PEOPLE: International Journal of Social Sciences
ISSN 2454-5899

Heiba, et al.

Volume 5 Issue 3, pp. 51-61

Date of Publication: 19th November 2019

DOI: https://dx.doi.org/10.20319/pijss.2019.53.5161

This paper can be cited as: Heiba, E., Al- Yahyai, F., Mansour, H., & Al- Amri, M. (2019). The Use of Physical Phenomenon as an Innovative Source in Art Education. PEOPLE: International Journal of Social Sciences, 5(3), 51-61.

THE USE OF PHYSICAL PHENOMENON AS AN INNOVATIVE SOURCE IN ART EDUCATION

Eslam Heiba
Faculty of Education, Sultan Qaboos University, Muscat, Oman
Faculty of Specific Education, Menufia University, Egypt
eslam@squ.edu.om

Fakhriya Al- Yahyai
Faculty of Education, Sultan Qaboos University, Muscat, Oman
fakhriya@squ.edu.om

Heba Mansour
Faculty of Education, Sultan Qaboos University, Muscat, Oman
Faculty of Applied Arts, Helwan University, Egypt
hebamansour@squ.edu.om

Mohammed Al- Amri
Faculty of Education, Sultan Qaboos University, Muscat, Oman
mhalamri@squ.edu.om

Abstract

It is undoubtable that there is a reciprocity relationship between the different sciences and fields of knowledge. The relation between art and science is one that extends ancient times since both of them use search and experimentation methods in pursuit of reaching the best results and satisfactory solutions which makes them in continuous development. Likewise, Art education draws its references and aesthetic values from all that is found neoteric whether it is in nature,

heritage or other sciences. The idea of integration between art and science prompts on finding innovative ways towards creativity, because whenever the sources behind the design were of a scientific nature, the higher the visual connotations are closer to perception and mental receptivity. Hence, researchers are trying to create new experimental approaches through the study and analysis of some physical phenomena, such as energy, frequency and vibration, which produces precise and perfect artistic forms in harmonious rhythms and in accordance with formalized geometric and mathematical relations of scientific origin that can be used by art students to create innovative design works as intellectual starting points, can be consulted and relied on as technical references, with a formal logic, and mental legitimation, which contributes to the enrichment of the aesthetic values of the art work. So, this study aims to take advantage of some physical phenomena such as energy and frequency and vibration and its formal output as an innovative source in teaching arts.

Keywords

Physical Phenomena, Formal Regulation, Surface Values, Art Education

1. Introduction

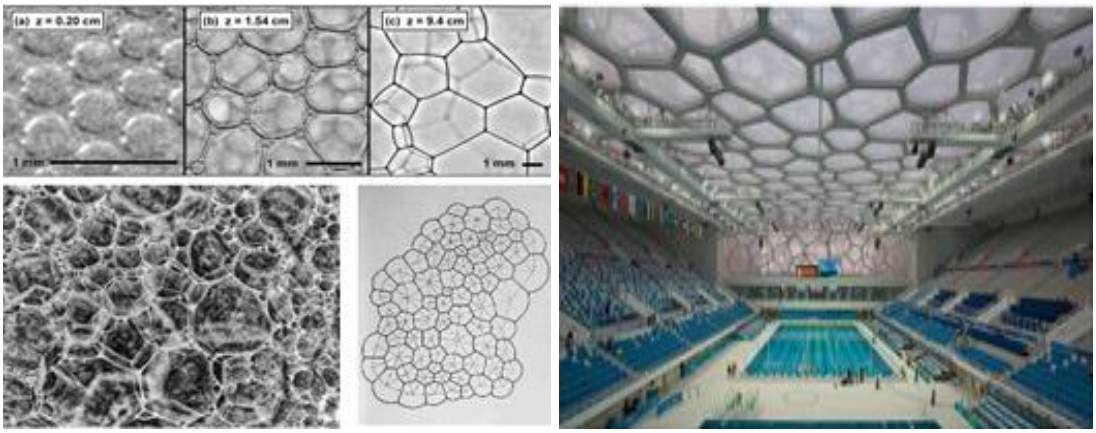
There are different views and attitudes of intellectual upon the relationship between science and art. Both are fields of knowledge interesting in experimentation with continuous search and research. Also, they are always in the case of discovery and development. This relationship raises a most important question about how science meets with art, what are the benefits and how that Art-science relationship can be achieved (Born & Barry, 2010; Gewin, 2013; Nora, 2015).

