

Preface

Science centers play a key role in many countries in popularizing science and technology to the public. By sensitizing the public through the provision of a context that allows them to realize how science and technology impact on their everyday lives and society, science centers provide an upstream initiative for the fostering of literacy in informal science. Their impact is to a significant extent confined to people who enter their premises to savor their attractions, though many science centers are also involved in outreach initiatives, which help to expand their influence further. Avenues that help science centers to reach out to more people will allow them to fulfill their mission objectives even more purposefully.

In recent times, the Internet has made a profound impact on various aspects of society, including education. The availability of a PC and a network point is opening up new possibilities for learning and other fruitful endeavors. It is testament to the vision of science centers that they have not overlooked the potential of the Internet to aid them further in their popularization efforts. This has led to the birth of the virtual science center, the Web-based equivalent of a traditional science center. Whilst pioneering efforts were limited to the offering of simple information on their Web sites, advances in technology have allowed science centers to unleash a slew of resources and other attractions on their Web sites, so much so that the virtual science center now constitutes a new genre of learning in informal science education.

This book aims to provide an overview of the state-of-the-art developments in the field of virtual science centers and address the needs of practitioners in this fast developing field. It is the first book on Web-based science centers to appear in the market. Addressed at science and technology centers, science museums, and researchers and practitioners in Web-based education, it offers an overview on developments in a new and emerging field of science education. Other target audiences for the book include teachers, multimedia developers, educational administrators, developers and managers of Web technologies, and Web content developers.

The 20 chapters accepted for publication in this book span a diverse spectrum of topics. It represents contributions from science centers/science museums, academia and other organizations. A total of 44 authors from 27 institutions are represented in

this effort. The international flavor of the book can be seen from the fact that the authors come from eleven countries: Brazil, Canada, Finland, France, Germany, Israel, Italy, Norway, Singapore, UK, and the US.

The 20 chapters are grouped into three sections: Theoretical Issues, Design Considerations and Case Studies. The choice of chapter assigned to a particular section is primarily determined by content coverage and, secondarily, by convenience for readers. Inevitably, there is bound to be some overlapping coverage in the three sections. A brief commentary on the various chapters follows.

Section I features six chapters on theoretical issues. The platform afforded by theoretical issues presents an opportunity to analyze issues from fundamental considerations. In the chapter titled *Establishing Identification in Virtual Science Museums: Creating Connections and Community*, Billie Jones draws on the identification metaphor from the communication domain to advance the view that science museums on the Web need to connect with their audience through suitable site design and content. This is indispensable for attracting site traffic as well as drawing repeat visitations from the Web-surfing public. Kathryn Haley Goldman and Lynn Dierking, in their chapter *Free-Choice Learning Research and the Virtual Science Center: Establishing a Research Agenda*, suggest that the contextual model of learning can be a useful tool to understand the virtual science center and help frame a research agenda for free choice learning — learning that is self-directed and voluntary. They suggest that better understanding of the nature of such virtual experiences and the factors that contribute to online learning will enable science centers to better design their virtual domains as well as build a knowledge base on how people engage in free choice learning online. In their chapter *Contextualized Virtual Science Centers*, Andreas Zimmermann, Andreas Lorenz and Marcus Specht argue the need to consider issues such as modality, reception style, technical limitations, location and time when contextualizing information delivery on the Web-based science center. They draw on information brokering techniques to advance an approach for the development and maintenance of context-sensitive systems and techniques suitable for virtual science centers. Bronwyn Bevan, in her chapter *Starting With What We Know: A CILS Framework for Moving from Physical to Virtual Science Learning Environments*, considers how the essential characteristics of learning within science centers can be translated and applied to learning in Web-based science centers. She advances the view that science centers need to leverage on their intrinsic strengths and unique pedagogy to fill an educational niche in the Web landscape rather than compete with commercial and other educational agencies engaged in the development of online learning environments. In the chapter on *Weaving Science Webs: E-Learning and Virtual Science Centers*, Susan Hazan suggests the need for science and technology to be placed in a social context that solubilizes the perceived boundaries between art, culture and science that are inscribed in institutional activities. Using examples from museums and other online architectures, she explores innovative systems that harvest data across electronic highways, online collaborations between museums and their public, and other narratives that invigorate community knowledge and stimulate science discourse. In the chapter *Resource-Based Learning and Informal Learning Environments: Prospects and Challenges*, Janette Hill, Michael Hannafin and Denise Domizi explore how a resource-based learning approach can be implemented on the Web sites of science centers. They describe opportunities and challenges associated with such an endeavor.

