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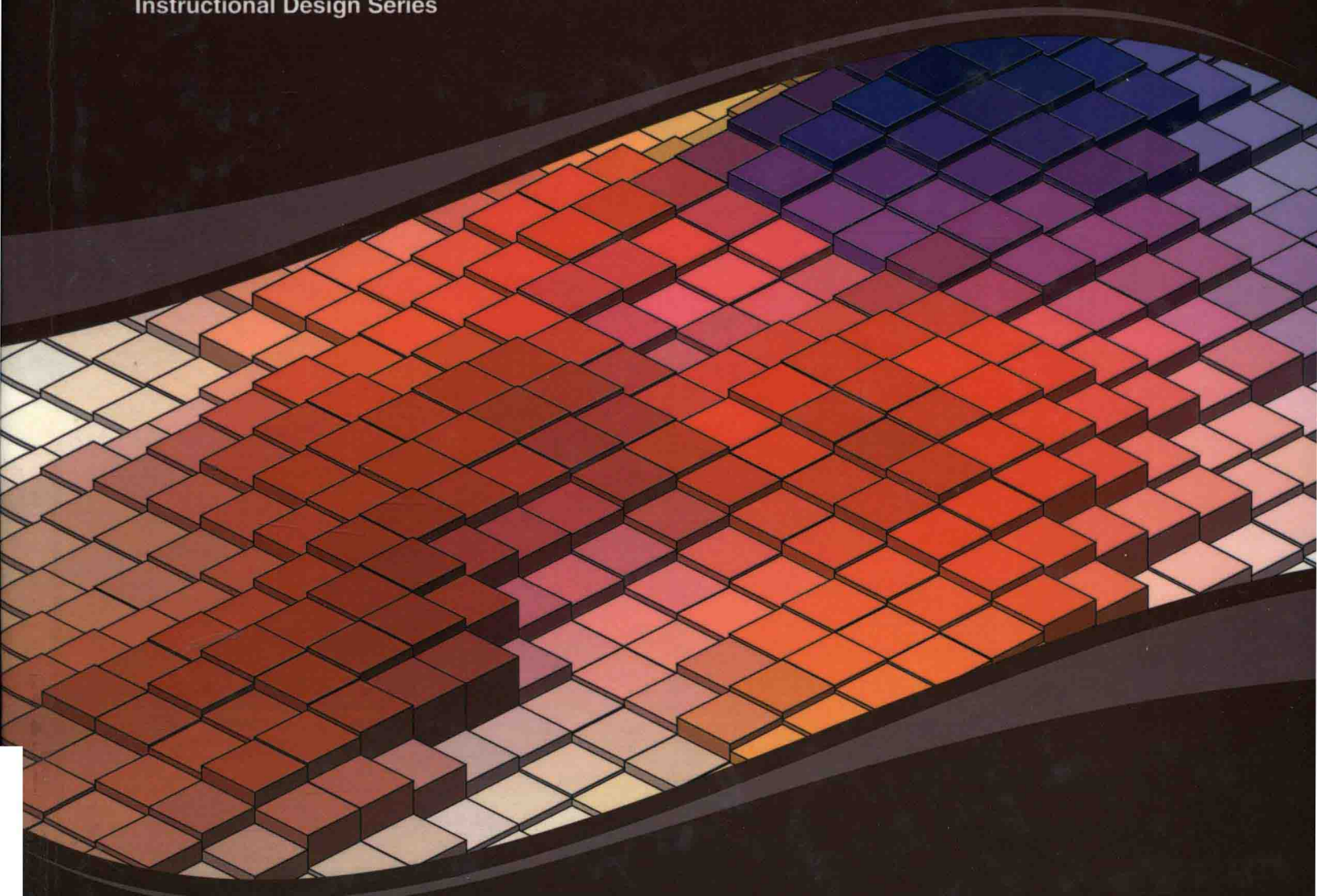

Shalin Hai-Jew

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Packaging Digital Information for Enhanced Learning and Analysis:

Data Visualization, Spatialization, and Multidimensionality

Shalin Hai-Jew
Kansas State University, U.S.A

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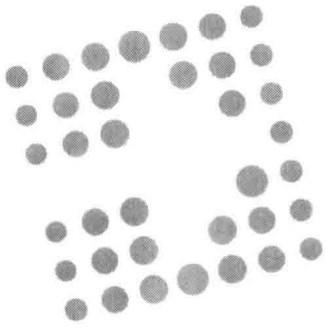

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Preface

The idea for *Packaging Digital Information for Enhanced Learning and Analysis: Data Visualization, Spatialization, Predictiveness, and Multidimensionality* came to me as I was taking part in a regional conference in Hutchinson, Kansas. I had given a short talk on a software tool that enabled the mapping of data to geographical space. The small audience had been generous and asked me to give the "TMI" (Too Much Information) version of the talk, which included some musing on the challenges of collecting and analyzing valid data to draw more accurate conclusions. I had stayed over an extra night in the town in order to take in some of their local wonders—a space museum and a historical salt mine. This was in April 2012. By the time I had driven the few hours back to my town, I had decided to write a book prospectus based on the notes roughed out in the hotel room. Now, more than a year later, the text itself has coalesced with a broad range of creative and achieved researchers who are sharing their insights on how to package data and information for enhanced comprehension, and ultimately, decision-making.

