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Theories about Light for Sale: An Installation Representing Theoretical Concepts¹

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Theories about Light for Sale: An Installation Representing Theoretical Concepts¹

Ioanna Giannoulatou, Antigoni Paroussi, Vassilis Tselfes

Abstract

In the text below, we explore the possibilities whereby an artistic installation can alter the formal or “non-didactic” functioning of demonstration artefacts/experiments by imposing its artistic dimension as dominant instead of the scientific one. More specifically, relying on artistic disciplines, twelve trainee preschool educators attempted to address the following impasse: we would like the demonstration artefacts (such as the experimental setup or the testing apparatus) to show to the uninitiated the theoretical ideas traversing them, while knowing full well that theoretical ideas usually precede these arrays, guide their construction and only arduously emerge from them. From its application and results, it appears that art can create what is substantially an interdisciplinary/cross-thematic framework, which succeeds in bridging the distances between scientific ideas and ideas that have different “origins”. This helps the student-creators to distinguish and handle the tensions traversing scientific ideas by using terms drawn from aesthetics – and the lay persons forming the public to consider the targeted scientific (and other) ideas through the aesthetic tensions of the overall project.

Key words: *installation art, natural sciences teaching, educators’ education, interdisciplinarity*

1. Introduction

The term ‘installation art’ describes three-dimensional artworks in the form of an environment or an assemblage, which function by transforming the viewer’s perception of space as well. The parts composing installation art can be tangible or intangible, large or small, digital or analogue, sonorous or visual, embodied or not. New means, such as video, digital sound, virtual reality and the Internet (Grau, 2004) are now used together with the performance and traditional materials of the visual and pictorial arts to create new works, which can immerse the contemporary spectator in different ways in a dreamworld (Bishop, 2005a; Bishop, 2005b). Usually, the spectator enters the installation art and is called to experience it using their mind and senses (Bishop, 2005a; Bishop, 2005b). Thus, installations offer the viewer the possibility to participate actively, which resembles a “game” of representations, interventions and ideas (Haralambidis, 1995). According to this logic, installations belong to the category of the conceptual arts, where the artists also “construct” the public’s interventions (DeOliveira, Oxley, & Petry, 2003), by also seeking to construct meanings through these interventions.

At the same time, at least in the field of informal/non formal education, we come across installations that, without having a starting point in the artistic space, tend to be considered as conceptual. For instance, since the 1960s, scientists have created installations in collaboration with museologists and artists in natural sciences museums, so as to promote the functioning principles of the exhibited artefacts (Koliópoulos, 2017), that is to say to teach the scientific ideas behind the constructions of the artefacts, but also the evolution history of these ideas. A basic component of the exhibits usually corresponds to certain scientific artefacts / demonstration experiments, which the installation can also convert into interactive elements. What about the artistic value of these installations, though? An important difference between an artwork and an artefact that stems from scientific disciplines is possibly due to their aesthetic value. According to Mouriki (2005), the aesthetic value of an artwork renders comprehensible the fact that it does not repeat something already given through a different means. On the contrary, it articulates something new and different. It does not comment on or interpret the world it represents, nor does it represent the world of the work as a reflection of the creator's inner world. Through its aesthetics, an artwork presents an "other world" via which it attempts to give meaning to the "world".

Based on the above, the central question we discuss in this article is whether it is possible to create, in a formal -or not- educational context, artistic installations capable of modifying the "didactic" function of demonstration artefacts through the use of their artistic-aesthetic dimension in order to also interpret scientific ideas; or, to put it differently, to construct an "other world" through which to also give meaning to the "worlds of science".

