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# Understanding the taxonomic skill of non-science major students: How the students would name and classify plants?

**Jess H. Jumawan*[1,2], Jay Torrefiel[1], Inocencio E. Buot Jr[1]**

[1] *Institute of Biological Sciences, University of The Philippines, Los Baños, College, Laguna, Philippines*

[2] *Biology Department, Caraga State University, Butuan City, Philippines*

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**Abstract**

The study is a follow up to the research conducted to the non science major college students in the University of Hawaii. The activity was performed with students from Putho Tuntungin High School, Los Baños, College, Laguna, Philippines with limited background in taxonomy. The students were given a task to name and classify selected plant samples with complete autonomy. There were 33 plant samples collected from the vicinity of the University of the Philippines, Los Baños. The whole exercise including the giving of instructions lasted for about 30 minutes. The results indicated that the term types used in the naming (27 types) and categorizing (15 types) plant samples were highly variable. The names and adjectives were the frequent term types used by the students. The monomials were preferred over the binomials indicating convenience and less exposure to binomial nomenclature in taxonomy. The name types were sourced from names of common people and entertainers for both naming and categorizing plants. The adjective types were rather variable used in both naming and categorizing plant samples. The flower was the frequent plant part used by the students in the activity. The combination of noun-adjective was largely employed in the naming of plant samples. The adjective was rather preferred in categorizing plant samples. Lastly, monomial nouns were highly preferred both in the naming and categorizing plant samples.

***Corresponding Author:** Jess H. Jumawan ✉ jehoju@gmail.com

**Introduction**

Taxonomy originated in ancient Greece and Linnaeus introduced the binomial classification nearly 250 years ago as basis of modern method we still used presently (Godfray, 2002). The science of taxonomy is dedicated to discovering, describing, naming, and identifying species and other taxa and in recent years has been subjected to many debates (Rouhan and Gaudeul, 2014; Carvalho *et al.*, 2008). Species worldwide were fast disappearing while taxonomy is suffering from shortage of expertise and declining resources. (Agnarsson and Kuntner, 2007; Smith *et al.*, 2008; Pysek *et al.*, 2013).

Significance of taxonomy is immense in the application of human development. The prevailing taxonomic system relies heavily on specialists with long training periods whose knowledge is lost upon retirement. New generations of taxonomists were needed to be trained to address the dwindling number of taxonomists (Agnarsson and Kuntner, 2007; and Rodman and Cody, 2003). Parataxonomists were also developed for species collection and identification with expert taxonomists (Basset *et al.*, 2004; and May, 2011).

Traditionally, humans name and classify organisms in a form of folk taxonomy (Berlin, 1990). The recognition of inherent order and structure in the biological world is common to human beings everywhere (Berlin, 1992). Further, we have only scratched the surface of how folk classification systems relate to our entire cognitive model world (Lampman, 2010).

Linnaean binomial nomenclature is a modification of noun and adjective combinations used in most human societies (Knapp *et al*, 2004). The Linnaean taxonomic classification arises on how we commonly name objects and functions best when the objects have levels of relationships (Stevens, 2002). A binomial nomenclature by and large consist of term types either adjective-noun or noun-adjectives and have hierarchical category levels.

Taxonomic skills develop over time through studies, researches, and trainings. The development of future taxonomists is important in resolving taxonomic impediments (Carvalho *et al.*, 2007; Godfray, 2005; Rodman and Cody, 2003). University graduates do not develop enduring understanding of subject matter nowadays (Lord and Baviskar, 2007). Outsourcing future taxonomists would come from high school students entering college courses with taxonomy related fields. How would the non-science major students name and classify plants? The present taxonomic skill of high school students is not well understood.

The study attempted to determine the pattern of naming and categorizing plants among high school students. Specifically, it aimed to determine if “noun adjective” or “adjective noun” naming systems would be common among these students.

*Materials and methods*

The procedure was adapted from Han Lau *et al.*, 2009 with modifications. It was initially conducted to college students from freshmen to seniors. The background of students was heterogeneous from various ethnicity. This activity was conducted to high school students 3$^{rd}$ year to fourth year with homogenous ethnicity background.