In the fifteenth century, Leonardo da Vinci (1452-1519)– the Anatomical Artist, was not only a painter, but also one of the pioneers in many fields of science, where his models and art works reflect clearly his scientific experience in both anatomy and/or perspective (Subramnian, 2008; Walter, 2017). Isaac Newton (1642-1727), formulated the movement and the law of general attraction, which were dominated the vision upon the physical universe that was reflected with varied terms in plastic art such as "Gravity" "tensile tension" and "floating area (Cynthia,2005; Subramanian, 2008).

In addition, there are many physical phenomena that can play an important inspiration role in art. One of these phenomena is “Surface tension” which can be explained in terms of molecular forces (Temperley & Trevena, 1978), where the molecules within a fluid (liquid or gas) move

continuously with a chaotic motion and interact with the neighbouring molecules in all directions. For example; the Surface Tension and Soap Bubbles which is always very attractive, as the soap films deposited upon thin frames with different geometrical shapes that represent a simple way to teach the surfaces of minimal area for given boundary conditions depending on the type of liquid and temperature to produce discriminatory shapes and forms (Gambi & Straulino, 2010).

From the artistic point of view as shown in Fig. 1A; the soap bubbles resulted from the surface tension in a complex geometrical grid, helped in inspiring the design of the National The National Aquatics Centre in Beijing (Richard & Susan, 2009). The repeating units were boundlessly bounded in a three-dimensional space and were then rotated and cut around the axes to form the final geometrical construction as shown in Fig.1B. That example demonstrates the relationship between art and science, thus the structural system of soap bubbles has led to an important artistic functional building in a contemporary manner.



A **B**

Figure 1: ***A****- Geometrical Structure of Soap Bubbles in Binary and Tertiary Dimensional Form, and* ***B****- The National Aquatics Centre in Beijing-China*

Another point of view was shown in Fig.2 that illustrated the artwork "Nude Descending a Staircase No. 2" of the French artist Marcel Duchamp (1887-1968), in which he attempted to reflect and slow down the time through the reflexive view of the body while moving away from the realistic mental image, i.e., the metaphysical solution of Pataphysics.

The constant stages of the moving thing, resulting in the so-called virtual image, which has become the expression of the tools of modern technology an important means to emphasize the theory of art and image and animations as evidenced by the similarity between this movement in the work of Duchamp and the experiment of the French scientist; Etienne-Jules (1830-1904) on

recording the movement and time as shown in Figure 3. (Oliver, 2003; Jean & Alex, 2004; Andrea, 2018).

Figure 2: *Nude Descending a Staircase No. 2*

Figure 3: *Man Walking- 1882 by Etienne*

Recently, Art-science has been used as a comprehensive term to describe the logical use to achieve artistic creativity based on scientific intellectual methodology. This type of art has given rise to an echo in a growing number of museums and galleries that define themselves as performing a form of art (Subramanian, 2008; Oliver, 2003).

This relationship between the two fields requires a great deal of contemplative thought, whether through the apparent or the abstract systems. The concept of contemplative thinking refers to the mental activity which is reflected through the skills of optical vision, as thinking here is a kind of research and discovery to obtain logical results based on standardized inputs (Andrea, 2018)

The artist community speaks of the desire to depict the science in a language that also speaks to our humanity (Francesca, 2016). It was denoted that the teams of artist and scientist push technology in creative new directions, especially when interact with computers that can impact many domains across science, engineering, and medicine…etc. (Coffey, et.al, 2012)

Faculty of Fine Arts and Engineering in Colorado during Spring 2003 conducted a workshop for the students of photography about the physics of fluids and the relationship between science and arts. Some experiments were taken place to determine the optical image with variable central light values resulted from the circular motion of water with some elements such as fluorescence followed by exposure to ultraviolet radiation as shown in Figure 4, or the optical

image of the linear chains resulting from the turbulent flow of air generated by the box fan as shown in Figure 5, as well as the visual representation of the flow of soap liquid through the sunlight and the resulted color interference and values as shown in Figure 6. (Hertzberg and Sweetman, 2004, 2005)