2. Theoretical background

At first view, the question above relates directly to whether the demonstration experiments that the educational framework as a rule adopts can project the scientific ideas that created them (Roth & Lucas, 1997; Roth et al., 1997; Tselfés & Paroussi, 2008; Tselfés & Paroussi, 2015). Adapting a more recent analysis by Roth (2005) regarding this issue, we have considered as functional the categorisation of spectators into those who gaze at an experiment, those who observe it and those who consider it ("see as"). Gazing resembles what we do on a daily basis when we walk in the streets of our home town; it does not involve us in any particular process of conceptual construction, nor does it prompt us to recall particular conceptual patterns. Observing involves the viewers in ways that lead them to connect their current experience with previous ones and possibly also use new patterns in order to effect the connections between the two, while seeing as involves the spectators in the conceptual construction/building of the fact-artefact they are observing as an example of a model or a theory/idea and therefore as part of a world with a specific cultural identity. In the domain of science, it is considered as given that the seeing as capacity belongs to the viewers who possess specialised knowledge and skills. We, however, wish for the uninitiated spectators to be able in some way to "see as" the artefacts we exhibit. Could the aesthetic dimensions and appropriately transformed theme of an artistic installation mediate for the required points so that, through the artwork, the non-expert spectators of a demonstration experiment/artefact can shift from gazers to observers and possibly even seers (cf. also Milne & Otieno, 2007)?

An artistic installation of this nature should create points that project theoretical scientific ideas, combining the installation site's referenced entirety and the representing elements of the individual constructions in such a way that the ideas at issue are explained (Peirce, 1964). At the same time, it should be possible to approach each individual construction, as well as the work as a whole, as a creation of pleasing aesthetics (Kharkhurin, 2014), which is likely to involve spectators by means of paths that are not necessarily scientific ones. Could a tension of the "scientific world" be explained to the uninitiated viewer, for instance, through the artistic work's "other world" (Mouriki, 2005)? The latter appears as relatively feasible, as the "landscapes" created by scientific disciplines are by their very nature characterised by at least one tension: they represent the empirical world known to all in an incredibly different manner to the one taught by human experience. For example, in classic "scientific landscapes" no single body touches any other, yet everything interacts with everything; and if two of these are attracted one to the other, one does not embrace the other...

Of course, as an end result, an artwork that is based on artistic disciplines and tries to showcase scientific ideas needs to include at least some of the fundamental traits of both the - possibly incompatible - cultures (Snow, 2012) it is attempting to connect. Thus, beyond the scientifically-inspired tension that contributes to its aesthetics, it also needs to live up to an aesthetic approach, such as the one suggested by H. Wölfflin (1992). It must also allude to the fundamental scientific regularities that construct the scientific aspect of the evidence, which in our case is showcased through the artistic organisation of individual points.

More specifically, the installation (or its individual elements) can be considered as being artistic if considering it on the basis of the pairs linear-pictorial, surface-depth, closed-open form, multiplicity-unicity and absolute-relative clarity (Steiakákis, 2013; Wölflin, 1992) led to a more or less specific artistic style. Similarly, what it projects as its scientific points should refer to the representation of the “other world” in two ways (Hacking, 1992; Tselfés, 2003), both through ideas and through evidence; indeed, also ensuring in some way (interpretation, prevision, etc.) the linkage of these two ontologically different representational approaches.

Which, then, could be the place of the demonstration artefacts in an artistic installation of this nature, shaped as a creative, semiotic and aesthetic environment? And in what manner can the entire activity of creating it be incorporated into the context of education? We attempted to answer these questions through an installation-case study that aspired to “teach” scientific ideas about the nature of light to lay persons.

3. Methodology

3.1. Description of the educational intervention

Twelve students of the University of Athens’ Department of Early Childhood Education, who over previous semesters had attended classes on theatrical expression and on teaching natural sciences, worked in groups of a varying composition for an academic semester. Under the guidance of their teachers (a physicist, specialised in teaching it, a specialist in theatrical expression and direction, and a postgraduate student with studies and work in the theatre and in installations), they attempted to create an artistic space that promotes ideas relating to the nature of light. The educational objective of this process was to instruct the students in artistic and scientific disciplines, while simultaneously offering the educators (specialists in different fields) the opportunity to master ways for their specialisation fields to coexist; an activity which we took for granted would improve the educational practices of both the teachers and the learners.

