Exhibition Design and Professional Theories: The Development of an Astronomy Exhibition

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Abstract

In their chapter 'Exhibition Design and Professional Theories' Dirk vom Lehn, Kate Sang, Richard Glassborow and Louise King's authors explore the development of an interactive gallery from its inception through to its deployment in an observatory. They consider how the design team used a generic concept of the relationship between audience, exhibition content and its interpretation to develop an exhibition for an 'imagined audience' whose composition, knowledge and interests as well as actions are drawn from visitor research.

Introduction

Scientists, policymakers and science educators are concerned with people's disengagement with and lack of interest in science. Since the late 1990s, science centres, museums and other science-related exhibitions have been developed all around the world to re-engage people with science and scientific debates (Hein, 1990). The case study examined here is an example of an exhibition created during this science exhibition boom. While a large body of research explores visitors' engagement with science in these kinds of exhibitions (Falk & Dierking, 2000; Hein, 1998), there is a dearth of studies investigating the development of science exhibitions. This chapter is an important initial step to address this gap in research. It contributes to related research on exhibition design and curatorial work conducted in the context of art exhibitions (Acord, 2010; Acord & DeNora, 2008; Kreps, 2003).

Our study focuses strongly on professional theories about the 'imagined audience' that underpins the work of the interactive designer and his team. These professional theories are critical tools and resources for the designer and his or her team when they generate ideas for exhibits that are supposed to engage the audience with scientific concepts of astronomy, such as light waves and

gravity. At the time, when team members develop the exhibition, they do not yet know its audience. The uncertainty about audience is increased by the fact that the observatory is frequented not only by local people, but also by tourists from all over the world. As we will show in the analysis, the design team decided to develop interactive exhibits, some of which involved the use of digital technology. The team thereby was concerned about overshadowing visitors' experience with digital features of the exhibition. The chapter explores the development of the exhibition from initial ideas through to the deployment of exhibits. We will investigate how members of the design team deployed professional theories about the imagined audience to inform the development of the interactive exhibits.

Methods and Data

For the purpose of the research, the first author of this paper regularly met with the creative director and interactive designer during the design process and conducted informal narrative interviews, during which notes were taken and documents relevant to the design process were copied. The interviews lasted for about an hour each and were set up to obtain an understanding of the organisation of the design process and to identify challenges. In this sense, we followed what Holstein and Gubrium (1995) call an 'active interview'. The interviewee is not considered a passive 'vessel waiting to be tapped'; rather, the interviewer and interviewee collaborate in the interview.

In interviews, participants were encouraged to specify their perspectives and explicate their views on the content of the exhibition. Within the interviews and discussions, participants used diagrams, sketches and reports by an external audience consultant to discuss their exhibition concepts and ideas. We used these visual and written documents to support our analysis of the design process and its relationship to the audience (Silverman, 2001, 2009).

The content of the interviews and discussions, together with the visual and written material, was systematically examined to allow us to explicate how the creative director and the broader design team conceptualise the audience and its behaviour. The analysis initially examined the data for references to the audience and its behaviour. We then returned to the interactive designer and creative director for further informal discussions about their views of the visitors to further focus the analysis. The analysis allowed us to understand how the design team progressed with the design process up to the deployment of the exhibits in the observatory.

The members of the design team were informed that they were participating in a research project. At the beginning of the project, the interactive designer introduced the researcher to the members of

the team. The research explained the purpose of the project and informed participants of their right to withdraw from the research at any point. As we proceeded with the analysis, the interactive designer and creative director became increasingly interested in using the research process to reflect on their work. Their increasing involvement in the analysis led to the decision to co-author this paper, which enhanced the reflective process (cf. Schön, 1983).