Figure 4: *Optical Image with Egg Beater in a Circular Cylinder, a Florescent Maker was added from above and exited by UV*

Figure 5: *Optical Image Resulted from the Flow of Air Generated by the Box Fan*

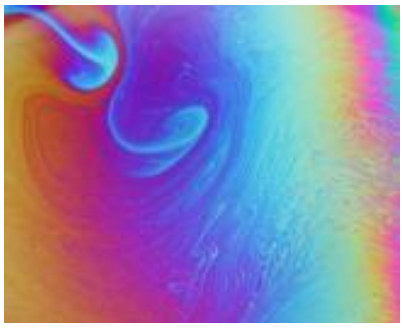


Figure 6: *Optical Image of the Draining of Soap Film, Illuminated by Diffuse Sunlight*

The collaborations between artists and scientists can be presented in many forms that produce a wide range of outcomes which are mostly communicated on an emotional as well as intellectual level. Unexpectedly, there are collaborations that are moving the arts as well as the sciences into new directions, opening new fields of artistic practice and changing the direction of visualization science and the science behind the data (Francesca, 2016). From this point of view, this research study aims to take advantage of some physical phenomena such as energy frequency and vibration, and its formal output as an innovative source in teaching arts.

2. Methodology

The research follows the analytical descriptive method and the experimental method. It was depended on the scientific experiment of the German physicist Ernst Chladni as shown in Figure 7 (Meera, 2018) to create unconventional forms and models for constructing artworks.

The effect of different vibrations under the different frequencies on the distribution of sand grains on the metal surface (Chladni plates) were studied. The resulted different models and forms from these vibrations were analyzed, and the visual image at a specific frequency that presents certain artistic values was determined. The linear approximation for the structure details were

illustrated to create new visual formats, then repeated in quadratic form to deduce the innovative optical systems.

Figure 7: *Ernst Chladni Experiment on the Vibrations of Sound, and the Effect of the Different Frequencies of the Mechanical Vibrator (Tuan, 2015)*

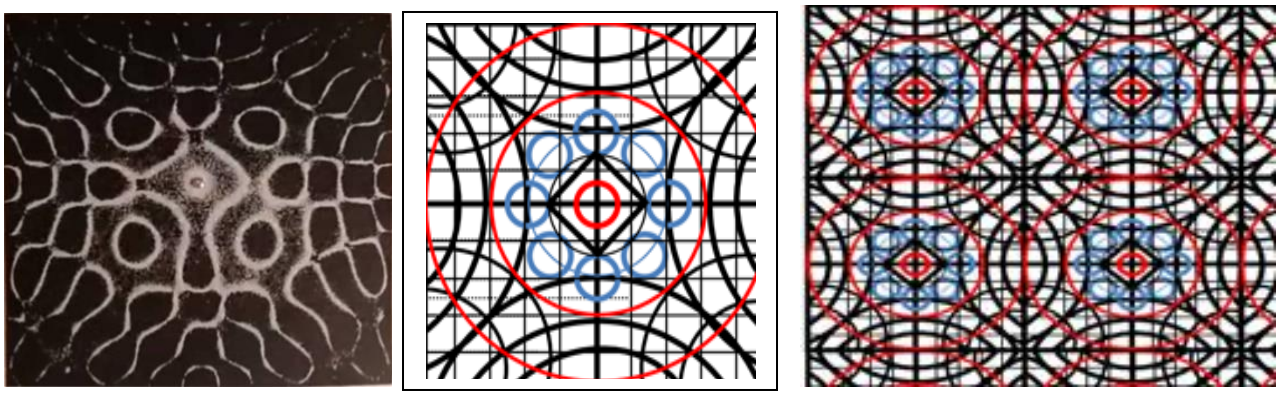
So, this experiment provided a means to portray the effects of vibrations on mechanical surfaces; to conclude innovative visual forms with new intellectual principles through which art students can be benefited from this study in the production of innovative artworks while applying the aesthetic principles in art and design such as unity with diversity, balance, mathematical relations and proportionality between elements….etc.(Richard, 2018)

3. Results and Discussion

The samples of art works were analyzed. The surface formulations were described, the color scheme was clarified. The concerned concept of formalism based on the description, organization, the relationship between form and space and the arrangement of the elements was determined. These were carried on according to the following criteria to construct the aesthetic visual meaning according to the elements and principles of design (Mark & Thomas, 2012; Wucius, 1993; Richard, 2018).

