122. Communicating Science via Art Installations

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Abstract. Science is part of our everyday lives, and so is art. Particularly, art installations require an active presence; thereby they contribute to the raise of awareness, promote understanding, and generate an emotional response. This project seeks to explore the connection between art installations and science communication through experiential learning. The sample for this study consisted on two groups of participants. One was exposed to a list of scientific facts, the second one contributed in the creation of an art installation. The results as a whole, suggest that art installations does aide in long term fact retention. Therefore, the creation of art installations can be considered an interesting media to convey science in an attractive, reliable, and memorable way.

Keywords: AEIOU, Art installation, Experiential learning, RIRC method

Introduction

Science is one of the disciplines that is constantly struggling to achieve a better diffusion of its knowledge. We are conscious of the difficulty encountered in achieving the above goal. It is because of this that sometimes, the public becomes discouraged in its attempt to penetrate the scientific world and erroneously avoids the topics that are of great significance to the evolution and development of the world. In light of this, how can we foster an interest in scientific knowledge? How can we construct a bridge between science and society in general? How can scientific knowledge be part of our culture and daily experience?

It is important to mention that in recent years, education has become a multidirectional, inter-disciplinary process, in which different subjects try to give an explanation of the world that surrounds us. Science is no exception; discovering common elements with other disciplines will facilitate the communication of scientific knowledge and values in a way that is easy assimilated.

With the goal of bridging the gap between science and public, the following investigation rests on two fundamental axes: experiential learning and artistic “installation.”

Experiential learning

Experiential learning alludes to one of the most important methods of knowledge acquisition, in which sensory experience, imagination, and long-term memory construction play a pivotal role. If we recall Aristotle, the first experience revolves around the senses. Later on, a process of repetition and abstraction of ideas is carried out, in which once having interacted with the images that are created by the imagination, sensory experience becomes intelligible to create knowledge. One of the advantages of experiential learning is that it achieves not only short-term, but long-term knowledge acquisition.

The cognitive process involves making connections, exploring patterns and capturing the big picture with all of its details. One of the elements that help the memory retain information is the mnemonic system. This refers to the process of the mental association of ideas; it involves schemes, systematic exercises, and repetitions in order to facilitate the process of memorization. (O’Brian 2000) The mnemotic system also uses visual aid to establish associations easy to be remembered. We often discover that mental images last longer than facts. The capacity of the human mind to remember images is generally larger than that of remembering words. The imagination is the way of mentally representing a sensation, and the memory is the way of retaining it. As Einstein once said, “Visual images are the antechamber of words.”

The psychologist Carl Rogers distinguishes learning in two different types: the cognitive (insignificant) and the experiential (significant). The first corresponds to academic knowledge such as the learning of Spelling lists or multiplication tables. The second refers to applied knowledge: such as learning about motors in order to repair an automobile. The key to the distinction is that experiential learning takes into account the needs and desires of the public.

According to Rogers, learning is simplified when the student completely participates in the process, has control

of, and can direct, his or her learning. It is important that the participant confronts the information with social or personal experiences. Finally, self-evaluation will be the principal method to obtain successful results. Rogers emphasizes the importance of always being open to change in order to update and generate new knowledge. (Rogers 1969)

Art installations

Art, specifically postmodern contemporary art, is starting to take force as a learning tool in education institutions. The ways in which it is applied are different; nevertheless, there exists a pronounced line that consists in involving feelings, emotions, creativity, and knowledge in only one process in order to reinforce cognitive learning. (B. 2006) Art motivates the student to learn and helps him or her to develop higher-order thinking skills. (O'Farrell 1994) Art is valuable since it encourages different forms of human intelligence; it can fulfill the purpose of both entertainment and education. (Gardner 1983) The creation of art results in the conjunction of information with the imagination; this way the audience uniquely conceptualizes the represented reality.

Artistic installation is a contemporary art genre that began to take a strong hold in the artistic community beginning in 1970. The installations incorporate many artistic mediums to create a visceral or conceptual experience in a determined environment. In general, artists of installations incorporate the demonstration space, using it like another element of the work; whether they are public spaces, museums, art galleries, or even urban spaces.

An art installation is an expression that is realized in a multidisciplinary and multisensory approach. It consists of a work in which its creation is part of the technique and also of the ultimate expression, involving the active presence and participation of the spectator. (Morales Morales 2009) This active presence is what interests us as a participatory element in the diffusion of scientific topics. For a long time, science lived behind laboratory walls, but today, it is not only necessary for people to understand it, but to take possession of it, to live it and to experience it, and to express an opinion regarding its role in everyday life.

