



## Expressing Chemistry through various art media

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**Abstract:** This paper examines the theory of Eisenkraft (2006) in expressing chemistry concepts in the forms of lines, shapes, colors or the combination of these through various art media such as crayons, moulding clays, colored pencils, neon pens and acrylic paints. Two topics (1) Properties of Matter and (2) Chemical Bonding were the focus of interpretations of 71 subjects. Each art work was evaluated through an objective categorical label coding scheme or content analysis (Miles and Hubberman 1994). Categorical labels as relevance, patterns, relationships, application, color and emotions were noted; short interviews were also conducted. The result revealed that chemistry concepts are commonly associated with daily activities and things that are frequently seen around the environment, home or community thus, method of instruction in teaching chemistry must progress on the practical application rather than concept, emphasizing real-world use of this science for higher appreciation. Artworks showed that students' minds are open that chemistry is in the surrounding hence teachers need to associate the lessons to real-life events. Participants also interpreted that the focus of teaching strategy must be on the tactile and visual methods rather than auditory as exposed in drawings of things which are mostly tactile and visual in nature. Students also expressed that purpose, function, task or role must be introduced prior to concepts' description, category or classification. Students associate reactions of elements/compounds to human characters such as cooperation, support, teamwork, collaboration, working together, finding groups and even finding partners. The paper suggests that today is the time to operationally use the term chemistry as "central science" as it covers not only the matter itself, but what is within the matter that really matters. The artworks highlighted that chemistry must be taught not only as a study of matter but of human life, human connections and emotions.

**Key Words:** Chemistry Arts; Chemistry Teaching; Fun Chemistry; Content Analysis

### 1. INTRODUCTION

"Art is the result of the human need to express himself. It tells stories of societies, eras, and individuals. It can toil and create a work of art that represents a human being and/or the person's time using appropriate artistic techniques. A human being

can also create a museum display that includes a demonstration of techniques which involved original artwork, and a museum placard that can explain the chemistry involved (Eisenkraft, 2003).

However, chemistry is known to be one of the most dreaded subjects in high school as well as in the

tertiary level. Apart from the numerical component of this science, the aspect of being abstract and high on memory work is one of the most distinguished characteristics of this subject (Yalcinkaya, 2012).

The objective of this study therefore is to explore the idea that chemistry concepts can be expressed in the form of lines, shapes, color or the combination of these (Eisenkraft, 2006).

This study aims to bring about ideas from the student participants regarding the topics (1) Properties of Matter and (2) Chemical Bonding, on the other hand, it was noted that chemistry conveys anxiety to students (Eddy, 2003 In Kurbanoglu 2010); this research also explored the potential of art activities to lessen or eliminate such anxieties.

In addition, it has also been observed that many students fear chemistry activities and such fear are characterized by disappointment among the students towards the subject (Jegade, 2007), parallel with this, the study considered the fears that might manifest in the participants' outputs.

According to Keeves and Morgenstern, (1992), students' anxiety towards the learning of chemistry and chemistry activities makes students lose interest in chemistry, to address this anxiety, this study allowed the students to choose between the two topics and the medium of art that will be utilized to create an illustration which expresses the student's ideas about the subject. The students were also allowed to work in groups.

## 2. METHODOLOGY

Each art work was evaluated through an objective categorical label coding scheme or content analysis (Miles and Hubberman 1994). Categorical labels as relevance, patterns, relationships, application, color and emotions were noted. Short interviews were randomly conducted to quote for the meaning, reasons and explanations of the artworks.

Seventy-one senior students from Bataan Peninsula State University were randomly selected with two topics under study (1) Properties of Matter and (2) Chemical Bonding.

Prior to data gathering, students were given a 40-minute review on the two topics. After a 15-minute break, the students were told that an art work activity will be conducted. Students were provided with bond papers, crayons, molding clays,

colored pencils, neon pens, paint brushes and acrylic paints to express anything about the lesson.