From Audience Research to Exhibition Design

There is hardly any product that is not tested with consumers or at least based on knowledge about consumers' preferences before it is developed. The purpose of audience research with consumers prior to and during the process of product development is to ensure the market success of new products (van Kleef, van Trijp & Luning, 2005). This is true for new products in all industries, including tourism and museums (Hodgson, 1990). The audience research undertaken for the development of new exhibitions has methodological similarities to sociological research concerned with participation in the arts; it uses surveys and interview techniques to identify different segments of the population who are visitors or non-visitors of museums (Hanquinet, 2013; Hanquinet, Roose & Savage, 2013; Tolmie, Benford, Greenhalgh, Rodden & Reeves, 2014). However, it differs in purpose, as it is undertaken to inform the development of a particular exhibition rather than to investigate people's interest and engagement in the arts generally. In this section, we explore how the design team used information about the audience to communicate its decisions about exhibition themes and content.

Informing Exhibition Design through Audience Research

When the managers of the observatory decided to renew parts of the exhibition, they employed a consultant with expertise in museum audiences to explore the socio-demographic composition of its current audience and investigate current visitors' attitude towards and knowledge of astronomy. The consultant conducted a survey of visitors attending the existing exhibition in the observatory and undertook qualitative interviews with teachers, members of the local community and visitors in the present gallery. From her analysis, the consultant produced a report that created a typology of audiences: 'local audience', 'overseas visitors', 'family visitors' and 'formal education groups'. The analysis of the interviews with audience members led her to suggest that people considered astronomy very 'technical', 'scientific' and 'difficult to access'.

The audience consultant's report provided exhibition management with valuable information for the writing of the design brief that was used to tender for a design team. Management also used the information in the report to offer the successful tendering design team information about the likely audience of the redeveloped galleries, the anticipated audience's motivations, interests, knowledge, attitudes and expectations towards astronomy, and the forms of audience engagement anticipated or desired in the new exhibition. Moreover, the discussions between management and design team, and the report itself, generated information used by the design team to develop the exhibition.

The Design Team and Design Approach

The design team comprised an exhibitions manager and interactive designer, who worked with specialists from other companies for the production of the exhibits. The exhibitions manager had many years' experience in exhibition design and was therefore able to mediate, manage and facilitate the specialists, who were from outside the museum, into a small core team. As part of regular meetings with the observatory's management, the team presented ideas and progress reports on the redevelopment of the galleries. Communication about the project was underpinned by a general model, the design approach (see Figure 1). This approach allowed team members to present the project coherently to different audiences. The design approach used by the interactive designer—employed in several other projects—helps team members describe the relationship between audience, (exhibition) content and (exhibition) interpretation. Figure 1 shows the three components of the model and highlights variables that further specify them.
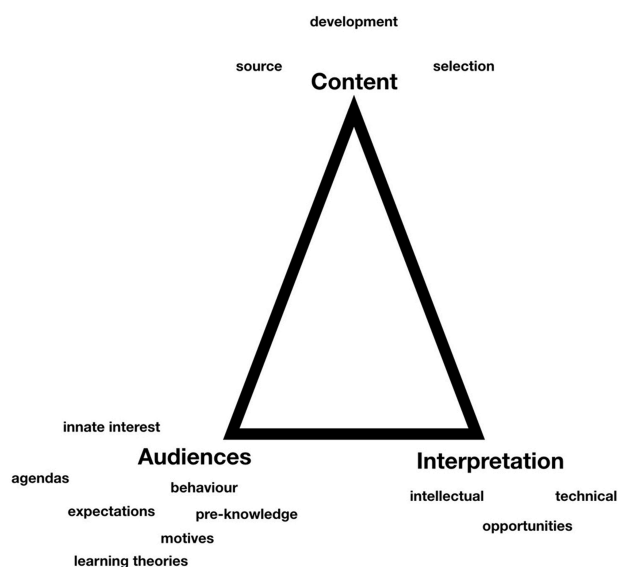

Figure 1: The 'design approach': The key tool to communicate about the exhibition.

Despite its generic nature, the model is sufficiently flexible to allow adaptations of its components regarding the specific requirements of design projects. While the three core components of the approach—audience, content and interpretation—remain unchanged, how the members of the design team refer to these components, relate them with each other and discuss them varies. This depends on the specific situation in which the design team discusses particular aspects of the project. Therefore, the model is a key tool to maintain and demonstrate the coherence of the project that is produced and advanced by the designer, exhibition managers, museum management, fabricators and museum educators. The malleability of the model for use in different contexts is ensured by its generic components that participants can specify in discussion to pursue their individual agendas while talking a common language.