As shown in Figure 8; (A) represents the resulting shape from the aggregation of sand grains on a square board at a frequency (6051 Hz), (B) illustrates the linear approximation of the visual form of the structural shape and the characteristic of system organization which depends on the central formality distribution unit formed by different diameters and dimensions and (C)illustrates the repetition of form in (a) of the resulting optical body at frequency (Hz 6051) where the unit was repeated vertically and horizontally in a quadrilateral form to produce new visual formulations and compositions with a morphological diversity and linear rhythmic symmetrical balance forming a unity with a variety of elements. The total and partial gradations confirmed the

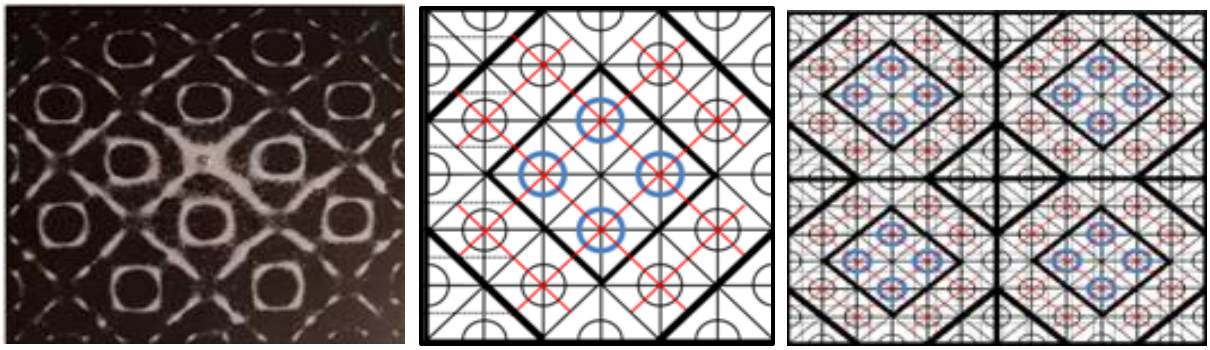
equilibrium. The symmetrical replication resulted in the creation of new forms with different visual parameters that resulted from the richness of the composition, as well as the linear intersections between the parts of the unit that achieved the formality.



A **B** **C**

Figure 8: ***A****- The Resulted Shape from the Aggregation of Sand Grains on a Square Board at a Frequency (6051 Hz).* ***B****- The Linear Approximation and the Central Formality Distribution Unit Formed by Different Diameters and Dimensions and* ***C****- The Repetition of Form in (a) of the Resulting Optical Form at Frequency (Hz 6051)*

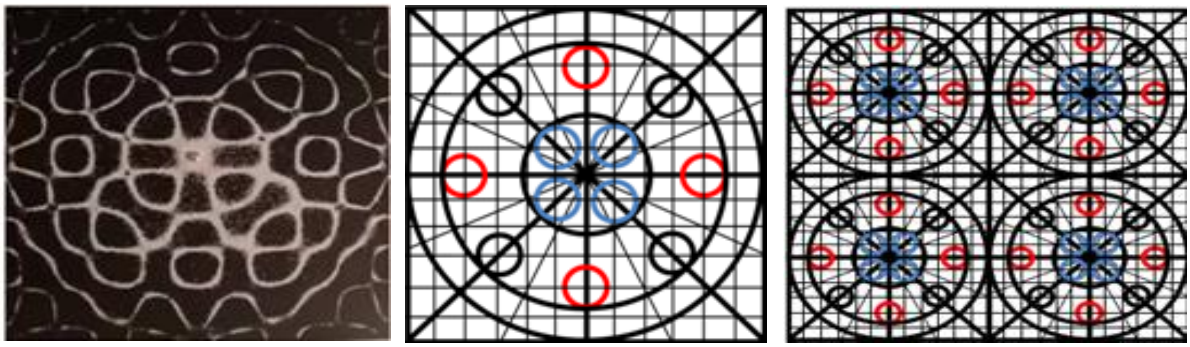
As shown in Figure 9, (A) represents the resulted shape from the accumulation of sand grains on Chladni plates at the frequency (Hz 5284). (B) illustrates the linear simplification in accordance with the construction of the regular geometrical forms between all the diagonals and the vertical and horizontal axes on the surface , and (C) represents the formal repetition of the resulting visual form at a frequency (Hz 5284) in a regular geometrical grid distribution in a set of concentric circles, producing equal symmetrical squares. These repetitions form a movement in different directions



