Machine Learning Household Waste Disposal Behavior Related Factors

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ABSTRACT

Waste problems are now more serious and need to be managed properly urgently. The popular waste management method is 3Rs: Reduce, Reuse, and Recycle. The effective waste management needs to get every one's participation. This is a human behavior acting in response to the waste disposal. Psychology is used to explain the cause of human behavior. Nowadays machine can learn to extract knowledge from the data. This research we use machine learning to extract factors relating to waste disposal behavior in order to support effective waste management for decreasing waste problems in the society. We applied classification approach by using See5 and got the results. Then we tested the correctness of the results by observation and discourse in three communities. We found that the results are true in all five communities testing.

Key words : classification, household disposal behavior, machine learning, See5.

1. INTRODUCTION

Nowadays, the waste problems have been increasing more and more. Many places around the world have been trying to combat waste problems. The best practices in waste management is 3Rs: Reduce, reuse and recycle. Reduce using the things tending to be the waste in the future. Reuse the things tending to be the waste. Recycle the recyclable waste. All 3Rs need participation from everyone in the world, disposing behavior. The waste should be segregated. The first place that this action should take place is in the household at every time of disposing. The reusable things will be kept up to reuse again instead of disposing. Reusing things can support reducing using new things tending to be the waste. The recyclable things could be separated and stored in the special bin in order to let the recyclable provider pick them up to recycle. This action is to make it feasible to decrease the amount of waste in the society.

There are many studies finding out the factors effecting on disposing behavior in waste segregation as seen in [1] shows that the convenience for waste separation is an important factor improving household waste separation behavior. In [2] shows that the influent factors of household waste separation behavior are subjective norms, perceived behavioral control, past experience both behavior and intentions. But in [3] shows that moral obligation is an important factor effecting on household waste separation. In [4] shows that the accessibility to recycle bins has high priority to support waste separation. In [5] suggested that the local authorities should take actions to support appropriate facilities for food waste segregation in the communities. In [6] shows that household income, education, gender relating to household waste separation. It is unsafe practice in household waste segregation and seriously needed the authorities to fix the waste problem.

Machine learning is the ability of machine to learn the data to get the knowledge from the data. There are many researches done with machine learning to help human being fix real world problems such as [7-15]. Machine learning should work well in this problem too.

In this study, we use machine learning to find out the factors effecting on disposing behavior in segregation the waste in the household.

Different people have different thoughts, different beliefs, different responses, different behaviors, different life styles, different influencers, different activities, and so on. Within the same group, there are some things the same. The factors relating disposing behavior could be the same within the same group. As shown in [1-3, 16-36] that in different groups of people, the factors effecting on human behavior are different. So, we decided to study in focus group only to see how machine learning support in this area. Our focus group is SSRU undergraduate student.

Using machine learning, we need to have the data for learning. In [23, 37, 38] shows that the factors effecting on human behavior are attitude, norm, reinforcement, facilities. The details are shown in next section.

2. DATA

We collected the data by using questionnaire. We asked SSRU undergraduate students, majoring in computer science to complete our questionnaire upon their available and willing to participate. Finally, we got 188 responses.
There are 11 questions in the questionnaire as shown follow.
1. Is there any positive reinforcement in your household?
2. Is there any punishment in your household in case

you do not dispose the waste in correct bins?
3. Is it disposing the waste in correct bins your household's norm?
4. Are there many bins in your household?
5. Is it useful to yourself if you dispose the waste in correct bins in the household?
6. Is there any bad effect to yourself if you do not dispose the waste in correct bins?
7. Is disposal the waste in correct bins everyone's duty?
8. Are you disposing the waste in correct bins in the university?
9. Can you dispose the waste to the right bins if forced?
10. If being forced to separate the waste at disposal time, is there any obstacle of disposing the waste to the right bins?
11. Do you dispose the waste in correct bins in your household?

In each question, there are two answer choices: yes, no.
From the questions above turned to be the attributes as shown follow.
1. positive reinforcement from household
2. punishment from household
3. household's norm
4. many bins in household
5. useful to self
6. bad effect to self if not
7. everyone's duty
8. in the university, waste disposal to correct bins
9. can dispose to the right bins if forced
10. obstacle of disposing to the right bins
11. in household, waste disposal to correct bins
The meanings of each attribute are following
1. positive reinforcement from household = positive reinforcement like a reward in the household for disposing the waste with segregation.
2. punishment from household = punishment or negative reinforcement in the household for disposing the waste without segregation
3. household's norm = disposing the waste with segregation is the norm in the household
4. many bins in household = there are many bins in the household for waste segregation at the time of disposing the waste
5. useful to self = disposing the waste with segregation have usefulness for yourself
6. bad effect to self if not = there is bad effect to yourself If you do not segregate the waste at disposing time
7. everyone's duty = disposing the waste with segregation is everyone's duty
8. in uni., waste disposal to correct bins = in the university, you segregate and dispose the waste in correct bins
9. can dispose to the right bins if forced = If you are

forced to dispose the waste in correct bins, whether you can do.
10. obstacle of disposing to the right bins = there is any obstacle of disposing the waste in correct bins
11. in household, waste disposal to correct bins = in your household, you always segregate and dispose the waste into correct bins
The target attribute is attribute 11 which is disposing the waste in correct bins in the household.

