and sustainable waste management system. The success of the system is not only based on the right system design, but also on a good supporting program. Changing habits in understanding waste management and sorting requires time and consistent effort from all components in the school. As a form of future development, it is recommended to integrate suitable technology for monitoring system development and establish a special management unit. This unit will ensure program implementation according to the vision and carry out regular standard updates. Program sustainability can be improved through strengthening various education and outreach, establishing strategic partnerships, and structured routine evaluations.

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## BIOGRAPHIES OF AUTHORS






**Dr. Hisyam Ihsan, M.Si.**    is a lecturer at Makassar State University (UNM). The author pursued a bachelor's degree in mathematics education at UNM, Makassar from 1985-1989, Subsequently, the author completed a Master's degree in Mathematics at Gadjah Mada University, Yogyakarta from 1992 to 1994. From 2002-2007, the author undertook doctoral studies at Hasanuddin University. He can be contacted at email: hisyamihsan@unm.ac.id






**Dr. Fajar Arwadi, M.Sc.**    is a lecturer at Makassar State University (UNM). The author pursued a bachelor's degree in mathematics education at UNM, Makassar from 2005 to 2009. Subsequently, the author completed a master's degree in mathematics education at Sriwijaya University, Palembang – Utrecht University, Netherlands from 2010 to 2012. From 2019 to 2023, the author undertook doctoral studies at UNM. He can be contacted at email: fajar.arwadi53@unm.ac.id






**Muhammad Ammar Naufal, M.Ed., Ph.D.**    is a lecturer at Makassar State University (UNM). The author pursued a bachelor's degree in Bilingual Mathematics Education at UNM, Makassar from 2010 to 2014. Subsequently, the author completed a master's degree in mathematics education at University of Technology Malaysia from 2015 to 2017. From 2018 to 2021, the author undertook doctoral studies at University of Technology Malaysia. He can be contacted at email: ammar.naufal@unm.ac.id






**Riswansyah**    is a German language education study program student from 2021 until now Universitas Negeri Makassar. He can be contacted at email: riswansyah@gmail.com



**Ahmad Israk**    is a German language education study program student from 2021 until now Universitas Negeri Makassar. He can be contacted at email: ahmadisrak@gmail.com



**Lutfiah**    is an accounting education study program student from 2021 until now Universitas Negeri Makassar. She can be contacted at email: lutfiah@gmail.com