The organisation of the activity was based on the logic of Dewey’s flipped curriculum (Stoller, 2018). The students were initially informed about the installation’s structure and functioning, as well as about a series of hypotheses/ideas concerning the “nature of light”, drawn from tradition, philosophy and science. Following this, they undertook the realisation of this installation, which was scheduled to be visited by a public of outsiders who meant a lot to the students (relatives, friends, etc.), with the teachers’ participation.

We based our project on the following hypothesis: if the end installation took the form of an artistic event comprising a series of artefacts (smaller installations) that promoted ideas about light (from tradition, philosophy, science or even religion, indiscriminately), then maybe the students would be able to approach scientific ideas as the alternatives for other ideas they could already handle without the awe that accompanies the school sciences. We also assumed that the viewers of the installation would be more at ease managing their interaction with the artefacts-exhibits as a process referring to the ideas that emerge from the constructions and, consequently, would dare to consider or observe them without the awe that accompanies the artefacts presented by scientists. This hypothesis is adequately supported by the activity’s artistic nature for, as already shown by the experience of our programme (Tselfés & Paroússi, 2015), artistic creation is a strong incentive for the students to effectively engage with issues of a theoretical-scientific content, while simultaneously being a field where the non-experts grasp that what they see refers to ideas that are “hidden behind” and are not explicitly stated/presented (Tselfés & Paroússi, 2017).

3.2. Subsidiary considerations

Based on the above, the collection of the data concerning the entire process was carried out on the basis of the following subsidiary considerations:

- a. Did the installation and its individual elements adequately signal ideas related to the “nature of light”? Were these transformed as regards the ideas of reference and in what ways?
- b. All in all, did the installation and its individual elements compose an artwork? In other words, was it possible to talk about its style and aesthetics?
- c. Did the individual elements of the installation also “speak” the “language” of science?
- d. Did the student-creators use personal ideas (Stoller, 2018)? How did they connect them to those projected by the installation and to what degree did they modify them in scientific directions?
- e. Did the students review and improve their educational strategies and practices? And, lastly,
- f. Were the visitors-viewers prompted to consider or to observe and not only to gaze at the installation elements?

3.3. Data and data analysis

The installation comprised a total of ten creations, exhibited in an artistically arranged space, whose objective was to communicate ten different ideas about light. The students were part of the installation, conversing with the visitors and displaying their artefacts. The installation title “Theories about light for sale”, bearing the subtitle “You pay at the exit, by telling us your ideas”, featured boldly at the site entrance.

For question (a), we used photographs and videos of the installation site as data, which we analysed according to Pierce (1964). In this way, we approached the degree to which the installation’s global referent, but also the representant/signifier of each creation separately, was adequately connected to the interpreted/signified idea about light intended by the student-creators.

For question (b), we used video excerpts from the installation events as data, which were analysed in terms of their aesthetic value on the basis of the Wölfflin scale (Steiakákis, 2013), but also with regard to their creative value according to Kharkhurin (2014). We were thus able to have an overall picture of whether the installation that was created did indeed constitute a creatively artistic event.

For question (c), we used the results of the semiotic analysis (of question a), which we analysed epistemologically based on Hacking’s model (1992). In this manner, we attempted to ascertain whether the evidence presented by the artefacts’ “other world” is connected to the targeted ideas in ways also accepted by the scientific disciplines (they explain, interpret, predict or...).

For question (d), our data was the texts written by the students once the process was completed, where they described and evaluated their personal trajectory (what they aimed to achieve, how they approached it, why and where they succeeded or failed, etc.). By analysing the content of these texts, we attempted to identify the personal ideas used by the students, as well as their transformations.

For question (e), we used as our data the video of the interaction between the students and the non-specialist viewers, where the students assumed the role of presenters of the exhibits. Our analysis focused on whether and in what ways the students’ action moved beyond the presentation of the artefact content (a teaching approach of content transfer) towards approaches that infer processes of discovery, construction or exploration.