Participants freely select between the two topics and were also given liberty to work alone, with pair or as a group with maximum number of four members.

## 3. RESULTS AND DISCUSSION

### Distribution between Properties of Matter and Chemical Bonding

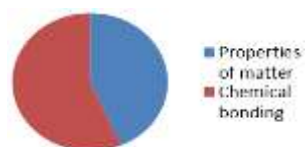


Figure 1. In 23 outputs, 10 artworks focused properties of matter and 13 on chemical bonding.

On properties of matter, only one student worked alone, two by pair, four groups with three members and three of four members. On chemical bonding, no student worked alone; three by pair, four groups with three members and six groups of four members.

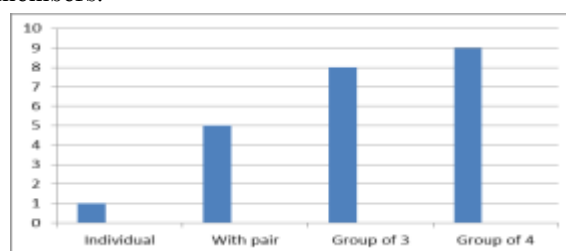


Figure 2. A total of 71 students participated in the study, only one opted to work alone; five outputs were made by pair, eight groups worked with three members while nine groups were composed of four members.

Because students were given liberty to express everything or anything about the two topics the following schemas are noted:

Table 1. Concepts on properties of matter

Hard	4
Soft	4
High Temperature	8

Low Temperature	2
Conductivity	5
Shiny	6
Dull	2
Malleability/ductility	5
Sonorous	1

Student expressed ideas on properties of matter by drawing things in the community like concrete church or house walls to describe hardness, sun or fire for high temperature, electrical post to conductivity, gold for metal as shiny, a broken heart to express brittleness, guitar string and clothesline were also drawn to describe ductility and flat sheets of roof for malleability.

Table 2. Five human senses

Touch	10
Sight	8
Hearing	1
Smell	0
Taste	0

Categorical label related to five human senses were also depicted from students' artworks. The sense of touch (tactile) and sense of sight (visual) manifested more in the artworks than the senses of hearing, smell and taste.

Table 3. Various representations

Sun	6
Gold	5
Fire	4
House	4
Man/Woman	3
Heart	3
Moon	1
Rain	1

Students' artworks depicts that temperature is associated with the sun. Most students drawn that the ultimate source of heat and light in the world is the sun while fire is another source. It is also noticeable that the 'shiny' property of metal is often associated with gold.

The drawings of house or house parts were also used to express other properties of matter such as hardness, malleability and reflection of light.

Heart was also used to represent hardness and brittleness, as if it is really breakable or unbreakable. These representations mostly focused on entities that students commonly see every day.

Table 4. Human emotions

Happiness	4
Love	4
Sadness	2

Most of the students' outputs were also associated with human feelings. Students drew red heart, smiling faces of man and woman or couple to represent happiness or love.



Figure 3. Illustrations of properties of matter depicting emotions

It is an important detail that no student included a sad face in the artworks which implies that students, while working on the activity did not feel fear, sadness, or anxiety.

Table 5. Associated with gender

Man and woman together	2
Man or woman alone	1
No gender (neutral)	8

The artworks on the properties of matter also showed that many students perceived matter as neutral entity but when it is associated with humans, two genders has to be presented--male and female.

One artwork showed dominance of male character wherein the student represent human as a man playing guitar.

Table 6. Color dominance

Yellow-orange-red	8
Shades of green	0

Shades of blue	1
Brown	1
Black	0

Most students opted to use colors like yellow, orange, yellow-orange, red and pink even when other colors were also provided for use.

The artworks were brightly expressed through vibrant combinations of hues which can also be associated with the emotions of the students while doing the activity. Vibrant hues are often linked with emotions such enjoyment, delight, merriment and cheerfulness.

