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**Abstract**

This article approaches the diffusion of information for learning processes in museums, supported by interactive digital technology artifacts, Analytical categories of interaction typologies stem from bibliographic research and field survey. Relevant theoretical references were initially selected, in order to understand several categories of the concept of interaction as described by various authors. Then, we propose a categorization of interaction typologies that consider the interrelated input and output modalities, namely: linear, multiple and open. Nine resulting categories are associated with case studies selected and analyzed according to their opening, to elaborate and disseminate the information and the learning process through the user-machine interaction.

**Keywords:** Human-Computer Interaction, Cybernetics, Conversation, Learning, Museums

## 1 Introduction

Due to the spread of computers in the various scales of human life, the design has been gradually recognized as a major tool to humanize and make friendly interfaces with such devices, and thus expand the ability to meet our needs. Design is in charge of this function and has the means of designing technology directed to the users of such devices, from the area of knowledge of Human-Computer Interaction (HCI). The HCI discipline specifically targets the design of computer applications and interfaces for better machine interaction and usability. "A good computer system, like a good pair of shoes, should be natural, comfortable and serve without the user being aware of it." (Faulkner, 1998, p.7). We note that the Humanities increasingly assume a quite relevant role in understanding the subjective aspects of people's consciousness when interacting. Its contribution clarifies the understanding of aspects of perception and cognition related to technological devices. From the perspective of the humanization of technology, this article has a transdisciplinary approach, aiming to discuss various types of user-machine interaction, and their possible influence on the construction of information in museum spaces.

To consider an artifact as interactive means to refer to a categorization of objects according to their ability to "behave", activated by interactive technology (Moggridge and Atkinson, 2007). It means to give it the potential to capture user's information and some space aspects in order to translate these into digital information, and consequently into communication through interaction. This experiment understands that to consider interaction as dialogue can build ways for new possibilities of understanding how design can contribute to constituting the information through interaction with digital artifacts. Consequently, we find exhibition and museum spaces to be the appropriate *locus* for this discussion, given that the use of technology in these institutions is a practice that is increasingly growing and being consolidated throughout the world, including Brazil.

This paper is a portion of one chapter of the author's thesis written for his master's degree, and its objective is to reflect on the dissemination of information for learning in museums through the use of interactive digital technology artifacts by proposing analytical categories of interaction typologies based on bibliographic and field research (Ricca, 2019). Parting from this, an interpretative reading of design strategies was developed in regard to a series of selected case studies. This experiment is therefore characterized as exploratory research, the method of which consists of site visits to selected museums. It is complemented by bibliographic and pictographic groundwork, including catalogs, photos, books, articles and other publication genres, of which 13 artifacts located in 11 different institutions were selected in total[1].

## 2 Content mediation: interaction in dialogue, theoretical reference

The act of communication lies in mediating content, which, based in a medium, transmits a message. It is thought that knowing and delving into theoretical aspects of interaction can be a way to approach a greater understanding of design criteria for digital mediating artifacts in museums. Moreover, this can foster dialogue between human beings and machines, and, therefore, the elaboration of information and learning. It is worth highlighting the fact that in this article the term Communication cannot be reduced to verbal language; its meaning is expanded to also comprise interaction itself as a communicative activity.

One effective way to represent human-computer interaction is the feedback loop.This consists of a cyclical exchange of information in the form of data relayed from a human to a system – a computer, a mobile device, or a car, for example – and back to the human. Receiving this feedback, the person evaluates if this information has achieved the objectives that motivated the initial stimulus. This interpretation of the system output then directs the next action undertaken (Dubberly, Pangaro and Haque, 2009). In this way, it is understood that the cyclical nature of information enables new ways for it to elaborate and disseminate itself. This interactive loop model of systems dynamics suggests the following investigation: do different degrees of interaction exchange lead to different modes of information exchange? In order to discuss this point, we proceed next to the screening of various categories of the concept of interaction undertaken with selected authors. [2]

### 2.1 Types of interaction

The human-machine relationship can occur in various ways, and it also allows its classification into multiple categories to facilitate its understanding and reading. Authors Dubberly, Haque, and Pangaro (2009) - in their article *What is interaction? Are there different types?* -conceive, in light of Gordon Pask's Second Order Cybernetics (1976), a systematization of interaction with support from what they call dynamic systems. For these specialists, a system is not considered interactive due to its characteristics per se, but to the nature of the information exchange that is realized between the elements of a system. These are classified into essential types: **0) linear**, **1) self-regulating** and **2) learning**. **Linear systems** (0 order) react in a standardized manner to stimuli and their expressions.