The importance of using artistic installations as a medium of scientific diffusion is founded in two elements. First, it turns the public into an active participant in the creation and conceptualization of the work of art; therefore the public acquires experiential learning. The flexibility characterized by artistic installations permits themes or topics to be expressed in different forms, textures, sounds, sizes, smells and colors, emphasizing the importance of a first sensory approach. In this way multisensory learning is adapted and internalized by the participant.

The second factor is that we recapture one of the forms previously used in the comprehension of scientific topics: AEIOU learning (this term was developed by T. W. Burns, D. J. O'Connor and S. M. Stocklmayer in "Science Communication: a Contemporary Definition").

AEIOU learning

Scientific communication (SciCom) is defined as the use of skills, means, activities, and dialogues adapted to produce one or more of the following personal responses towards science: Awareness, Enjoyment, Interest, Opinion-forming and Understanding. (T.W.Burns 2003) The diffusion of science through artistic installation seeks to incorporate the five components through a process of active participation and scientific information that have been conceptualized in an artistically-designed expression. This type of communication seeks, through an existential metaphor, to design a bridge between imagination and critical thought, as well as between the public and science. The result is a rational opinion, which, thanks to the metaphor, alludes to conscience forming regarding the topic.

The practical section of this investigation includes the previous design, and the creation of an artistic installation that conceptualizes, in this case, the topic of environmental deterioration and the consequences of the cycle of consumption. To carry out the project and to measure the level of acquisition of scientific knowledge, two groups were formed: a control group called the factual group and another group called the art installation group. The first group was exposed to information related to the topic of the deterioration of the planet Earth. The installation group had access to this information while at the same time, created an installation where each material and form represented one of the facts.

RIRC method

It is important to use a method that helps us analyze the effectiveness of science communication via art installations. This way results can be measured, and according to the analyzed data we can think of better ways to improve the stimulus. In this case, we used the RIRC method (A. y. Negrete 2010) to evaluate the comprehension and retention of scientific knowledge. RIRC method uses three tasks to measure explicit memory (involves a conscious recollection of data): declarative knowledge, recognition, and recall. The method also includes a task that measures implicit memory (involves the use of previous experiences that are not consciously recollected): procedural knowledge.

Declarative knowledge refers to facts being recalled, recognition implies identifying elements that were previously learned, and recall is about producing a fact, words or a story that has been retained in our memory. Finally, the tasks that involve procedural knowledge are those in which abilities or behaviors are learned and can be remembered. These groups of memory tasks were designed in order to measure how the public learns and retains information, as well as the different levels of understanding the provided information. (A. y. Negrete 2010)

The RIRC method was originally used to compare and contrast the performance of public exposed to scientific facts using narrative forms. Due to the characteristics of an art installation, the use of different forms, odors and materials, help create different ways of understanding and perceiving the information. The part regarding Opinion-forming (represents the "O" in the AEIOU method) differs from participant to participant it is important to analyze the way in which consciousness is address by each one of them. The art installation had an extra task involving procedural knowledge in order to understand the relation established between facts and the art installation concepts.

Objectives

1. Explore the possibility of art installations as a media to communicate scientific knowledge.
2. Compare and contrast how participants understand and remember information from a list of facts and through experiential learning.
3. Develop opinion forming through a meaningful sensorial experience in order to obtain a personal consciousness about, in this case, environment deterioration.

Stimuli Development

The objective of this section is to fully explain the process in which the stimulus was presented to each group. From now on, we will refer to the first group as the "factual group" and the second group as the "art installation group". The factual group was exposed to a list of scientific facts. The art installation group participated in the creation of an art installation while scientific facts were provided to them. Each group was composed of 17 participants between the ages of 20 to 23, all of them current students.

During the first session, the factual group was exposed to a list of ten scientific facts concerning environmental deterioration. (Table 1) After ten minutes, a questionnaire (the characteristics of the questionnaire will be explained further on) was handed to them and had fifteen minutes to complete it. The second group assembled an art installation following a specific procedure. The group was divided in 3 teams: green, black, and yellow. Each one of them had a specific task during the construction process. A procedure sheet (Table 2) and a diagram (Fig. 1) were given to each team describing the assembly process, as well as the responsibilities for each one of them. After the installation was completed they were asked to answer the same questionnaire as did the factual group.

Methodology

The questionnaire applied incorporated 4 different tasks to fulfill the requirements of the RIRC Method.

Table 1. Scientific facts

This is part of the evolution process of human being on Earth. Are we doing things the right way?
The Earth was formed 4.5 millions of years ago.
The "homo" appeared 2.5 millions of years ago in the Paleolithic period.
A great part of humans existence is known thanks to art expressions. This is how the human being has left its mark.
Since the first half of the XX century, the human being has been considered the greatest super-predator in habiting the planet Earth.
We have finished with the 80% of forests on this planet.
Each person produces 2 kg of garbage every day.
If every country would consume the way the United States of America does, we would need 5 planets to get enough resources.