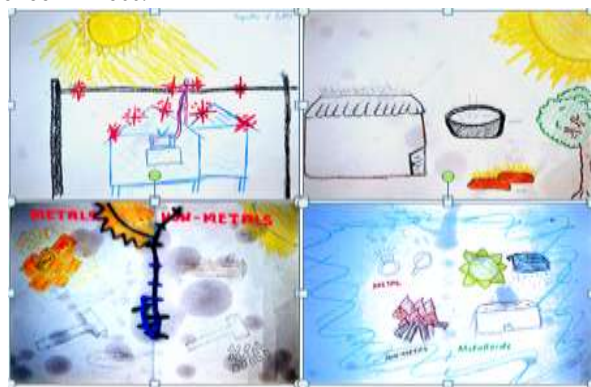


Figure 4. Depicting properties of matter

Students often associate the 'shiny' property of metal to gold. This set of illustration show shining gold bars and golden ring as representation of this property. In the same set of artworks, it is noticeable that the sun is referred to as ultimate source of heat and light energy.

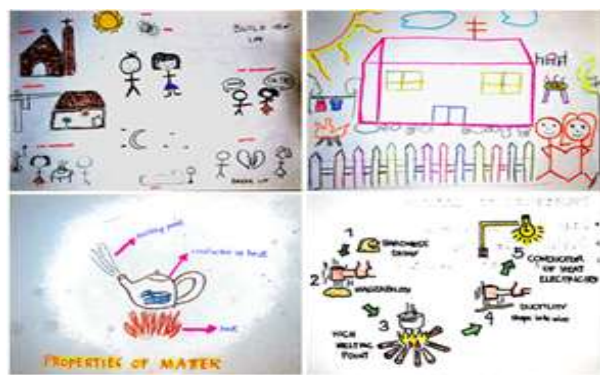


Figure 5. Illustrations of properties of matter represented in daily activities

Students presented ideas on properties of matter by drawing common activities in their lives such as cooking, having coffee and sleeping. Familiar objects and structures were also used to characterize other property and this includes houses, church, table, kettle, hammer, ring, bulb and clothesline. In this set of artworks, students also included humans as main character.

Table 7. Concepts on chemical bonding

Bonding (unidentified)	9
Compounds	8
Elements	7
Covalent bond	6
Ionic bond	6
Alloys	3

Students identified the concepts on chemical bonding by examples such as NaCl, H<sub>2</sub>O, CH<sub>4</sub>, CO and CO<sub>2</sub>. Symbols of elements as He, H, O<sub>3</sub> and O<sub>2</sub> were also drawn.



Figure 6. Chemical bonding illustrated in common structures and things

The understanding of chemical bonding represented in artworks for this group are more complex than in properties of matter. Participants depicts chemical bonding as something that works together and not enclosed in idea of ionic and covalent alone, but in partnership. Students drew the purpose and task of each part to accomplish common good for entire unit. The purpose, function, task or role comes first before the description, category or classification.

Participants also illustrated familiar objects like house, buildings, bridges, cars, bulbs, sun, trees, roads and human body. The addition sign is the symbol which most students drew to represent bonding activity between elements.

Table 8. Using various representations

Human activity	10
Structures (Building, House, Bridge)	8
Human/Man/Woman / Body parts	6
Solutions/ Molecules (circles)	5
Bulb/ Sun	3
Car/Tire	3



Figure 7. Human activity illustrated in students' artworks

Human activity topped the list on chemical bonding. Working together, playing, cooking, driving, nail polishing, hair dyeing and cleaning were associated with chemical bonding, thus in common household activities students can relate the reactions of elements.

Common infrastructures were also present in eight of the thirteen artworks such as buildings, houses, bridges and roads. The students perceived chemical bonding working around the community, something that can be useful.

Human, either a representation of man or a woman, are also in the artworks. This group perceived chemical bonding as something that involves people. Circles, on the other hand, are the shape often associated with molecules, compounds or elements before and after the bonding process.