**Self-regulating systems** (1st order) are characterized by giving different responses arising from the type of input they receive, adjusting their behavior, and modifying their responses through the stimuli collected in a cyclical way despite that this had been previously established in their programming. However, **Dynamic learning systems** (2nd order) are characterized not only by adjusting their behavior directly from the input, but also by learning from changes to the stimuli that are received. The system thus learns from the user, and vice versa, in a multicyclic or spiral manner in which information can be constructed constantly (Dubberly, Pangaro and Haque, 2009).

| Systems Combination | |
|---|---|
|  | 0+0 Linear+linear. Reacting. |
|  | 0+1 Linear+Self-regulatng system. Regulating. |
|  | 0+2 Linear+Learning system. Leaning. |
|  | 1+1 Self-regulatng + Self-regulatng system. Balancing |
|  | 1+2 Self-regulatng + Learnig system. Managing and Entertaining |
|  | 2+2 Learning+learning system. Conversing interaction |

**Table 1:** Classification of interaction systems. Source: Adapted from Dubberly, Haque and Pangaro (2009).

From the authors' perspective, simply pushing a button (real or virtual) is not interaction, but rather a reaction. In a reactive system, the input and output – stimulus and response – are fixed. However, in interactive systems, the stimulus and response elements feedback in a way that produces a dynamic system, and, therefore, is progressively more interesting for the user (Dubberly, Pangaro and Haque, 2009). Starting with the systems discussed above, the authors elaborated six different interaction models as shown in **Table 1**.

In the **0+0system combination, Reaction**, the inputis generated by a stimulus in a device – tapping, turning, signaling, pushing. According to Gordon Pask (1976), this action causes a predetermined and often limited reaction. Based on this description, it is noted that many of the content mediating artifacts in museums fall into this category. The **0+2 system combination, learning,** denotes a typology of interaction that encompasses many human-computer interactions. In these, a learner system (a human) interacts in a process of linear input. The system responds, and the human adapts to the output. The human learns from

the system; however, the system does not learn from the human. As Dubberly et al.say (2009), these are not characterized for allowing conversation itself since the machine does not learn from the inputsbrought by the user.

In **system combination 1+2, Entertainment**, the authors highlight the example of electronic games in which a system is created that progressively increases the level of difficulty according to a player's developing abilities. Design strategies like these begin introducing surprises and challenges that renew and reinforce interaction, contributing to the engagement through entertainment (Dubberly, Pangaro and Haque, 2009). In this category, rules, rewards, and challenges are deployed to increase the difficulty for users in competing or collaborating. In **interaction 2+2, Conversation**, there is a cyclic process of input and output in which two learning systems communicate with each other (Dubberly, Pangaro and Haque, 2009). In museums, allowing conversation in the interaction between content and visitor requires that there is, in fact, an exchange between systems.

In order to better understand and develop the implementation of interactive projects, architect, artist, and media designer Ruairi Glynn classifies interactions into three types based on their reactions to stimuli (Glynn, 2008). The first type starts with an **automated reaction** and has only two states, on and off and is characterized as being independent of external inputs. The second type is classified as **reactive** as it acts according to previously defined criteria. Many examples of these are erroneously characterized as interactive. For Glynn, a systemcan only be considered **interactive** when there is autonomy in the system itself that, by a variety of means, facilitates the achievement of the objectives initially established in its programming. Similarly, artist Jim Campbell (2000) characterizes interactive interfaces into two modalities. The first is **a discrete interface**, for which he cites the example of a carpet that triggers an image when a visitor closes a circuit by stepping on it. The person here does not interact with the program or the image, only the carpet with a button, so that, "... there is no dialogue, only the states of on and off." (Almeida, 2014 p.131, our translation). Campbell's second classification is characterized by **continuous interface**, which occurs, for example, when a hundred buttons are arrayed on a carpet, and, by stepping separately on each one, a hundred responses are generated and displayed on a monitor which has been uniquely stimulated based on the mapping of the person's position (Campbell, 2000).