AN INFORMATION-CENTRIC WORLD

In another sense, this idea of packaging digital information has been a long time in coming. In my past seven years of working as an instructional designer at Kansas State University, I have come across many different opportunities to consume and analyze data. I have learned that practitioners in different domain fields have inherent standards for research and the integration of new information in the field. They have differing ways to validate data. They also have deeply held assumptions about understanding information based on acculturation to their respective fields. These are ways of understanding that have evolved over time and long thinking and much academic combat. In their expert-based conceptual models, they have information ontologies or structures. To create coherence for learning, these Subject Matter Experts (SMEs) would require both explicit and implicit clarity. They would have to control for misunderstandings. They would have to help novice learners come to the correct conclusions. Those who have been in the classroom for years begin to understand where common misunderstandings may occur as learners strive to make sense of the new information. These challenges become more difficult in dynamic and changing systems, cross-domain learning, real-world decision-making, problem solving, and in innovating. Each new challenge results in additional layers of complexity. Further, very few active learning domains have all the foundational information mapped out. Rather, most fields are actively conducting research for deeper knowledge. In graduate-level education, SMEs need to further convey what is unknown and perhaps the known limits of knowability without closing off possibilities.

The SME ability to articulate the learning is only one part of the challenge. Another part involves actualizing their vision in digital form. SMEs can often describe an idealized presentation of their knowledge, but it may not be fully feasible, given the constraints of the technologies, the budget, the time

constraints, and the scripting/coding constraints, among others. The numbers of file types (expressed in various file extensions) that may be used for delivery via the Web are finite, and there are de facto file types and accessibility standards.

Practically speaking, the design of a digital learning object requires a number of steps in order to achieve design coherence.

- The selectivity of data—inclusion or exclusion
- The order of the presentation (spatial, sequential, or other)
- The methods of the presentation (static or interactive; the selection of multimedia)
- The provided context and tone
- The cognitive scaffolding and other learning elements
- The evaluation methods

For any instructional design situation, there are a range of considerations. Depending on the project, some aspects come to the fore. The limitations (constraints) of software and technological sub-structures means that there is always a gap between the intentions of the subject matter expert and what is digitally rendered; further, there is also often a gap between the information delivered and what is perceived (in part because learners have not been trained in particular understandings).

By practice, there are conventions for digital packaging. For example, there is the "rule of threes" in the cropping of two-dimensional images. There are conventions in structuring non-fiction writing in rhetorical modes. Video scripts follow pre-set structures to capture viewer attention and contextualize the information. Trusted human or avatar hosts may serve as narrators to increase the veracity of a presentation. Slideshows follow dramatic storytelling trajectories. In various forms of modeling and simulations, the learning objects are designed to help learners perceive and understand relationships between variables and to see patterns, even at the cost of highly simplifying information.

To conceptualize the "packaging" of digital information, it helps to view information as a fluid and malleable substance. If treated in some ways, it takes on a form of its own. If treated in other ways, it may be transparent or opaque; it may take on a particular hue. Information may be elusive or very present and memorable. It may catalyze new ideas, or it may reaffirm existing understandings. It may inspire new thinking, or it may shut down learners. How people organize and present information affects how it is conceptualized and consumed.

While foundational design precepts are generally followed for various types of digital packaging, there is plenty of room for customizing for target learners or unique contexts; there is room for signature design. The examples suggested point to digital packaging around processed information. If there is an information pipeline, where raw data is captured and analyzed and processed into domain knowledge, the prior examples are usually used for data that has been highly processed into information. This digital design challenge is compounded with the presentation of new and raw data, which has not yet transmuted into some consensus understandings in a particular domain.

DIGITALLY PACKAGING RAW DATA

In this current age, a wide range of raw data is accessible. They stream in from sensor networks. They are collected on social media platforms, content sharing sites, microblogging sites, wikis, and email systems.