Similar with the properties of matter, participants associate heat to the ultimate source of energy which is the sun. Cycles are also drawn, which mean that students see chemical bonding as an important factor in the continuing cycle of life.

Table 9. Associated with human character

Working together	10
Happiness	5
Dispute	2

Specific human characters were observed in this group like cooperation, teamwork, support, coordination or helping each other to achieve a common goal.



Figure 8. Chemical bonding illustrated as human-like behavior such as cooperation and teamwork

A hand with five fingers was painted in acrylic to represent various tasks of elements. The student told that like fingers with various functions, elements work together in different purposes to achieve good status in life, that when one finger is gone others cannot perform the task specifically made for it. The student said that *even if the fingers are not of the same size, for example thumb is smaller than the pointing finger, middle finger or ring finger; its work is as important as the others.*

Another student told that *"life is sometimes bright or happy and sometimes it is dull but combining is important because new things can be produced out of these combinations."*

All artworks with faces or human-like faces depicted smiles. In one clay-molded output, students told that working together, like elements, brings happiness which the students' represented through the five circles (balloons) with happy faces.



Figure 9. Chemical bonding illustrated in human-like scenario

Illustrations also represented policies or rules. One student's painting in acrylic wrote that elements follow rules too; together with the numbers under the word RULES. *"Humans like elements obey rules when they combine and do not just move whenever they like, this is similar to people because people don't do everything they want since there are certain limitations on the things that we can do."*

Table 10. Associated with gender

No gender (neutral)	10
Man or woman alone	3
Man and woman together	0

In chemical bonding most students' artworks drew no gender identity and man or woman having no partners. This can be associated with a distinct idea that elements, compounds or molecules cannot be associated with specific characters of a male or a female.

Table 11. Color dominance

Shades of blue	10
Yellow-orange-red	5
Shades of green	3
Brown	1
Black	0

Most students of this group opted to use colors like blue, yellow, orange, red and green, even when other colors were also provided for use.

## 4. CONCLUSIONS

The result of this study revealed that chemistry concepts are commonly associated with

daily activities and things that are frequently seen around the environment, home or community.

This further showed that the method of instruction in teaching chemistry must progress on the practical application rather than the concept. Teachers must seek for ways on how to highlight the real-world use of chemistry in students' lives so that the context can be appreciated.

Moreover, the teacher needs to associate the content to actual events in students' lives. If possible, the teacher has to elicit basic examples of daily activities where lessons can be applied.

Students' artworks expressed that the strategies in teaching chemistry must focus on the tactile and visual methods rather than auditory method because the representations and schemas used are mostly tactile and visual in nature.

Students expressed the functionality of chemistry concepts by drawing purpose, function, task or role of the properties of matter.

If given liberty students opt to work in groups. This further showed that when students are allowed to freely work with a friend, lesser pressure is observed. Leadership and fellowship was also seen in students who worked in groups with three to four members.

Another message that this study suggests is that students are not exactly afraid of chemistry or chemistry activities. Students can perceive chemistry as enjoyable, fun, happy, delightful, amusing and even easy subject if only proper techniques are used convey the fundamental ideas involving this science. Processing the information is what the students perceive as difficult and frightening. The study resulted to positive emotions from the student participants thus opposing the common notion about chemistry as a problematic and fear-provoking subject.

Lastly, chemistry must be taught not only as a study of matter, the changes it undergoes and the energy that accompanies these changes but chemistry must be about human life, human connections and emotions.

Students are fond of relating human characters with non-living matter like elements, metals and molecules. Students associate reactions of these entities to human nature such as cooperation, support, teamwork, collaboration, working together, finding groups and even finding partners. Perhaps it is the time to operationally use the term chemistry as "central science" for it will cover not only the matter itself, but what is within the matter that really matters.

## 5. ACKNOWLEDGMENTS



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