In the past 30 years, we have terminated with 33% of the natural resources on the planet.
Our economy demands us to consume. Buying has become a ritual to achieve spiritual satisfaction.
The process of buying things is resumed in 5 main steps: Extraction–production–distribution–consumption–disposal.

Table 2. Resumed procedure
(EVERYONE) Arrival to the meeting point. Leave your shoes in the black corner. In the patio, you will find a specific shape made out of masking tape. Recognize it and form a circle around it of approximately 10 m. of diameter. Each team will remain together, pick a leader. Identify, using the diagram sheet provided, the location of the pile of leaves, the recycled garbage, and the shoe pile.
(GREEN TEAM) Each integrant will pick as much leaves as possible from the leaves pile. They will be placed as shown in the diagram. When you are done, the leader will raise his hand and the team will return to the circle.
(BLACK TEAM) Each integrant will pick several pairs of shoes from the shoe pile. They will be placed as shown in the diagram. When you are done, the leader will raise his hand and the team will return to the circle.
(YELLOW TEAM) Each integrant will pick several cans and bottles from the recycled garbage pile. They will be placed as shown in the diagram. When you are done, the leader will raise his hand and the team will return to the circle.
(EVERYONE) Make sure the figure is exactly the same as shown in the diagram, make any adjustments if necessary.

One question involved the free-recall task (Retell): Mention all the facts that you can recall from the given information. A five item list of the most important concepts was established that enclosed the given scientific facts. The maximum points for this task were 5.

For the recognition task (Identify), 3 multiple choice questions were designed. Therefore,

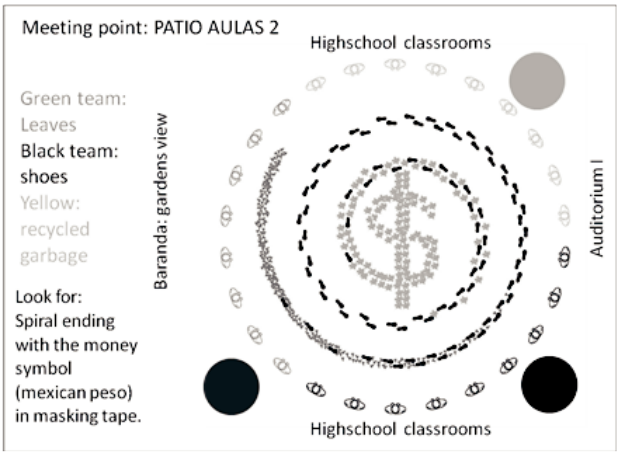

Figure 1. Diagram the maximum possible points for this task were 3. In order to have an optimal answer the participant should have been able to identify the mentioned fact from a series of possible options.

For the recall (Remember), two types of questions were considered: short answer and fill in the blank. This kind of tasks helps to measure the information that can be produced using explicit memory. The maximum possible points for this part were 4.

Question number 9 refers to the procedural knowledge task (Contextualize). The objective of this question was to create a different context, and measure the ability of the participants to apply learned facts in a specific situation. This task is connected to opinion-forming and gaining consciousness.

An extra question concerning also procedural knowledge was applied to the art installation group. Its purpose was to identify the ability of participants to refer scientific facts to material, forms, and colors in the installation. Most art installations intend to provoke an emotion, feeling or sensation among the public. The art installation should have helped them reinforce the retention of scientific facts throughout the senses of sight, smell, touch and hearing.

Results

The results suggest that the factual group had a better performance during the first session compared to the art installation group. The factual group had better results in the four applied tasks, and in general terms the standard deviation of the art installation group was lower that the factual one. (Table 3)

In the second session we could observe differences in the way scientific information was retained. During this session the art installation group had better results in all four tasks. Furthermore, the results between art installation and factual group performance during session 2 are much more apart, than the results obtained in the first session. Although the general standard deviation in the art installation group during the second session is lower, we can observe that in most of the tasks the factual group maintained better homogeneity in 3 out of 4 different tasks. (Table 4)

Table 3. Performance during session 1

	Retell	Identify	Remember	Context	Total
FACTUAL GROUP					
Optimal answer %	58%	78%	75%		
59% 67%	Standard deviation	1.65	0.79		
1.12	0.75	2.89			
	ART INSTALLATION GROUP				
Optimal answer %	46%	76%	65%		53%
58%					
Standard deviation	1.69	0.69	0.94		0.62
2.54					

In the case of the factual group we observe that over time the retained information is lost, especially in the tasks that measure explicit memory. In this area the factual group experienced diminishes of 37% on the number of optimal answers. In the procedural knowledge task the results maintained, but we could also perceive that the standard deviation increased. In the art installation group the results of the second session suggest an improved performance. For the explicit memory tasks, the optimal answers were superior in 17% exceeding the results of the ones of the first session.