Section II features eight chapters that focus on design considerations. The allure of a virtual science center hinges significantly on its design as much as its content. Design elements that are compelling have the advantage of adding value to the content hosted on the Web sites of science centers. Michael Douma and Horace Dediu, in their chapter *Interactivity Techniques: Practical Suggestions for Interactive Web Sites* draw on their experience and expertise in creating interactive Web sites to offer comprehensive advice to science centers on making online exhibits interactive. Indeed, interactive exhibits are a major consideration in drawing online visitors to the Web sites of science centers as well as helping to extend their dwell times there. In the chapter *From the Physical to the Virtual: Bringing Free-Choice Science Education Online*, Steven Allison-Bunnell and David Schaller draw on their experience and expertise to propose strategies for recreating science center exhibits online. They argue that while physical and virtual exhibits share certain common features, interactive virtual exhibits need to be configured in terms of the strengths and limitations of the Web. Anja Hoffmann, Stefan Göbel, Oliver Schneider and Ido Iurgel, in their chapter *Storytelling-Based Edutainment Applications*, underscore the need for science centers not to overlook the potential of storytelling contexts when interpreting science content online. Storytelling has the advantage of fostering easy connection with the audience, and interactives incorporating such narratives can confer yet another dimension to the learning process. While existing technological contexts have served Web-based science centers well, Ramesh Srinivasan argues on the need for science centers not to overlook the potential of new information architectures in his chapter *Revolutionizing Information Architectures Within Learning-Focused Web Sites*. He presents two approaches for information design: community driven ontologies and social information filtering agents, and addresses the question of how to share knowledge across a community of visitors without physical co-assembly. In her chapter titled *From Information Dissemination to Information Gathering: Using Virtual Exhibits and Content Databases in E-Learning Centers*, Joan Nordbotten draws on some of the experiences of traditional museums to provide pointers for science centers to use virtual exhibits and content databases in the e-learning process. She discusses how different e-learning architectures can support different forms of learning in Web-based science centers and science museums. Renata Piazzalunga and Saulo Barretto discuss some fundamental questions concerning creation and development of interfaces in their chapter *Challenges in Virtual Environment Design: An Architectural Approach to Virtual Spaces*. They address three levels of complexity and offer useful tips for science centers to re(design) their virtual space to promote better interaction with cyberspace visitors. The subject of personalization — how to tailor an e-learning experience for an individual visiting the Web site of a science center, is the focus of the chapter *Personalization Issues for Science Museum Web Sites and E-Learning*, by Silvia Filippini-Fantoni, Jonathan Bowen and Teresa Numerico. Science centers and science museums have yet to tap into this tool to a significant extent but it has the potential to draw repeat visitations and enhance user experience. John Falco, Patricia Barbanell, Dianna Newman and Suzanne Dewald, in their chapter *E-Learning and Virtual Science Centers: Designing Technology-Supported Curriculum*, propose a partnership model involving virtual science content providers that creates technology-infused science curriculum using interactive videoconferencing technologies and supporting Web resources. They argue that such enriched content can promote new structures of pedagogy that can motivate students to enhance their cognitive development.

Section 3 on case studies features six chapters. Case studies help to bridge the gap between theory and practice, and thus offer useful insights for science centers to learn from the experiences of others. In the chapter *A Virtual Museum Where Students Can Learn*, Nicoletta Di Blas, Paolo Paolini and Caterina Poggi use the example of the collaboration between the Israel Museum and the Politecnico di Milano to show how Internet and multimedia technologies can be effectively exploited to deliver complex scientific and cultural concepts to middle and high school students. It is based on a shared 3-D online environment where students from five different countries meet together to learn, discuss and play, thus dissolving the boundaries of space and time when reaching out to new audiences and promoting outreach. In his chapter *Open Learning Environments: Combining Web-Based Virtual and Hands-On Science Centre Learning*, Hannu Salmi recounts the experience of the Finnish Science Centre and other European science centers to show that the virtual science center need not be a disparate endeavor. By judiciously integrating elements of the gallery experience with the Web experience, he adds that new avenues for promoting effective learning can emerge. In their chapter *Use of Log Analysis and Text Mining for Simple Knowledge Extraction: Case Study of a Science Center on the Web*, Leo Tan Wee Hin, R. Subramaniam and Daniel Tan Teck Meng use log analysis of server data to study the Web site of the Singapore Science Centre. They present a commentary on the use of log analysis, an overlooked tool, for studying the effectiveness of content hosted on the Web sites of science centers. In the chapter *The Development of Science Museum Web Sites: Case Studies*, Jonathan Bowen, Jim Angus, Jim Bennett, Ann Borda, Andrew Hodges, Silvia Filippini-Fantoni and Alpay Beler trace the historical development and features of a number of pioneering science museum Web sites. These historical developments present useful insights for science museums and science centers, including those that have yet to transplant themselves onto the Web. Roxane Bernier, in her chapter *The Educational Approach of Virtual Science Centers: Two Web Case Studies*, uses the examples of The Exploratorium and the La Cité des Sciences et de l'Industrie to cement her argument that innovative pedagogy leveraging on real-time Web casting can act as a focus to enrich people's interest in the notion of public understanding of research. She suggests that a reflective perspective drawn from a multidisciplinary approach can aid science centers to form their own viewpoints on contemporary issues ranging from genetic engineering to space exploration. Jim Spadaccini, in his chapter *Real Science: Making Connections to Research and Scientific Data*, shows how compelling scientific imagery in a variety of fields of study that are publicly available can help science centers open up another niche area to help the public better understand scientific research and the scientific process. He draws on his experience and expertise with four key educational Web sites to provide useful perspectives.

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