In discussing interactive media with a propensity for communication, Jens Frederik Jensen defines interaction as, "... a measure of a medium's potential ability to allow the user to influence the content and/or form of mediated communication," (2008, p.129). Based on this definition, he describes four subconcepts of interaction: **transmission interaction** consisting of a "one-way" medium such as a TV that does not allow the user to make requests other than to change the channel; **consultation interaction** in which there is the possibility of allowing the user to choose pre-produced information, as on an Internet website; **registration interaction** in which there are automated responses given to users from their needs and actions (Jensen gives as an example systems that automatically sense environmental stimuli and adapt, such as security systems, home-shopping, automatic lights in smartphone interfaces, etc.); and **conversation interaction** where there is "two-way" sharing, for example, in the exchange of emails between two people in a human-to-human interaction over the Internet (Jensen, 2008). Considering the taxonomies shown above, a table has been elaborated in which are reproduced, in summary, categories drawn by each author.

| Authors | Categories | | | |
|---|---|---|---|---|
| Dubberly, Pangaro e Haque (2009) | 0+0 Reaction | 0+2 Learning | 1+2 Entertainment | 2+2 Conversation |
| Jim Campbell (2000) | Discrete - carpet and button | | Continuous - carpet and 100 buttons | |
| Ruairi Glynn (2008) | Automatic - on and off | Reactive - previously defined criteria | | Interactive - Input and output constant feedback |
| Jensen (2008) | Transmission - "one--way" - TV | Consultation- choice possibility | Registration - Automa-tion of the response | Conversation - "two way" - Sharing |

**Table 2:** Definitions of interaction among various authors. Source: Author's elaboration based on the referenced literature (2018).

## 3 Design strategies - stimulus and response diagrams

Analyzing the table in the previous section, a pattern categorizing outputs in human-computer interaction can be perceived and, in this article, we propose to analyze these multiple definitions based on three typologies: 1) linear – when there is automated input or output with standardized responses in which the participant has few, or only one, possibility of stimulus; 2) multiple – when an output that is also standardized, though, with possible variables depending on the stimulus elicited, which allows a multiplicity of inputs from the user and thus greater resourcefulness in a system; and 3) open – when feedback between inputs and outputs is permitted, as in a conversation, indicating a dialogue between human and system which is non-standard, cyclical and variable, and in some cases approaching a randomness randomly opening itself to the undetermined. These three descriptions are illustrated graphically in Figure 1.

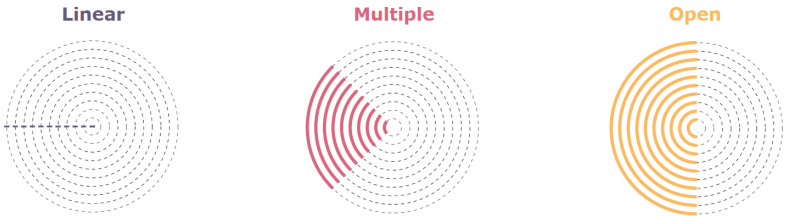


**Fig. 1:** The categories of Input and output. Source: The authors (2019).

Attempting to treat, in an equivalent manner, the reading of actions as much from the perspective of the machine as in relation to the human being, we proposed to classify the inputs and outputswithin these two types in interaction with digital technological artifacts. This way, a classification is carried out that seeks to understand the typologies of the possibilities of user actions, as well as the machine response modalities within the same structure of interpretation in order to understand the different possibilities for the construction and dissemination of information in such categories.