For question (f), finally, the data we used was the texts resulting from the answers given on leaving by the visitors as “payment”. The answers were triggered by an initial request (“tell us your own opinions-ideas”), their length depending on each visitor’s availability. The analysis of the content of these texts was undertaken with a view to revealing whether the visitor considered, observed or simply gazed at the exhibits. In other words, whether they answered within a worldview context, a (positive or negative) conceptual critique framework or, finally, on an assessment level only (I liked it/ I didn’t like it).

4. Results

1. Aesthetically, the overall installation was multimedia, interactive with the public and of a performative nature. The space was organised artistically and was based on the chromatic interplay of black and white (darkness – light): a black room with white benches, which served to display the artefacts. At the far end of the room, a white parachute hung from the ceiling on which a projection took place. A white piece of paper unfurled from the centre of the cloth and crossed the room, dividing it into two. On it, the visitors could write, draw, leave their impressions or anything else that took their fancy. Summary information about each idea featured on large posters hanging behind each bench. The students, dressed in white, were present and tried to “sell” their ideas to the visitors. Despite the fact that most of the individual elements were situated somewhere between the linear and pictorial styles, in the overall view of the display the linear style receded significantly, mainly because, to a great extent, the whole absorbed the details structured by the parts. Entering the space was penetrating into an “other world”; a world of ideas. The viewers experienced intensely their contact with what were, at first glance, strange artefacts, which they seemed sure represented ideas that they tried to guess at in the “other” world of a “souk” and its peculiar rules of exchange (ideas against ideas).

Epistemologically, through the artefacts and the possibilities of interacting with them, the facility’s “other world” provided visitors with concrete evidence. The ideas also came to the fore through the discussions initiated by the visitors and then involved the students. The ideas thus functioned in a mainly interpretive manner, whether they stemmed from the visitors trying to guess “what the artefacts mean” or from the students who answered them, either agreeing or disagreeing with them.

In Table 1 we present results from the first four levels of analysis of three connected exhibits from the field science.

**Table 1. Semiotic, aesthetic, epistemological and personal approach
(of the students) of three of the installation's artefacts**

	Semiotic approach	Aesthetic approach	Epistemological approach	Personal approach
<p>Light is a particle</p> <p>Light is a wave</p> <p>And the critical experiment</p> <p>An installation in three parts. In the first, a poster and a projection of a "rainstorm of particles" are used as a backdrop to photograph visitors. In the second, aided by the poster and various examples, the students explained the approach of light as a wave. In the third, the visitors withdrew to a dark space and tried to form the shape of the shadow of a circular disk on the wall. The students drew their attention to a bright spot that appeared in the centre of the shadow, sowing doubt about what the nature of light is, in fact.</p>	<p>The light as "particle" and the light as "wave" were two different kinds of installation placed one after the other. The representants of each explained the two different approaches concerning the nature of light. The first more effectively, through the process of photographing, and the second scientific-style representations of the waves and empirical analogies. The spot under the umbrella that protected the visitors from the "rainstorm" of light while they were photographed interpreted the model's functioning with tension, creating connections and analogies with empirical representations. The representants interpreting the nature of light as a wave functioned much less effectively. Indeed, they tended to create the first doubts about how satisfactory the absolutely understandable particle nature of light actually is. Thus, the installation's third part followed with the spot of light in the centre of the shadow interpreting an additional empirical doubt about the particle nature rather than offering evidence in favour of the wave theory (which remained rather unclear as to what its consequences are in practice).</p>	<p>The installation's world is created in a free and non-linear manner. The intention of motion and imprecision dominates, while overall the work is in harmony with the surrounding space. New images are created to represent how the theories function. Further, it creates new imaginary entities (e.g. the particles that are visible in the video, the abstract wave depictions of light, etc.). The installation's two parts create a central tension: when all is said and done, what is light? Particles or waves? Could the "big names" signing the different theories on the poster be mistaken? What about Newton? This tension was ultimately exacerbated by the final crucial experiment, which created feelings among the visitors where doubt was prevalent. In other words, we can say that, overall, the installation interpreted doubt as the driving force of Science: doubt about the correctness of what I think and maintain; doubt about the exact meaning of what I see before me!</p>	<p>The World created by the installation is functionally balanced between Ideas and Evidence. Although the evidence is constructed and its creation is due to making the most of artistic disciplines, the relation of the Idea of light as particles that constantly blast the human body together with the evidence resulting from the final photograph taken by the viewer closes the World-Idea-Evidence triangle perfectly. In a similar manner, the structure of the created World projected through the use of the Idea of light as a wave and the evidence that emerged as a result of the visitors' intervention via the material entities (torch, disk, shadow, etc.) of the installation's world also appears to be complete (at least as an effort, if not in terms of the result). The disciplines that were followed to create this World were the disciplines of the construction of this particular experiment, which was initially used to confirm, through Evidence, the Idea of light as a wave.</p>	<p>According to the students' texts, the aim of the first part of the installation was to showcase Newton's particle theory of light. The spectator is called upon to intervene and "play", so as to approach the theory in a "creative and theatrical" manner. The experimental confirmation of light's nature as being a wave constituted the idea behind the second and third part of the installation. The students considered that the experimental set-up and the repetition of Fresnel's classic experiment by the visitors would spark their interest, both due to the particularity of the activity of scientific experimentation and because of the "pleasant surprise" afforded to them by the experiment's unexpected result. Semiotically, though, the outcome was that it tended to provoke epistemological and philosophical questions among the visitors. And this, because the search for artistically and aesthetically pleasing artefacts highlighted as scientific those of the representations that have access to everyday culture (particles). Thus, the attempt to create tension ended up upgrading the doubt about the same, familiar, representation of the particles, but also towards the scientists who created it.</p>