3. METHODS AND RESULTS

In machine learning, finding out the cause effect relationship is a major work of classification approach. Machine learning used in this research is classification technique, Identification tree. Identification tree is a method to learn from the data to get identification tree which can be used to classify the data and can be used to predict the class of new data. In this research we use See5 [39, 40]. The results got from See5 and transform to be the tree which is easier to understand as shown in Figure 1.
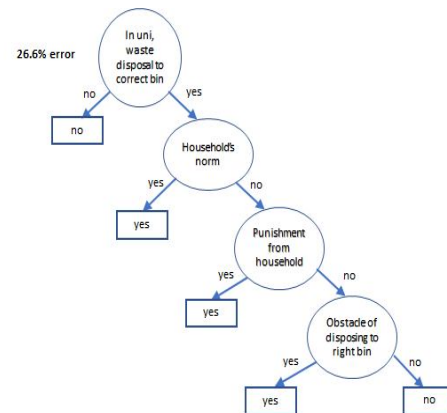

Figure 1: Results from See5, Decision tree with 26.6% error rate

From the identification tree got, we can see that there are four related factors which are disposal the waste to correct bins at the university, waste separation is the household norm, there is punishment in the household in case do not separate the waste at the time of disposal, some obstacles of waste disposing to the right bins. We can check that the people will separate the waste at disposal time or not by checking with the identification tree. If one does not separate the waste at disposing time in the university, one will not separate the waste at disposing time in the household. But if one separates the waste at disposing time in the university, and waste separation is the norm of the household, then one will separate the waste in the household. But if waste separation is not the norm in the household, and there is punishment in the household if do not separate the waste at disposing time, one will separate the waste in the household. But if there is not any punishment from the household, there will not be any obstacle

to dispose the waste to the right bin, one will not separate the waste in the household. On the hand, if there is any obstacle to dispose the waste to the right bin, one will separate the waste in the household.

From the results, we can predict that if at the university, one will not separate the waste at disposal time, in the household one will not do that either. But if waste separation is the norm in the household, one will separate the waste. If there is punishment from the household if do not separate the waste, one will separate the waste. These results make sense that waste separation at the university and the household are the same; and if being the norm of the household, one will follow the norm; and no one wants to get punishment, so follow the regulation which survive from getting punishment. But for obstacle for doing so, if yes, one will separate the waste; while if no obstacle, one will not do that. This is interesting.

4. TESTING THE CORRECTNESS

We test the correctness of the results by observation and discourse with three new communities and see the results.

Three communities tested are 1) meditation community, 2) temple's visitors, 3) undergraduate students of environmental science community.

We observe waste separation behavior of the first two groups: meditation community and temple's visitors. The waste separation norms are set up in the places and almost all in these communities did separate the waste at disposal time. For some people who do not separate the waste, there were some staff came to them and informed them to separate the waste, otherwise, there were social punishment to them by looking down from the other people in the places. These show that the norm and the punishment are the factors effecting on waste separation behavior. For obstacle, from our observation, we saw that even though some people could not find the separate bins for the separated waste, they found some staff to ask for the bin for disposing the waste in their hands. This show that obstacle there, but they still separate the waste and put the waste into the right bin. But for some people who really do not separate the waste, even though there is no obstacle to dispose the waste into the right bin, they insist no waste separation. We discourse these people directly, and got many answers. The answers we got are

They really do not want to dispose the waste into the right bin due to the security of the paper waste in their hands. They made their paper waste into small pieces and dispose some part of them into all bins in that place. They said that this action made the security in the waste paper is still kept. Some of them who do not separate the waste, do not put the waste into the right bin even though there are many waste bins in the same place, there is not obstacle for them to separate the waste. They told us the reason that they did not separate the waste because they thought that waste separation was not their own duties. It is the housekeepers, house-maid, servants. So they should not do that. So the obstacle of waste separation shows the intention of waste separation at disposal time. Even though, there is no obstacle of waste separation, they still do

not separate the waste. On other hand, if there are some waste separation obstacle, and if they intend to separate the waste, they will separate the waste.

5. DISCUSSION

The results from machine learning show that the psychological factors effecting on household disposal behavior conform to the results from literatures [41] [42] [43] [44] [45]. The self-usefulness is according to the research [45] which show the conditioning associated with behavior. Reinforcement both positive and negative have relations to human behavior as seen in [42]. Norm also relates to behavior [41]. There are also the other factors such as attitude showing as everyone's duty as seen in [44].

As we know that it is possible to have other related factors which do not exist in this data set. More data, more attributes should get more correct knowledge learned by machine learning.

6. CONCLUSION

This research we use machine learning, See5, to find out the psychological factors effecting on household disposal waste behavior. The results show that using machine learning alone giving many results which can make the users confusing and not quite make sense. Machine learning under human support can give the results more make sense and easier to be understood and used further.

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