*Participants of the activity*

The high school students were selected because the article suggested conducting similar activity to high school students from other parts of the world. The participants were 3$^{rd}$ year and 4$^{th}$ year students from PuthoTuntungin National High School, Laguna, Philippines. There were 56 individuals from 4$^{th}$ year high school students with age of 15-16 years old. There were also 56 individuals from 3$^{rd}$ year high school students with age of 14-15 years old. There were a total of 112 students who participated in the activity.

*Selection of plant samples*

There were 33 plants selected from the vicinity of University of the Philippines-Los Banos, Laguna, Philippines (Table 1). The same plant samples were assigned to each group. All the plant materials were fresh and had replacements when samples could be damaged. The plant samples were variable in texture, size, color and shape. The samples also vary as to plant parts like leaves, flowers, fruits, and seeds.

*Procedure of the activity*

The activity was conducted in two batches. The first batch was comprising 4$^{th}$ year students while the second batch was comprised of the 3$^{rd}$ year students. Each batch was divided into seven groups with eight members in each group. The plant samples were distributed to each group and arranged in working area in a similar manner with other groups.

It was emphasized in the instruction that the activity was not a test to their familiarity and knowledge of scientific names. They were encouraged to develop their own system of naming and classifying plants according to their desires.

The groups were allowed to decide in consensus to name each plant only once. The plant names were written on a provided 4x6 index cards. Afterwards, each group was tasked to organize the plants into categories using their own classification scheme. They were allowed to decide in consensus to name each plant group being classified. The manner of classification was implemented using a standard card sorting exercise. The students were given absolute autonomy in the naming and classification of plants. The whole activity was including the giving of instructions was limited to 30 minutes. The data consolidated in the activity were entered into Microsoft Excel Spreadsheet and analyzed accordingly.

Results and discussion

There were fourteen groups participating in the activity. A total of 430 names were generated by the students based on the 33 plant samples provided. Ideally, there could have been a total of 462 expected names and this inconsistency was caused by groups that were not able to finish or not naming all the 33 plant samples.

**Table 1.** The list of plant species used in the activity to explore the understanding of naming and classifying skill in taxonomy.

| | | | |
|---|---|---|---|
| 1 | *Abelmoschusesculentus*(L.) Moench | 18 | *Ipomoeaaquatica*Forssk. |
| 2 | *Albiziasaman* F. Muell. | 19 | *Ixoracoccinea* L. |
| 3 | *Allium cepa* L. | 20 | *Jasminumsambac* (L.) Aiton |
| 4 | *Allium sativum* L. | 21 | *Lablab purpureus* (L.) Sweet |
| 5 | *Amaranthusspinosus* L. | 22 | *Solanum lycopersicum* L. |
| 6 | *Araucaria heterophylla* (Salisb.) Franco | 23 | *Mirabilis jalapa* L. |
| 7 | *Artocarpus heterophyllus* Lam. | 24 | *Nephrolepis biserrata* (Sw.) Schott |
| 8 | *Phanera purpurea* (L.) Benth. | 25 | *Paspalum conjugatum* Bergius |
| 9 | *Brassica rapa* L. | 26 | *Phaseolus vulgaris* L. |
| 10 | *Capsicum frutescens* L. | 27 | *Plumeria rubra* L. |
| 11 | *Carica papaya* L. | 28 | *Pyrrosia piloselloides* (L.) M.G. Price |
| 12 | *Celosia argentea* L. | 29 | *Schefflera odorata* (Blanco) Merr. & Rolfe |
| 13 | × *Citrofortunella microcarpa* (Bunge) Wijnands | 30 | *Spathodea campanulata* P.Beauv. |
| 14 | *Codiaeum variegatum* (L.) A.Juss. | 31 | *Tabernaemontana pandacaqui* Lam. |
| 15 | *Drynaria quercifolia* (L.) J. Sm. | 32 | *Melanthera biflora* (L.) Wild. |
| 16 | *Eleusine indica* (L.) Gaertn. | 33 | *Zea mays* L. |
| 17 | *Equisetum ramosissimum* Desf. | | |

In the classification of plants, there were 60 higher level classification categories generated by the students. These plant names and classification categories were arranged as term types. The plant samples were initially adjusted from 40 samples to 35 samples. There were two flower samples which dramatically wilted and damaged and were discarded eventually. Exactly 33 plant samples were used consistently with ample replacements when necessary. The planned 40 minute activity was adjusted to 30 minutes because the high school students have lower attention span compared to college students. It was suggested by the high school teachers based on their experience and it was implemented in this exercise. Flexibility in the use of methodology was important to reduce erroneous responses (Lahe-Deklin and Si, 2014).