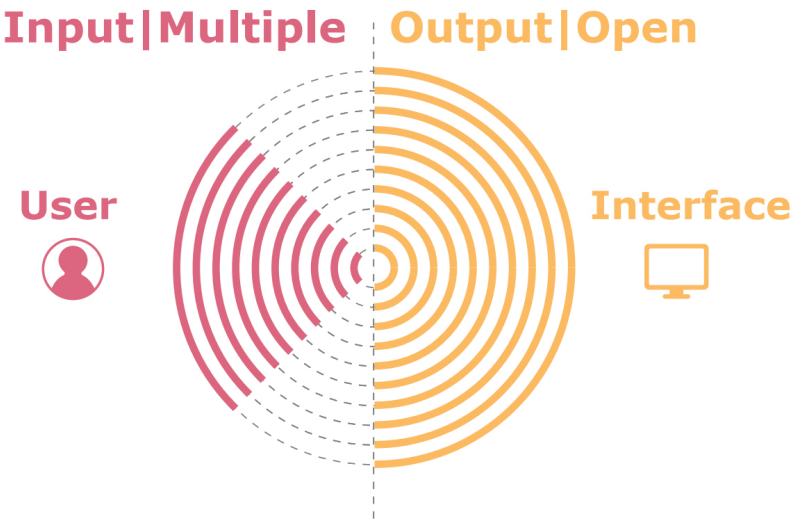


**Fig. 2:** Human-machine representation. Source: The authors (2019).

Regarding this classification as applied to content-mediating digital technology artifacts, a way of reading is proposed which seeks, visually and conceptually, to facilitate the understanding of the artifacts' proposals for interaction that have the visitor, as much the structuring element, act as the system. The figure here shows the standard diagram adapted to each typology. On the left side in magenta is the input from the user, which in this case is of the multiple type. On the right side, the open output type is represented by a semicircle. This way of illustrating the interaction applies to inputs coming from the visitor as much as to outputs from the machine. In addition to this, we tried to map these possibilities as they apply to the actual cases we visited while considering the proposed outline of the research, that is, the relationship between visitors and the digital artifacts that mediates content in museums. There are, we find, three sorts of categories which, when combined, form nine typologies of distinct characteristics of information exchange through interaction, as can be seen in the following figure.

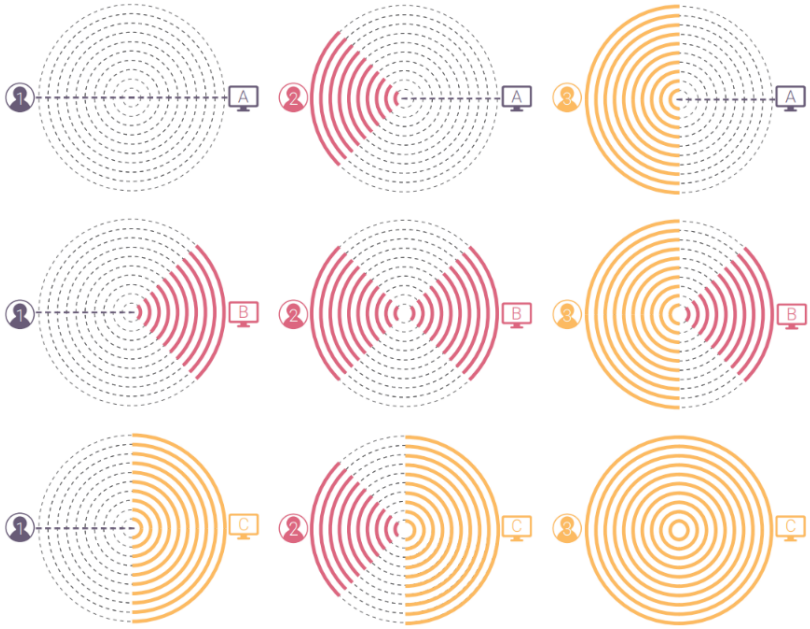


**Fig. 3:** Nine proposed analysis typologies. Source: The authors (2019).

### 3.1 3.1Linear Stimulus - Linear Response (1-A)

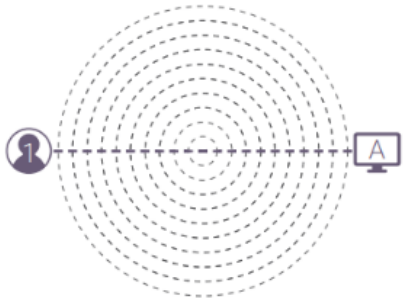


**Fig. 4:** Typology 1-A. Source: The authors (2019).

The classification typology **1-A** regards a stimulus with a linear character on the left side of the circle followed by a linear response on the right side of the circle. Such a relationship with a digital artifact is characterized by its simple understanding and limited, unilateral possibilities for information exchange. Examples of this type are largely found in museums using audio guides in which the visitor presses a predetermined code and receives a pre-recorded response.

An example of this typology can be found at the Ottobock Science Center in Berlin. It deals with the motor functions of the human body, and utilizes projection linked to simple sensors. The interface **1) More than skin deep** is activated by parts of the human body as they initiate animated projections on several tables, and through which the user can learn about tendons and muscles. **2)Test your balance!** is an interface in which the visitor walks on a straight line drawn on a patch of floor where images from varying heights are projected. These offer three levels of difficulty and demonstrate how a virtual stimulus can produce an imbalance in the brain and, consequently, in other parts of the body. This example in particular opens a space for playful social interactions to occur, even while it only deals with a linear-linear typology.


**Fig. 5:** Image A: Interaction 1) More than skin deep.Source: Ricca, 2019. Image B: Interaction 2) Test your balance! Source: ART+COM Studios. Available in: <https://artcom.de/en/project/science-center-medical-technology/> [Accessed November 2019].