A **B** **C**

Figure 9: ***A****- The Resulted Shape from the Accumulation of Sand Grains on Chladni Plates at the Frequency (Hz 5284).* ***B:*** *Illustrates the Linear Simplification in accordance with the Construction of the Regular Geometrical Forms between all the Diagonals and the Vertical and Horizontal Axes on the Surface.* ***C****: The Formal Repetition of the Resulting Optical Body at a Frequency (Hz 5284)*

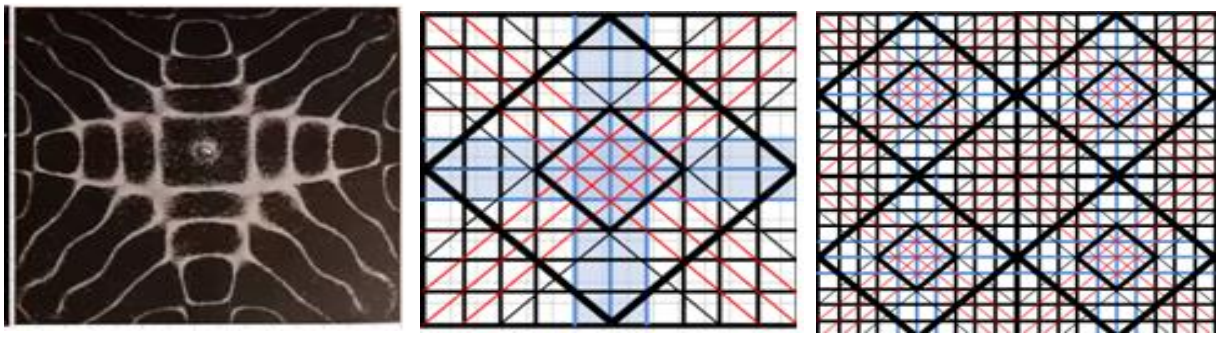
As shown in Figure 10; (A): represents the resulted aggregated sand grains on a square plate at frequency (Hz 5907). B illustrates the simplified abstracted lines according to the repletion of the radiant form of the circle in the direction of the outer ribs of square grid, and C- that represents the design of circular lines in radiating forms from the centre and directed towards the outer sides in a linear expansion in the form of a circle whose diagonals divide the perimeter of the circle into equal parts.



A **B** **C**

Figure 10: ***A****- The Resulted Aggregated Sand Grains on a Square Plate at Frequency (Hz 5907).* ***B:*** *Illustrates the Simplified Abstracted Lines according to the Repletion of the Radiant Form of the Circle.* ***C****: The Design of Circular Lines in Radiating Forms*

As shown in Figure 11: (A) represents the resulted shapes from the accumulation of sand grains on Chladni plates at the frequency (Hz 3835), (B): illustrates the produced simplified lines from (A). Figure 11 (C) illustrates the new visual formula based on square at the canter with rhythmic repetitions, confirming the movement, continuity and symmetrical formality



A B C

Figure 11: ***A:*** *The Resulted Shapes from the Sand Grains on a Square Board at the Frequency (Hz 3835.* ***B:*** *Illustrates the Simplified Lines that Occurred From (A).* ***C****: The Visual Structure of the Resulted Forms of a Central Formality Distribution unit based on Circles of different Diameters and Dimensions*

4. Conclusion

Various scientific fields are rich in many sources to enrich the drafting and construction of the art work. It is clear from this study that there are several elements which are common in physics and art and have the same cognitive connotations but differ in the process of aesthetic recruitment. The common factor between these elements has an important role in presenting the close relationship between art and science as both are a face of the concept of creativity. It is concluded that the search in the sources of the scientific field can create aesthetic backgrounds that might help the Arts' students to find innovative solutions in arts and design. So, the teachers and students have to pay attention to the results of the scientific studies that benefit the field of Arts by acting as intellectual references for art students.