When triangulated, the results of this analysis show that the attempt to artistically represent scientific ideas improves the students' personal views, because it forces them to also acknowledge the tensions contained in scientific creations; tensions that the students neither recognise when explicitly informed of the scientific content, nor dare or are able to formulate in writing (due to the inability to handle scientific language), but which they need in order to create an aesthetically satisfactory artistic production. We reckon that this result highlights a way for the expression through performing arts to intervene actively and enhance the understanding of the scientific content's components:

In the case of Prometheus' light-fire, its dimension as a "gift of the gods" mentioned in the students' texts was transformed by the sentence "...give me your liver", which was used to provoke a tension that would enhance the construction's aesthetics. At the same time, though, it shifted the value of fire-light towards realistic and alternative directions that demystify "gifts".

In the case of Archimedes, the students' decision to hand over to the viewers the responsibility of handling the beam of light to "burn the ships" came from their effort to aesthetically improve the installation through the tension of play; this handling, however, "taught" practical ideas about the nature of light as an entity in space, as well as ideas about the way it interacts with mirrors.

In the case of Aristotle, the artistically unsophisticated and as regards the represented ideas imperfect installation was guided by the tension of "creation" and its metaphysical approaches so as to provoke fundamental ontological questions that had not been planned in advance.

In the case of the Big Bang, showcasing the philosophical issue linking scientific ideas with truth and its creators as a central question does not appear to have been among the students' intentions, but it emerged in practice through the idea of the mirror used to upgrade the aesthetics of the exhibit.

In the case of Einstein, except for the pre-planned outcome, the installation also brought to the fore the theoretical construct's particularity of predicting experiences that we, as people, have never had and quite possibly never will do either. Even though this artistic contribution cannot be considered as particularly original (similar time travel scenarios have long been a scenario beloved of artists), in the case at hand we can say that the artistic tension effectively connected a theoretical idea's "inconceivable" dimension to an empirically charged everyday situation like age (without resorting to "space" worlds).