**Table 2.** The term types used in naming and categorizing with their respective percentage.

| Term Types | Names (%) | Categories (%) |
|---|---|---|
| Names | 57.2 | 8.3 |
| Adjectives | 10.5 | 60 |
| Food, beverages & food plants | 5.1 | 5 |
| Descriptive | 3.7 | 18.3 |
| Animals | 3.7 | 1.7 |
| Plants | 3.5 | 1.7 |
| Tools and utensils | 3.2 | N.A. |
| Animal/ Human Parts | 3.2 | 1.7 |
| Places | 3 | 3.3 |
| Brands | 3 | 3.4 |
| Phrase | 2.8 | 8.3 |
| Unknown | 2.1 | 5 |
| Constructions, inventions & technologies/ Appliances | 1.7 | N.A. |
| Scientific terms | 1.6 | N.A. |
| Song, Movie and TV show title | 1.2 | N.A. |
| Natural inanimate objects | 1.2 | 3.4 |
| Explosives | 1.2 | N.A. |
| Actions | 0.9 | N.A. |
| Plant parts | 0.9 | 15 |
| Plant types | 0.9 | 6.7 |
| Accessories | 0.7 | N.A. |
| Toys | 0.7 | N.A. |
| Generic terms | 0.5 | N.A. |
| Events | 0.5 | N.A. |
| Decorations | 0.2 | N.A. |
| Experiences | 0.2 | N.A. |
| Religious | 0.2 | N.A. |
| Band/Groups | N.A. | 18.3 |

*The preferred term types*

The different term types used in naming and categorizing with their respective percentages was provided in Table 2. There were 27 term types and 15 categories generated. The highest term type, "names" consisted 57.2% The "name" as term type included names of people, religious figures, politicians, prominent individuals in history, athletes, entertainers (actors/actresses, singers, dancer, and other performers), and mythical, computer game, story, cartoon, comic and movie characters. The attempt to initially identify the plants must have been the reason behind giving each plant sample distinct names. The "adjectives" (10.5%) and "food, beverages & food plants" were the next two most common term types for plant names. The students used obvious descriptive features of the plant and as food, beverage and food plants. Many plant samples were fruits, vegetables and spices which were familiar to them. For the category, "adjectives" was used in 68.3%. Both the "descriptive nouns" and band/group names were used in 18.3% of the category names, making them the second most popular category term types, next to the "adjectives". Furthermore, the students were also able to come up with terms that were of unknown meanings. Terms with unknown meanings were equivalent to 2.1% for plant names and 10.0% for category names. All of the term types presented in Table 2 were easy to understand and exhibited diversity in terms of the words used by students.

**Table 3.** The number of terms used in names and categories in the activity.

| Number of Terms | Names (%) | Categories (%) |
|---|---|---|
| 1 | 72.1 | 48.3 |
| 2 | 24.8 | 38.3 |
| 3 | 2.1 | 10 |
| 4 | 0.5 | 1.7 |
| 5 | 0.5 | 1.7 |

*The preferred number of terms*

The number of terms used by the students ranged from 1 to 5 (Table 3). The monomials showed the highest number of terms consisted of 72.1% for names and 48.3% for categories. This was followed by binomial naming with 24.8% and 38.3% were employed to binomial classification. The rest of the names and categories employed polynomials consisted of 3 to 5 terms. Only a few had used 4-5 number of terms in the activity suggesting that the students does not prefer long terms in the naming and classification of plants.