Learning management systems offer "big data" to analyze learner behaviors and profiles. Much of what is collected has defined usage for experts in a number of fields—for their awareness, research, analysis, and decision-making. Much of this data is delivered through user interface designs and componentized dashboards. Still other data, such as data extractions from social media platforms and the Internet, are portrayed as social network diagrams, which require some complex study in social network analysis to understand and exploit (These visuals are created by the extracted data through layout algorithms.). Data then is abstractions of the world; it is representational measures of particular aspects of the world. For this data to be relevant, users of those floods of data require clear understandings of what is being represented and what it might mean.

More and more, though, instructors and researchers are having to package digital contents from raw data and to make it make sense to colleagues and learners (This is especially so in cross-domain collaborations. Expertise in one domain field does not often transfer to expertise in others. However, there is a wide need to collaborate across fields. Designed data and information are then critical in helping others acclimate to a field.).

Ideally, area subject matter experts bring a seasoned expertise and an analytical aptitude to their reception (or rejection) of new data. They have the wherewithal to understand how the data was captured and then how it was rendered and delivered to the viewer. Depending on the data, there may be a range of possibly valid insights. The design challenge here involves how to present this data in a way that enables learners to make sense of it with accuracy. If a core competitive advantage in this modern age requires the ability to engage data practically, then surely, increasing data coherence for wide distribution is a critical goal. From the examples here and outside this work, it is clear that data coherence is achievable.

The content providers who provision raw data and processed information via the WWW and Internet have differentiated themselves from their competitors by their credibility, accuracy, speed, and methodologies. For most contents on any range of topics, there are only a handful or two of serious content providers. With such narrow streaming of data resources, it is all the more critical that such resources are digitally packaged with broadest usage and far-reaching clarity.

TARGET AUDIENCE

Those in higher education and K-12 are expected to use data analytics to enhance their decision-making for student learning and learning design. Therefore, it is critical for them to understand how to read complex data from Web interfaces.

Further, educators and instructional designers have to improve how they present complex data online so as to present their data with clarity and without miscommunication. Because data is used in many ways for many purposes, and most information today is delivered through Web and Internet, means for a broad audience, it is critical that there is a discussion on the optimal design approaches and practices.

The scholarly value of an edited collection is that those engaged in this work may share their learning and help propagate the best practices in this area to their colleagues. This work may also help those who are designing such systems to see educators' data analytics needs as a broad "use case" to improve the tools (both proprietary and open-source).

The potential audiences would be educators, trainers, instructional designers, Web designers, and graduate students. A strong design may stand the test of time (relatively speaking) with various fungible data and information contents.

AN OVERVIEW OF THE CONTENTS

Packaging Digital Information for Enhanced Learning and Analysis: Data Visualization, Spatialization, Predictiveness, and Multidimensionality was initially conceptualized to include a variety of approaches to the capturing of data and its representation to a broad audience. It was a stated goal to include work in K-20. In that sense, this would not capture data visualization for specialists who do not interface with the public. The initial call for chapter proposals included long sections on the disambiguation of data. It highlighted both static and dynamic information collection systems. It suggested spatialized information and digital mapping. It referred to the uses of data for trend-lining and predictive analytics. Finally, the element that would bring this together was the electronic visualization of the data—both on the Web and on desktop computing devices. This book achieved some of these initial objectives.

Every text is a work in motion. A collection is really a work by its respective authors, and *Packaging Digital Information for Enhanced Learning and Analysis...* captures a range of insights from the field. This provides a brief overview.

Section 1, "Principled Strategies in Packaging Digital Contents," includes works that articulate practical concepts and approaches to packaging digital materials. All of these insights are abstracted from actual practice. Dr. Mitch Ricketts's "Making Health Information Personal: How Anecdotes Bring Concepts to Life" (Ch. 1) shares an approach to creating visuals for teaching and learning about safety issues that brings in deep understandings of human perception, cognition, and learning. Brent A. Anders's "More than Just Data: The Importance of Motivation, Examples, and Feedback in Comprehending and Retaining Digital Information" (Ch. 2) elaborates on the human side of engaging with digital information for learning, based on the Attention, Relevance, Confidence, and Satisfaction (ARCS) model. Dr. Shalin Hai-Jew builds a partial typology of various types of branching logic applied in instructional design in "Branching Logic in the Design of Online Learning: A Partial Typology" (Ch. 3).