### 3.2 Linear Stimulus - Multiple Response (1-B)


**Fig. 6:**Typology 1-B. Source: The authors (2019).

Interaction type **1-B** as well as **1-A** only allow linear stimuli, that is, of a singular character, however, they also accept a certain amount of variation in the possibilities for response. A didactic example of this includes the act of throwing a virtual die wherein the human is only allowed to have a linear behavior by throwing it, and by which six possibilities of response usually emerge, thus characterizing the output modality as **multiple**. This artifact typology was found in interface**3) *Waltz-Dice-Game*** at the Haus der Musik Museum in Vienna, where it is possible to compose a song together with other visitors based on the simultaneous rolling of four virtual dice. The composition occurs with multiple possible combinations and can be shared virtually with users.


**Fig. 7:**Waltz-Dice-Game on Haus der Musik Museum. Source: Hanna Pribitzer. Available at: <http://bit.ly/2ZemXGk> [Accessed August 2019].

### 3.3 Linear Stimulus - Open Response (1-C)


**Fig. 8:** Typology 1-C. Source: The authors (2019).

In the context of linear possibilities in type **1-C**, the artifacts that allow the elaboration of open responses are those in which the visitor's stimulus, even if limited, can produce constantly changing responses and information. A fictitious example of an interface of this type would be an installation in which, using a presence sensor, some random kind of audiovisual phenomenon is expressed. The presence of a visitor would be categorized as a linear input, as it cannot be changeable; whereas the media, being random and without standards, could be categorized as open. It turns out that this is a typology that was not found in the researched cases. When dealing with examples that propose to be content, these consist mainly in the sense of the construction of information and not in the interaction itself. It is assumed that because its open nature of response comes from a linear stimulus, this has limited characteristics available for reproduction.

### 3.4 Multiple Stimulus - Linear Response (2-A)


**Fig. 9:** Typology 2-A. Source: The authors (2019).

Regarding the context of multiple stimulus possibilities now, the category **2-A** has a linear type of response. This mode of relation with the artifact is characterized by denoting several possibilities of interaction configuration which boost standardized and constant responses. By allowing more than one mode of action, these types of artifacts tend to have a lot of potential for engagement as they give rise to multiple possibilities, and as they give the visitor a good degree of autonomy for deciding what they want and what they don't want to learn from the information. Observing that, due to the multiplicity of the stimuli and standardization of responses depending on the user, the designers tend to generate too much content, requiring time and patience to access all the information made available, and, often, it is not accessed in its entirety. This occurred, consequently, in examples **4) Body Scan**and **5) Narratives by Tokens**. It was noted that, in these cases, the visitor is enchanted by the possibility of interaction, but soon gets tired of the linearity of the response, quickly moving on to the next work or installation of the museum and thus limiting the elaboration of information by not allowing an effective exchange with the user.

Example **4),** found in the Micropia Museum in Amsterdam, is meant to show the life of microbes. The interface consists of a large screen with a sensor that detects poses of the visitor's body. The system uses these poses as controls as visitor´s bodyparts are freely moved and reflected by a virtual human body as if it was a scanner. By selecting a specific body part, the extensive content related to the bacteria of that chosen part is shown. Example **5),** found in the Vikings section of the Moesgård Museum, is designed for ethnography and is located in the city of Aarhus, Denmark. It consists of hung pendants tokens, inside which there are radio frequency ID chips (RFIDs). Visitors, upon entering the room, choose one or more tokens relative to the character that most interests them. With these, they can hear different versions of narrative explanations about the sculptures or historical objects just by placing the desired pendant on the receivers.


**Fig. 10:** Image A: Interaction 4) Body Scan. Design by Kossman.dejong. Source: Thijs Wolzak. Available at: <http://bit.ly/2P3Oo1U> [Accessed August 2019]. Image B: Interaction 5) Narratives by Tokens. Source: Ricca, 2019.

### 3.5 Multiple Stimulus – Multiple Response (2-B)

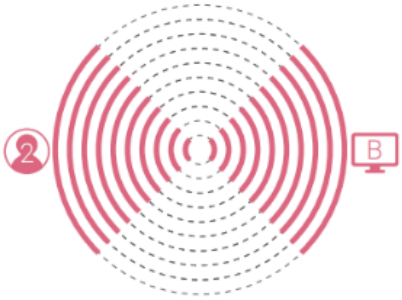


**Fig. 11:** Typology 2-B. Source: The authors (2019).

This is the typology most often found in the spaces visited, and these allow the visitor to have a certain multiplicity of possible actions, allowing also for varied responses, without, however, being fully open. It was noted that this type of interaction generates, at times, stimuli considered enriching for visitors, as it allows a greater dissemination of information in the exchange.Case **6)Microbe Wall** consists of a set of 30 stamp machines located in each one of the exposition stations at the Micropia Museum. When in front of an explanation regarding a specific microorganism, participants can stamp it on their visitor´s map, which, at the end, can be read on a digital table that projects animations with the collected organisms. Case **7) Game of Droughts**, located at the Cais do Sertão Museum in Recife, consists of an interaction in which singer Tom Zé narrates an interactive game of strategic challenges with the objective of ending the drought problem. The game system is based on competition between participants. The winner is the one who implements the most solutions that not only solve the drought problem temporarily, but also in the long run.