The model is of particular importance when, in meetings with management, the designer explains the reasoning behind his or her decisions. In the following, we will explore how the interactive designer used the design approach by interweaving it with information about the audience to communicate design ideas and decisions.

Interpreting Concepts, Designing Exhibit: Deploying Professional Theories

The design team and museum management met regularly throughout the project. In initial meetings, the team used the audience consultant's report to develop a 'proposal' for the galleries. Over the course of the project, this proposal was further developed and turned into a series of 'content plans and scheme designs', which were delivered in subsequent meetings. At these meetings, the interactive designer used the design approach as a template that was progressively turned from a generic model into a description of what the exhibits will achieve and how they will appear when deployed in the gallery. During the design process, plans and proposals were subject to changes but eventually, they resulted in concrete exhibits installed on the exhibition floor.

These exhibits were developed regarding themes related to astronomy that the management had identified as key for the exhibition: 'the universe', 'galaxies', 'stars', 'planets', 'gravity' and 'light'. From here, the design process involved decisions about the content of the exhibition. The team members conducted desk research to identify phenomena linked to these themes and explored ways these phenomena could be interpreted technically and intellectually for the expected audience.

Throughout the design process, management and design team have information only about the current audience and people living in the neighbourhood. They use this information to speculate about the audience that will visit the exhibition and combine it with:

- their experience from other projects

- their academic training

- knowledge of visitor behaviour acquired from reading visitor research literature

- their own visits to museums

- hearsay and so on.

This helps generate *professional theories* about the identity and demographics of audiences, their innate interest and knowledge about astronomy, their agendas, expectations and motives, and their behaviour in the galleries.

Regarding the development of the galleries in the observatory, the design team deployed three professional theories when accounting for their design decisions: 'People want interactivity', 'interaction and collaboration enhance participation and learning' and 'people want to connect with experts'.

People Want Interactivity

The decision for the development of an interactive exhibition originated in the audience consultant's finding that interviewees felt astronomy was a very 'abstract science' that they find 'difficult to access'. Although the design team's decisions were not based on scientific research, in presentations and discussions the interactive designer referred to scientific research to account for suggestions and decisions about the development of interactives. In particular, the interactive designer drew on constructivist theories that argue hands-on activities are more effective in increasing people's attention and facilitating learning than are more passive forms of engagement. In his presentations, he occasionally mentioned Piaget, the Swiss psychologist, and referred to contemporary discussions in visitor research and museum education, such as publications on learning in and from museums by Falk and Dierking (2000) and Hein (1998). Through these scientific arguments, the interactive designer underpinned decisions about the deployment of interactives that encourage people to actively engage with exhibits. He implied that 'interaction with exhibits' can reduce the intellectual 'distance' between the audience and the 'abstract science' of astronomy.

Having decided to develop an exhibition that at its heart will be 'interactive', the design team and museum management had to make further decisions on how to interpret the 'big issues' of 'the universe', 'galaxies', 'stars', 'planets', 'gravity' and 'light' through interactive exhibits. One exhibit was concerned with the astronomers' tools and 'how they know what they know'. *The Dice*

Interactive (see Figure 2) interprets 'the computer modelling of gravity' by offering visitors the opportunity to conduct experiments with and understand the workings of gravitational forces in space. The exhibit encourages them to arrange a number of dice with different symbols on them—each representing a planet or other mass—on a tabletop. The dice embody the variables relevant to the effects of gravity in one intuitive interface; the size of each dice indicates the mass of the object, and the number of arrows printed on each face of the dice indicates the speed and direction of movement. The distance between the dice represents distance between objects in space. An industrial vision recognition system captures the initial condition of the dice and the symbols on them, and a computer system translates and displays this information on a computer screen. When the computer model is activated, the result displayed is a computer-generated model of how the objects would behave according to the laws of gravity—orbiting, colliding or escaping objects. A flipbook is provided to guide visitors towards interesting and revealing ways of arranging the dice or to facilitate their own experimentation.