2. The analysis of the data from several video recordings of the conversations between visitors and students proved to be simple and conclusively showed that the students' "teaching" approaches did not move beyond that of a "knowledge transfer". The students presented and explained the exhibits in the manner in which they themselves apprehended them. However, this transfer process was, in an unexpected way, effective – and the reasons for this appear to be extremely simple: the oral presentations and explanations were requested by the visitors, who indeed often had an opinion and entered into heated debates, while the students gave presentations and explanations using a form of speech that tended to diffuse scientific terms and concepts into everyday speech rather than construct sentences in the "scientific dialect" that visitors did not appear to master either. These facts reinforce the following interpretive hypothesis: "knowledge transfer" is not a problematic teaching approach. What is problematic is the dilemma "whom does knowledge interest: the person learning or the person teaching?". What is also problematic is the teachers' use of a dialect that is unknown to the pupils. The installation succeeded in creating an artistic context within which the visitors sought to learn/understand. Within this aesthetically upgraded framework, the students' "knowledge transfer" proved to be effective, independently of how sound it was.

3. The analysis of the answers with which visitors "paid" as they exited the space led to the following results: out of the 39 visitors, it would appear that only 4 gazed at the exhibits, 16 of them observed them and 19 considered them closely.

For instance, the visitor who stated "I liked the first two, the one with the wave thing... I mean, I hadn't ever thought of it... everything was so different... it was really lovely" was grouped with those who "gazed" at the exhibits. A visitor who declared «... What wasn't clear right from the beginning was the subject. Was it physics? The natural sciences in general? Was it the light? I would have liked a little bit more of an in-depth analysis of its scientific piece, one click more, there where that was possible...» is quite obviously among those who observed. While comments such as: "Incredible... Can there be other theories and we don't know of them? I mean, that's what I wondered. Not necessarily scientific ones... As for the light from inside, which I saw in Plato, where does that inner light come from? I didn't understand, as I was "educated" too much. Does the inner light exist or not?..." or "Listen, they brought out those things that we never recorded

when we should have done... The things that are the most important to keep in mind and know about when day breaks in the morning... They presented theory in the form of a slogan. Isn't that amazing?..."; undoubtedly point to people who are considering what they saw.

The significant success of "considering" but also of "observing" among the viewers offers proof to support yet another interpretive hypothesis: the organisation of scientific representations within the same artistic-evocative framework as representations created by other human disciplines or activities releases them from the myth of "truth" and "difficulty" burdening them and frees the uninitiated so that they may also reflect scientifically.

5. Discussion

1. The outcome of the transformation of scientific knowledge under the pressure of its reframing in an artistic environment was expected as a matter of course. We believe that an important, positive and unanticipated characteristic of this reframing was the revelation of what, for the students, had been the unintelligible scientific aesthetics through the functioning of the artistic aesthetics they understood. The positive evidence regarding this statement, collected from all of the installation's components, appears extremely convincing: the aesthetics that all undertakings, scientific or not, contain either due to the tension underlying the conflict of the scientific with the everyday/empirical representations (e.g. the flow of time, light as a component of bodies or as an entity that exists in the void), or because of the clash between the scientific and the mundane self-evident/principles (e.g. the goods of nature as material goods, ideas as means of intervention, truth as a construct), appeared *ex post* as the outcome of the efforts to improve the artistic aesthetics.

2. The success of the teaching approach of "transposing" scientific knowledge into the installation's artistic environment reinstates a series of classical educational issues, which appear to persist: Why should we expect a successful "transfer of knowledge" in the context of a formal education classroom? A classroom where nobody has bothered with, or cares about, its aesthetics. A classroom whose existing, current "stage setting" does anything but prepare the pupils-"visitors" to confront tensions of a cognitive type and not of a social background. Why should we expect that a form of speech, which has been developed to serve communication in the context of professional scientific activities, can also serve communication in an everyday context?

3. The insistence about Science's distinction and "intellectual" superiority on behalf of those who try to disseminate scientific ideas, practices and concerns to non-expert audiences once again appears to be extremely questionable as to whether it is of help to them. An approach of this nature tends to support hypotheses that interpret the tendency to separate and positively discriminate the Sciences as choices that should convince of scientists' social superiority rather than about the particularity, utility or aesthetic value of their ideas.

Notes

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