**Fig. 12:** Image A: Interaction 6) Microbe Wall. Source: ART+COM Studios. Available at: <https://artcom.de/en/project/micropia/> [Accessed November 2019]. Image B: Interaction 5) Game of Droughts. Source: Livre Opinião – Ideias em debate. Available at: <shorturl.at/gnAC3> [Accessed November 2019].

In the chosen examples, it was possible to notice that such multiplicity of input and output is also a generator of social interactions, dialogues, and moments of playfulness, as perceived in these and other visited cases. Thus, relevant aspects are produced in the sense of transcending the limit of the identified multiplicity, enabling different manners of construction and dissemination of didactic information from the different design strategies of these artifacts.

### 3.6 Multiple Stimulus - Open Response (2-C)


**Fig. 13:** Typology 2-C. Source: The authors (2019).

The classification **2-C** is characterized by a multiplicity of stimuli (inputs) giving rise to variable response possibilities (outputs). When analyzing the application of this proposed typology, it was noted that, as with categories 1-B and 2-C, the forms of input are more limited here than those of the output. Category **2-C** aligned with only one of the cases in this exploratory research, which is case **8) The Portrait Machine** located in the Aros Museum of contemporary art. This interface enables the visitor to strike a specific body pose among a limited number of options and, from its captured image, generate an output of collages with different parts of various works from the collection. This response is characterized as open because it never repeats and is always variable, and it depends on visitors and their interaction with each other. The image shows the result generated from the researcher's interaction with this interface.


**Fig. 14:** Interaction 8) The Portrait Machine. Fonte: Ricca, 2019.

### 3.7 Open Stimulus – linear response (3-A)


**Fig. 15:** Typology 3-A. Source: The authors (2019).

In the context of open stimulus modalities, category **3-A** is defined as an interactive artifact typology in which visitors have a great deal of freedom within the system and the system responds to their information in a standardized way. The case that fits this description is **9) Exploded View**, which is located in the Swiss National Museum. In it, the visitor, by moving a concrete sphere, can go to several monuments around the world. Representations of the monuments are constructed of point clouds generated by the triangulation of innumerable tourist photos taken from different angles at these locations. The visitor's point of view has complete freedom to move about while the interface monuments do not change at all and only show varying angles in point clouds.

**Fig. 16:** Interaction 9) Exploded View. Source: Ricca, 2019.

### 3.8 Open stimulus – multiple responses (3-B)


**Fig. 17:** Typology 3-B. Source: The authors (2019).

In category **3-B,** the left side indicates that the possibilities for information input are open, and they produce multiple system responses, as depicted. This interaction typology allows the visitor to have freedom in their way of stimulate the system, and the system responds with multiple, though limited, possibilities. A case that expresses this typology is **10) Sketch your idea!**at the Cooper Hewitt Design Museum in New York. In it, visitors can create any shape they want with a system containing a pen and a digital table. The system interprets possible modeling options within the limitations of the collection which then transforms into different typologies of design artifacts: table, lamp, chair, etc.

Other cases that fit this category are several interfaces that use Artificial Intelligence (AI) to interpret visitor stimuli, such as partnerships between IBM and the Museum of Tomorrow, creating the system **11)*IRIS* +**, and the Pinacoteca do Estado de São Paulo that exhibits the project **12) The Voice of Art**. These partnerships have applied Watson AI to these cultural spaces, demonstrating a machine learning system response emitterthat, starting with open questions coming from the user, can even be interpreted by visitors as a fluid conversation, a dialogue in real-time with the machine, that is, in fact, based on predetermined responses recorded by humans beings.


**Fig. 18:** Image A: Interaction 10) Sketch your idea! Source: Chan and Cope (2015). Image B: Interaction 11) IRIS+. Source: Guilherme Leporace/CASACOR. Available at: <https://casacor.abril.com.br/noticias/iris-a-nova-inteligencia-artificial-do-museu-do-amanha/> [Accessed November 2019]. Image C: Interaction 12) The Voice of Art. Source: Ricca, 2019.