The greatest achievement for the art installation group was observed in the procedural knowledge task with a 23% improvement.

Table 4. Performance during session 2

	Retell	Identify	Remember	Context	Total
FACTUAL GROUP					
Optimal answer %	31%	55%	47%		
59% 45%	Standard deviation	1.84	0.86		
0.86	1.03	2.90			
	ART INSTALLATION GROUP				
Optimal answer %	65%	86%	68%		
76% 72%	Standard deviation	1.89	0.94		
1.05	0.85	2.48			

The general results imply an upgrading in the performance of the art installation group, while the number of optimal answers diminished in the factual group. The standard deviation data had a similar behavior. In the factual group, results from session 1 to session 2 mostly maintained the same; a slightly higher dispersion is observed. The results for the art installation group show that the standard deviation diminished during session 2. The dispersion of the data suggest that while information presented with a list of scientific facts loses accuracy and uniformity over time,

the information presented via art installation gains accuracy as well as homogeneity. The results obtained imply that art installations help enhance scientific knowledge.

In addition, question 10 was used to measure how much of the given information was successfully related to the art installation work. Participants in the art installation group with higher overall results on the 4 required tasks demonstrated a better connection of scientific data to art installation concepts.

Conclusion

The results of this study as a whole, suggest that art installations does aid in long term fact retention; knowledge. (Fig. 2) Therefore, the creation of art installations can be considered an interesting media to convey science in an attractive, reliable, and memorable way. Using the RIRC method gave us the opportunity to analyze quantitatively and qualitatively. This allows having more accurate measurements of the outcome, and encourages compare and contrast analysis.

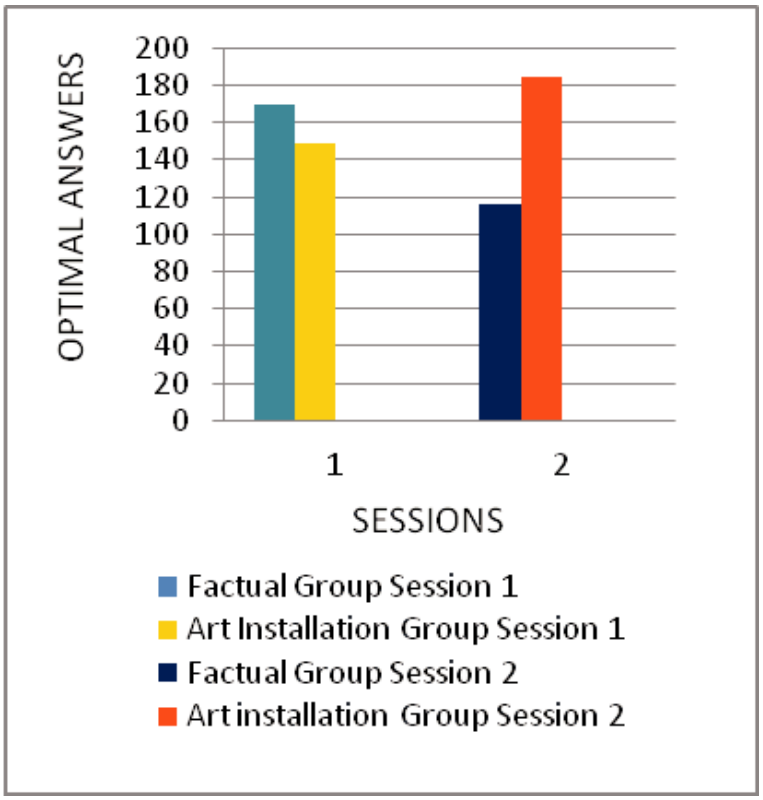

Figure 2. Session 1 & 2 Overall Results

One of the most important aspects that should be emphasized in this investigation is the ability of art installations to sensitize the participants experiencing different objects, feeling them, smelling and hearing scientific information at the same time. Different experiences are perceived, for instance, it is not the same to smell green fresh leaves, than to smell recycled cans and plastic bottles. The objective of experiential learning was reached when the participants' senses were stimulated and a greater impact was produced. Results suggest that this way, information is more accurately retained through time.

Carrying out this investigation resulted in a very insightful experience. The art installation group participants were able to connect facts with the items, forms and colors presented in the art installation. When the communicating process is not only addressed but developed by the public, a different kind of awareness is created. Each participant was able to acquire knowledge in its own specific way; therefore they had a unique opinion-forming during the activity. The ability of a person to develop consciousness is what gives facts an extra value; it is not just about retaining information, but of being able to use it in different situations.

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