References

Andrea, A. (2018). Modern Functional Evaluation Methods for Muscle Strength and Gait Analysis, (pp6-7). Springer publishing.

Born, G., Barry, A. (2010). Art Science. Journal of Cultural Economy, 3, 103-119. https://doi.org/10.1080/17530351003617610

Coffey, D., Korsakov, F., Hagh-Shenas,H., Thorson,L. Ellingson, A. Nuckley, D. Keefe, D. (2012). Visualizing Motion Data in Virtual Reality: Understanding the Roles of Animation, Interaction, and Static Presentation. Computer Graphics Forum, 31, 1215–1224.

Cynthia, S. B. (2005). Isaac Newton Physics, Gravity & Laws of Motion, (pp 6-7) Oxford University Press.

Francesca, S. (2013). Art- Science- Visualization Collaborations; Examining the Spectrum. https://visap.uic.edu/2013/papers/Samsel_ExaminingTheSpectrum.pdf

Gambi, C. M., & Straulino, S. (2010). Surface Tension and Soap Bubbles. http://hep.fi.infn.it/ol/samuele/didactics/tfa/surface_tension.pdf

Geon, H. B . (2017). Leonardo da Vinci by Walter Isaacson. New York: Simon & Schuster; 2017, BOOK REVIEW, (pp1-3), Korean Academy of Child and Adolescent Psychiatry publishing.

Gewin, V. (2013). Interdisciplinarity: Artistic merit. Nature, 496, 537-539. https://doi.org/10.1038/nj7446-537a https://doi.org/10.1111/j.1467-8659.2012.03114.x

Jean, H., Alex, S. (2004). A Course in Flow Visualization: The Art and Physics of Fluid Flow. Proceedings of American Society for Engineering Education Annual Conference & Exposition. Copyright © 2004, American Society for Engineering

Mark, A., T., Poppy, E. (2012). Exploring the Elements of Design, Cengage Learning, Third Edition, (p 18). Cengage Learning Publishing

Meera, R. (2018). A Study to Explore the Effects of Sound Vibrations on Consciousness. International Journal of Social Work and Human Services Practice, 6, 75-88. DOI: 10.13189/ijrh.2018.060302

Noël, C. (1999). Philosophy of Art. First published, (p108). Rutledge publishing

Nora, S.V. (2015). On Cultures and Art-science. Nordic Journal of Science and Technology Studies, l3, 3-11. doi.org/10.5324/njsts.v3i1.2152

Oliver, G. (2003). Virtual Art from Illusion to Immersion, (pp3-4). The MIT publishing.

Richard, L., Susan, L. (2009). The power of Art. Second Edition, (p408). Thomson Learning publishing.

Subramanian, N. (2008). Olympic Structures of China. NBM&CW. 246-264. http://www.thestructuralengineer.info/library/OlympicStructures08.pdf

Temperley H. V. & Trevena D. H. (1978). Liquids and their Properties; a molecular and macroscopic treatise with applications. Physics Bulletin, 30,309.

https://iopscience.iop.org/article/10.1088/0031-9112/30/7/029/pdf
https://doi.org/10.1088/0031-9112/30/7/029

Tuan,P.H., Wen, C.P., Chiang, P.Y., YuH, Y.T., Liangk, C., Huang,F., ChenKML, F. (2015). Exploring the resonant vibration of thin plates: Reconstruction of Chladni patterns and determination of resonant wave numbers. The Journal of the Acoustical Society of America, 137, 2113-2123. https://doi.org/10.1121/1.4916704

Wence, X. (2010). Chladni Pattern: Basic studies in Natural Sciences, (pp 1-56), RUC publishing. https://core.ac.uk/download/pdf/12517675.pdf

Wucius, W. (1993) Principles of Form and Design, (pp 41-50), John Wiley & Sons publishing