### 3.9 3-C: Open stimulus – open response (3-C)


**Fig. 19:** Typology 3-C. Source: The authors (2019).

From the analyzed cases, it was decided that allowing freedom of stimuli and responses within open possibilities offers different ways for the visitor to relate, be it with the information itself, with the interface, or

with the museum space and other visitors, thus permitting space for the unexpected to occur such that surprise can manifest itself and new forms of information construction can take place. Modalities of openness like these arise, as represented on both sides of the circle in the figure, and stimulate more playful possibilities for the visitor's relational interactions and contain aspects outside the interface itself that often make the interaction richer and more social and the dissemination of information, in most cases, more effective. For these reasons, this typology of categorization is considered closest to the definitions of dialogic interaction cited by several authors in the theoretical references (Campbell, 2000; Carneiro, 2014; Dubberly, Pangaro and Haque, 2009; Glynn, 2008).

The cases chosen to exemplify this category are: **13) Reliefs of the Earth in 3D** at the Catavento Museum in São Paulo; and **14) The Recording Booth** at the ARoS Museum. Case **13)** consists of a sandbox on which is projected, via augmented reality (AR), an image of reliefs and contours from the heights found in hills and slopes created by visitors themselves by handling the sand. The projector is connected to a computer that is integrated with a Kinect device that perceives distances and modifies the projected image in real-time to teach topography. Case **14)** consists of a recording booth in which there is a screen that displays instructions. There, two or more visitors are invited to answer questions about a work they select from the collection selected by them which are not aimed at testing knowledge, but instead stimulating questions that foster dialogues and social interactions. The recorded material becomes a video and a GIF sent by email for use and sharing and it remains in constant replay on museum screens, effectively making the visitor part of the collection. These enable the visitor to interact openly with the interface, which also responds in a unique way.

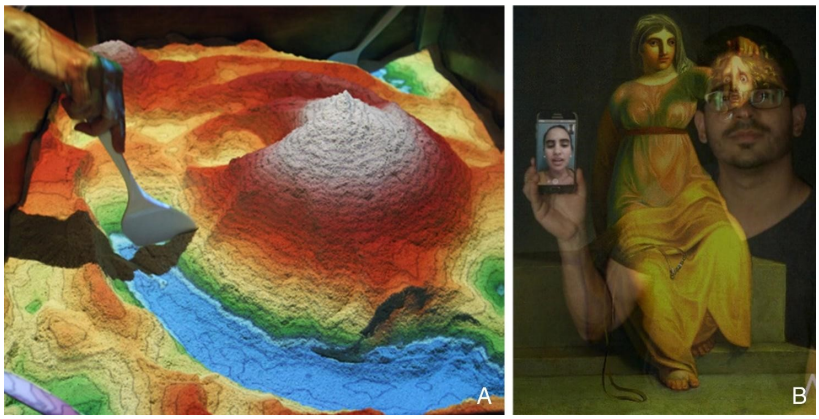


**Fig. 20:** Image A: Interaction 13) 3D Earth Reliefs. Source: University of California, Davis. Available at: <https://www.oceanit.com/products/augmented-reality-sandbox> [Accessed November 2019]. Image B: Interaction with Remote User 14) The Recording Booth. Source: Ricca, 2019.

## 4 Conclusion

Several types of interactions and possible consequences of their use for knowledge building and visitation experience enhancement were indicated in the text. The modality of classification realized here depended on the citation of practical examples in order to reflect the varied possibilities of using digital technology in content mediators located in exhibition spaces. With the cases listed here and the proposed analyses, it could be inferred that diverse design strategies can be directly related to subjective intentions directed at visitors, allowing new users to be encouraged to engage in these experiences, which in turn allow a broadening of social strata in these institutions as well as innovative possibilities for information transmission.

It was noted that the authors and experts cited here report in a similar manner on these typologies of interaction. By using diversified nomenclatures, many seek to define the same structural essence in de facto interactive environments. In sum, what these authors convey is a division based on how the type of logic routine for input and response output is implemented. For future works, it is interesting to note how this demand for more significant relationships with machines is repeated by several authors, deepening the points where these are differentiated. It is clear that interactivity at the dialogic level (3-C - open-open) is a challenge to be met, and that few cases show themselves as successful in this regard.