Figure 2: *The Dice Interactive* exhibit.

The interpretation of gravity through this interactive exhibit embodies the design team and management's theory that 'people want interactivity' and that learning about the abstract concept of 'gravity' will be enhanced through interaction. They expect that people's apprehension of astronomy as 'abstract' and 'difficult' (consultant report) can be refuted if they engage 'hands-on' with an exhibit related to this abstract concept. The exhibit allows people to play with the dice without needing to understand complex science. As they play, experiment, inquire and observe the exhibit's response to their action, including reading associated information in the flipbook, there is, as the designer says, 'hopefully a progressive closing of the gap between "difficult" abstract concepts and visitors' knowledge and understanding' (interactive designer).

The flipbook provides a clear illustration of the role of theories in design. It was added late in the design process as a supplement to the exhibit, 'not as instructions' but as 'prompts' (interactive designer) designed to appeal to different types of user behaviour or learning style. As such, this simple device combines both academic and professional theories. Further, as a sequel to the exhibition under discussion, the visitor behaviour observed in summative evaluation of this device and its role in user engagement with the whole exhibit influenced further development of the interactive designer's theories in support of subsequent projects.

In another exhibit, the design team interpreted 'light' as a continuum of the electromagnetic spectrum, of which visible light is only a small part, using interactive exhibits such as *The Infra-red Camera* (see Figure 3). The exhibit comprises an infra-red camera mounted above a table and directed down towards a plastic filter that is opaque to visible light but transparent to infra-red light. Visitors are directed by the design and the exhibit label to place one of their hands underneath this filter. Due to the physical properties of the filter, the hand cannot be seen with the naked eye. Yet, when they look up to a display screen next to the camera, they see an image of their hand captured by the infra-red camera (which can indeed 'see' through the filter). The exhibit offers a direct encounter with a phenomenon and firsthand 'proof' that information can be detected using 'light' outside the spectrum visible to our eyes.

Figure 3: *The Infra-red Camera* exhibit.

Like *The Dice Interactive*, *The Infra-red Camera* exhibit uses an activity by a visitor to encourage participation in and engagement with an abstract scientific concept. The idea for the exhibit is based on the design team's professional theory that people want interactivity and that interactivity can be used to kindle visitors' interest in science, maintain their attention on a scientific problem and support visitors' understanding of abstract scientific concepts like light waves. The professional

theories have been derived from information gathered at visitor studies conferences and from academic literature on visitor behaviour and learning.

These two exhibits are exemplary for the interactives deployed in the galleries of the observatory. Their design starts with information about the audience from the consultant's report and general themes in astronomy that the exhibition management considered central to the galleries and key to the exhibition. In discussion with the creative designers, the exhibition management, his team and the interactive designer interpreted the generic content and created 'interactives' that closed the intellectual gap between visitors and the academic discipline of 'astronomy' through 'hands-on activities'. In addition to these two interactives, the design team developed exhibits that encouraged a range of different interactive exhibits, such as a telescope powered by a computer system that allowed visitors to explore a virtual night sky, and an interactive exhibit that enabled visitors to observe a selection of space objects using different frequencies of light. The design of these and other exhibits in the observatory were based on the theory that people want interactivity. In meetings, the exhibition management often referred to this theory to account for design decisions.

Interaction and Collaboration Enhance Participation and Learning

From the interviews, it transpired that most visitors came to the exhibition with family or friends. In interviews with the audience consultant, visitors highlighted that they came to 'spend family time' and 'have fun'. The interviewees' emphasis on the social aspects of the museum visit, coupled with academic literature that highlights the importance of social interaction and talk for cognitive development and learning (Falk & Dierking, 2000; Lave & Rogoff, 1984; vom Lehn, Heath & Hindmarsh, 2005; vom Lehn, 2010), encouraged the designer to propose exhibits that facilitate and support collaboration and discussion. The designer knew from his experience with other exhibitions that such collaborative exhibits also needed to work for individual visitors. Together with his team, he proposed and developed a computer-based interactive, *Space Probe*, that allowed between one and three people to simultaneously engage in a game. This game simulated the collaboration among a team of space scientists and engineers working together to launch a rocket into space.