**Table 4.** The different name types used in plant names and categories with their respective percentage.

| Name types | Names (%) | Categories (%) |
|---|---|---|
| Names of common people | 51.8 | 75 |
| Entertainers | 31.2 | 25 |
| Characters as mythical, computer game, cartoon, comic, movie, etc. | 8.5 | N.A |
| Politicians | 6.5 | N.A |
| Religious figures | 0.8 | N.A |
| Prominent individuals in history | 0.8 | N.A |
| Athletes | 0.4 | N.A |

The high school students were not exposed or at least have limited exposure to binomial nomenclature in taxonomy. Binomial nomenclature is usually introduced in college courses in the Philippines. However, they may have learned the binomial naming of plants elsewhere from books, television, and other sources. The convenience of assigning a monomial name was preferred by the students in this activity. The binomials as number of term types were secondarily preferred. Few have used the polynomials (3-5 numbers of terms). The used polynomials with 3-5 terms came from lyrics and titles of songs, popular phrases, and titles of soap opera in the Philippines.

*The variety of preferred name types*

It was determined that different name types were employed in the naming and classification. The results showed that the "names" generally came from names of common people 51.8% for names and 75% for categories (Table 4). This was followed by names of entertainers 31.2% for names and 25% for categories. Among the term types used, the names and adjectives were highest in the naming. Familiar names from common people were often assigned to names and categories by the students.

The other sources of these names could be influenced by popular culture such were the entertainers and mythical characters from computer games, cartoons, movies and stories. The names of politicians were also used and this can be due to political affinities of the students and the peak of campaign season for national elections when the study was conducted.

The use of names with religious affinity was also noted and this can be due to strong Christian influence in the Philippine society. For the categories, the students only used names of common people and entertainers. In an attempt to categorize the plants, they may have assigned names from common people and entertainers to simplify the categories.

**Table 5.** The different adjective types used by students in plant names and categories with their respective percentage.

| Adjective types | Names (%) | Categories (%) |
|---|---|---|
| Feeling | 26.7 | 2.8 |
| Physical condition | 17.8 | 50 |
| color | 15.6 | 8.3 |
| Quantity | 11.1 | 16.7 |
| Size | 8.9 | 8.3 |
| Location | 6.7 | 8.3 |
| Taste | 6.7 | 2.8 |
| Texture | 4.4 | N.A |
| Smell | 2.2 | N.A |
| Shape | N.A | 2.8 |

*The variety of adjective types used in plant names and categories*

The second highest term type used by the students was adjectives (Table 5). It was also determined regarding the adjective types employed in the activity. It showed that the highest adjective types in naming were feeling (26.7%), physical condition (17.8%), color (15.6%), quantity (11.1%) and size (8.9%).

In the categories, the highest adjective types were physical condition (50%), quantity (16.7%), color (8.3%), size (8.3%), and location (8.3%). It indicated that the students prefer to describe using their feelings in the process of plant naming. While physical conditions of the plants were preferred in classifying into categories.

**Table 6.** The frequency of plant parts used in plant names and categories with their respective percentage.

| Plant parts | Names (%) | Categories (%) |
|---|---|---|
| Flower | 60 | 66.7 |
| Fruit | 20 | 11.1 |
| Leaves | 20 | 22.2 |

*The plant parts frequently used in naming and categorizing*

The frequent plant part used by the students was flower with 60% in names and 66.7% in categories (Table 6). Only three plant parts were used: flower, fruit, and leaves. Other plant parts may not seem to be very popular with the students.

They have preferred flower and might have find it interesting compared to other plant parts. Many of the fruits in the plant samples were edible such were *Abelmoschusesculentus, Capsicum frutescens, Carica papaya, x Citrofortunellamicrocarpa, Lablab purpureus, Solanum lycopersicum,* and*Zea mays*. The fruits may have been very familiar and they found the flowers more interesting.

## Conclusion

The preferred term type in naming was largely "noun-djective" while it was opposite in categorizing following "adjective-noun" as preferences. The names of ordinary people and entertainers were commonly used nouns in naming and categorizing. The commonly used adjectives were related to feeling in naming and physical condition in categorizing. Monomials were favored over binomials could be due to convenience and limited exposure to binomial nomenclature being high school students. Flower parts were often associated part of the plant in naming and categorizing.

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