With the events analyzed here, the assumption is valid that, for the institution, choosing to allow interaction with such interfaces means giving visitors the possibility to change the stimuli and the responses of the system, thus giving rise to various forms of elaboration and dissemination of content. Further, this way the designer does not have to limit possibilities but instead can widen them, and, in a positive way, explore rules and limitations and also playful, spontaneous social relations. According to Glanville (2001), the interaction itself deals with the undetermined and is a product of a circular, non-causal and uncontrolled relation. Gordon Pask discusses the importance of interaction and the need for novelty so that people engage in situations with their environment: “Man is inclined to seek novelty in his environment and, having found a new situation, to learn to control it” (1971, p.76). Based on these and other reflections pointed out in this paper it is possible to

assume that a simple series of actions in a linear sequence can be limited and fail to open a space to novelty, that is, to the element of surprise in an interaction, and thus restrict the elaboration of information by limiting it in its possibilities.

**References**


Almeida, M. A., 2014. *Ambientes interativos: a relação entre jogos e design para a interação.* Ph.D. Universidade Federal de Minas Gerais.

Almeida, M. A., 2016. A teoria da ludificação e os ambientes responsivos. *Blucher Design Proceedings*, 3(1), pp.838-843.

Campbell, J., 2000. Delusions of dialogue: control and choice in interactive art. *Leonardo*, 33(2), pp.133-136.

Carneiro, G. P., 2014. *Arquitetura interativa: contextos, fundamentos e design.* Ph.D. Universidade de São Paulo.

Chan, S. and Cope, A., 2015. Strategies against Architecture: Interactive Media and Transformative Technology at the Cooper Hewitt, Smithsonian Design Museum. *Curator: The Museum Journal*, 58(3), pp.352-368.

Dubberly, H., Pangaro, P. and Haque, U., 2009. What is interaction?: are there different types? *Interactions*, 16(1), pp.69-75.

Faulkner, C., 1998. *The essence of human-computer interaction*. London: Prentice Hall.

Glanville, R., 2001. And he was magic. *Kybernetes*, 30(5/6), pp.652-673.

Glynn, R., 2008. Conversational environments revisited. In: *Meeting Of Cybernetics & Systems Research*. Graz, Austria.

Haque, U., 2007. The architectural relevance of Gordon Pask. *Architectural Design*, 77(4), pp.54-61.

Jensen, J. F., 2008. The concept of interactivity: revisited: four new typologies for a new media landscape. In: *ACM*, pp.129-132.

Moggridge, B. and Atkinson, B., 2007. *Designing interactions*. Cambridge, MA: MIT Press.

Pask, G., 1971. A comment, a case history and a plan. In: Reichardt, J. (Ed.)., 1971. *Cybernetics, Art and Ideas*. Greenwich, CT: New York Graphics Society. pp.76-99.

Pask, G., 1976. *Conversation theory: Applications in education and epistemology.* Amsterdam/New York: Elsevier.

Ricca, D. E. P., 2019. *Artefatos tecnológicos digitais interativos: estratégias projetuais para fomento da mediação de conteúdo em museus.* Master. Universidade de São Paulo.

Ricca, D. E. P. and Mazzilli, C. D. T. S., 2018. Content mediation and digital technology in museums: design strategies to enrich the visitor's experience. In: *Congresso da Sociedade Iberoamericana de Gráfica Digital ( SIGraDi ).*


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1 **1) More than skin deep** and **2) Test your balance!** at Ottobock Science Center in Berlin; **3) Waltz-Dice-Game** at the museum Haus der Musik in Vienna; **4) Body Scan** and **6) Microbe Wall** at the Micropia Museum in Amsterdam; **5) Narratives by Tokens** at the Moesgård Museum in Aarhus, Denmark; **7) Game of Droughts** at the Museu Cais do Sertão in Recife, Brazil; **8) The Portrait Machine** and **14) The Recording Booth** at the Aros Museum in Aarhus, Denmark; **9) Exploded View** at the Swiss National Museum; **10) Sketch your idea!** at the Cooper Hewitt Design Museum in New York; **11) IRIS+**, a partnership between IBM and the Museum of Tomorrow in Rio de Janeiro; **12) The Voice of Art**, a partnership between IBM and the Pinacoteca de São Paulo; **13) Revelations of the Land in 3D** at theMuseu Catavento in São Paulo.

2 It is noteworthy that this compilation of authors and their respective concepts regarding different forms of interaction was also addressed by the author in the article "Content mediation and digital technology in museums: design strategies to enrich the visitor's experience", published in SIGRADI in 2018 (Ricca and Mazzillo, 2018).