Space Probe is a large installation comprising three individual workstations in front of a large screen equipped with loudspeakers that publicise information related to the activity throughout the gallery (see Figure 4).

Figure 4: The *Space Probe* exhibit.

The design team intended for the game to be played by up to three players, each standing at one of the touchscreen systems; if there are fewer than three players present, the computer system takes on the role of the (missing) team members, allowing the exhibit to work for individuals or two visitors. The players each take a different role in a team—engineer, scientist and communications officer—that is given the task of equipping a probe with the correct instruments to explore outer space. The design of the exhibit interpreted the theme 'space' and demonstrated to visitors that knowledge about astronomy is critical for space travel and the launching of rockets. The design of the exhibit and the structure of the game enabled collaboration between unacquainted people who just happened to arrive at the exhibit at the same time.

The design team drew on professional theories about interaction, academic literature and information from the audience report stating that people enjoy the social experience of museums to develop an exhibit that facilitates collaborative participation in a game related to the abstract concept of space and space travel. Moreover, the design of the exhibit shows the team's response to information about the audience's 'wants' and 'agendas' as voiced in interviews with the consultant. This information provided the designer and management with a rationale for the deployment of this exhibit, which allows small groups and families to jointly engage in the activity.

People Want to Connect with Experts

The consultant's report stated, 'the audience, overall, knows the observatory's historic connection with time and space, but believes it to be an aloof and difficult place'. It also suggested the creation of a space in which visitors could 'meet experts' and learn about space through 'talking with' and 'listening to' actual astronomers. Seeing and hearing astronomers talk intelligibly about their discipline and its relevance to questions people have about space was considered by the exhibition management a way to make the discipline more approachable and further close the intellectual gap between the 'difficult' and 'abstract' discipline of astronomy and the audience.

However, it was clear that to have actual astronomers in the galleries on a regular basis and respond to people's questions about scientific concept was too costly and impractical for the observatory. Moreover, some visitors' questions could be answered by the knowledgeable staff in the planetarium in the same building, where films related to astronomy and the solar system were shown several times a day. Hence, management decided to structure the exhibition in a three-partite way. In the first room, a short film was shown on a wall-sized screen that introduced the audience to the abstract concepts of astronomy in a gentle but inspiring way. The room and film were provided by a specialist design company. Having viewed this introductory film about stars, the Milky Way and astronomy, visitors continue their journey through the observatory in the interactive galleries (Gallery 2) and in the third and final gallery, where the design team—together with the creative designer and exhibition management—deployed an exhibit that allowed visitors to hear answers to astronomy questions from experts (see Figure 5).

Figure 5: *Astronomy Questions.*

Astronomy Questions invites visitors to sit on a stool or stand at a large table that has a continuously moving star-scape projected onto the surface. By moving a hands-on 'probe', visitors can select a target space object within the star-scape. When an object is selected, a visual link is made between the table and a vertical screen behind it; a video shows an astronomer discussing the phenomenon. As the astronomer explains his or her work, key questions visitors might ask are displayed on the table. Questions selected by the visitor will then be answered by the scientist in a prerecorded video.

The table is about three metres long and has three movable stools. The screens are large enough and the audio sufficiently loud to allow people standing in the second and third rows to watch and hear the video. The design of the exhibit combines interactivity—the use of the probes on the table—with watching videos that show astronomers responding to questions about astronomy.

The design and deployment of the exhibit embodies the design team and management's theories about people's behaviour in the gallery. Interaction with the exhibit gives people the impression that they control the questions asked at the exhibit. Further, the design of films feature large headshots

of astronomers, indicating that they are talking directly to the person at the screen. Thus, the prerecorded responses to questions about astronomy are perceived as responses to the 'user' of the exhibit, although they really have been produced for a generic audience.

The design of the gallery allows visitors to experience the exhibit differently. The people on stools at the table experience the answers directly. Others can follow from positions in the second row, where—as third parties—they view the videos that have been selected by those at the table. Thus, the design of the exhibit, together with its placement in the galleries, draws on the design team's theories about the audience. From the consultant's report and their reading of the literature, the designer and exhibition manager know that people usually come with others to museums. They also know that the exhibition, at least at times, will be very busy and not all visitors will be able to find a stool. Hence, they decided to create space in which people can stand and observe the events at the exhibit, and hear and learn about astronomy by watching the video. Third parties become an audience, not only to visitors' use of the cones on the table, but also to the exhibit's responses (i.e. the video showing an astronomer discussing a scientific question or phenomenon).

Discussion

This chapter has discussed some intellectual resources used by design teams when creating an exhibition for an observatory. It shows how the team's generic concept, the design approach (see Figure 1), is coupled with information about the current audience of the observatory, and knowledge about visitor behaviour and learning to assemble professional theories about the audience. We have discussed three such theories that were regularly used by members of the design team, who discussed the project and presented it to the observatory's management.

The audience referred to by members of the design team is an 'imagined audience', not the audience that visits the exhibition after its deployment in the observatory. The notion of the 'imagined audience', sometimes defined as 'a person's mental conceptualization of the people with whom he or she is communicating' (Litt, 2012, p. 330; cf. Macdonald, 2002), originates in communication studies and research into face-to-face interactions (Litt, 2012). It often implies a psychological conception that is thought to help participants to align their conduct with each other in situations. Our study begins to reveal that the 'imagined audience' is socially constructed in the design process by all those participating. Its construction is derived from the consultant's report about 'the audience' and from 'professional theories' about visitor behaviour and people's experience of the exhibition assembled by the interactive designer and members of the design team.

The professional theories that inform the communication about design ideas, proposals and decisions are social and collaborative attainments by all those involved in the development of the exhibition. This collaborative attainment involves the audience research consultant, her report about the 'audience' and discussions about the project between the creative director, interactive designer and design team. In these discussions, the designer and members of the team interweave information from the consultant's report with their knowledge of visitor behaviour, which is drawn from academic literature and their personal experience in exhibitions. At this stage of the design process, the consultant, design team and museum management do not know the real audience; they rely on theories of visitors' interest in and attitudes towards astronomy and science, and theories of visitor behaviour to make decisions about exhibits.

The professional theories are not a stable construct; they are a flexible tool used in discussions, meetings and presentations. The participants are able to maintain coherence when talking about the design of the exhibition by linking the theories with their generic design approach, which captures the relationship between interpretation, content and audience. The visualisation is sufficiently generic and malleable to allow its use in communication with the various stakeholders in the project, thus maintaining coherence in the communication. It allows the designer to translate contingent information about the audience and the exhibition, as well as emerging ideas and requests communicated by the museum management into concrete design proposals and decisions. Moreover, by referring to the same visualisation in meetings throughout the project, the designer is able to present the process as coherent; there might be changes in the detail, but the general structure of the project is maintained. Thus, design proposals and decisions about exhibition content and the interpretation are legitimised by embedding them within a concept that, according to the designer, when used in meetings with the team and museum management, has proven effective and useful.

By studying how the interactive designer and his team use professional theories in communications about their work, we begin to observe that these theories are not stable objects; rather, they are contingent and collaborative constructs that designers deploy for the practical purposes at hand. In this chapter, we have only touched on this link between professional theories and the work of designers. Future research will examine audio recordings and field notes from the design meetings to unpack the creative process and how it draws on professional theories.

Save for these findings about the process of exhibition design, the chapter is an example of a multidisciplinary collaboration between a sociologist, the principal author, a marketing scholar and two members of the design team who were actively involved in the design project under scrutiny.

Their design work has been the subject of the study. Therefore, the analysis has taken considerable time, as sociologists and designers have discussed the interpretation of the data. The interpretation process and the co-writing of the article have given the designers opportunities to reflect on their work and apply the learnings to their practice in this project (Schön, 1983). The co-analysis of other design projects will advance this reflective process, and we will determine if it influences designers' work.

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