Section 2, "Innovative Technologies and Techniques in Packaging Digital Contents," focuses on creative applications of technologies for teaching and learning, information finding, training, and marketing outreach. Dr. Ya-Chun Shih describes an innovative mash-up of Web 2.0 and facial expression recognition in a 3D English classroom to bring authenticity to foreign language learning in "Weaving Web 2.0 and Facial Expression Recognition into the 3D Virtual English Classroom" (Ch. 4). Her chapter offers a variety of scenarios with creative applied curriculum. Dr. Rob Gibson describes the use of augmented reality to enhance library user experiences in "Utilizing Augmented Reality in Library Information Search" (Ch. 5). Dr. Roger McHaney, Lynda D. Spire, and Rosemary Boggs describe the multi-year collaborative project of creating a publicly available faculty module tool to enhance the quality of online teaching and learning at a university in "ELearningFacultyModules.org" (Ch. 6). This team describes the integration of an open-source wiki tool, MediaWiki, to actualize this vision of an interactive training resource. In "Multimodal Mapping of a University's Formal and Informal Online Brand: Using NodeXL to Extract Social Network Data in Tweets, Digital Contents, and Relational Ties " (Ch. 7), Dr. Hai-Jew describes the analysis of the formal and informal social presences of a university in its various manifestations on social media platforms through data extractions and graph data visualizations.

In Section 3, "Packaging Digital Contents for Perspective and Analysis," a group of authors engage with issues of capturing, visualizing, and analyzing complex data. Drs. Luca Cagliero and Naeem A. Mahoto's "Visualization of High-Level Associations from Twitter Data" (Ch. 8) introduces the Twitter Generalized Rule Visualizer (TGRV), which mines Twitter Tweets and expresses these as visual organizational structures. Dr. William H. Hsu provides an overview of a broad range of "Information

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Visualization Techniques for Big Data: Analytics using Heterogeneous Data in Spatiotemporal Domains" in Chapter 9. Dr. Hai-Jew applies social network analysis to explore social hierarchies on instructional design projects in Chapter 10, titled "Using Social Network Analysis to Examine Social Hierarchies and Team Dynamics on Instructional Design Projects." Further, in "Beyond Surface Relations: Using Maltego Radium® to Analyze Electronic Connectivity and Hidden Ties in the Internet Understructure" (Ch. 11), Dr. Hai-Jew uses a penetration testing tool to surface information from academia for analytical purposes.

In Section 4, "Cases in Real-World Packaging of Digital Contents for Learning," researchers share their experiences using packaged digital contents in various learning contexts. If engineers are the ones who help bring new products into the world, the innovative faculty, administrators, and staff who connect the technological innovations with line-level practitioners in the field and learners are the other "bridging nodes" in complex innovation networks. Dr. Ya-Chun Shih and Molly Leonard, in "Immersion and Interaction via Avatars within Google Street View: Opening Possibilities beyond Traditional Cultural Learning" (Ch. 12), share a creative integration of real-world Google Street View scenes with avatar-based immersive foreign language (and culture) learning. Dr. Gladys Palma de Schrynemakers describes a project at her university that integrates uses of TED Talks resources for in-depth learning in "How Digital Media like TED Talks are Revolutionizing Teaching and Student Learning" (Ch. 13). Dr. Hai-Jew, in "Structuring an Emergent and Transdisciplinary Online Curriculum: A One Health Case" (Ch. 14) focuses on some strategies used to create an online curriculum about an emergent and evolving topic.

In Section 5, "Digital Packaging for Young Learners," researchers share their insights on creating both digital and analog objects for learning in augmented ways. Soren Eskildsen, Kasper Rodil, and Dr. Matthias Rehm describe a creative educational project "Identification and Analysis of Primary School Children's Knowledge Acquisition: Using Knowledge Visualization Scenarios and Information Visualization Methodology" (Ch. 15) deployed at a zoo. Finally, in Chapter 16, reading expert Dr. Carol Stockdale describes her research insights in using an analog technique for improving letter memory. Her chapter, "Evaluating a Technique for Improving Letter Memory in At-Risk Kindergarten Students," describes a tactual and visual analog technique which could be enhanced with digital methods for more effective learning.

Packaging Digital Information for Enhanced Learning and Analysis: Data Visualization, Spatialization, Predictiveness, and Multidimensionality captures a sense of the state-of-the-art in terms of data visualization, particularly as it is being practiced in the real world of teaching and learning and analysis.

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Acknowledgment

Those dear readers who hail from academia will likely have a sense of the cooperative hard work of so many that has made this work possible. It helps to conceptualize *Packaging Digital Information for Enhanced Learning and Analysis…* not as a one-off but part of a long chain of efforts, all with learning and professional benefits along the way.

A singular chapter, which may be consumed with a fair amount of ease, requires a complex amount of dependencies to achieve. All the authors had to immerse in their respective domain fields. All had to conduct literature reviews. They had to mull the research and to design it. They had to actualize the research to standards (To do this, many had to use a range of technologies.). These authors have had to analyze their data. They had to package their chapters and visuals in a coherent way based on the conventions of the field. They had to revise their chapters after undergoing a double-blind peer review process. They had to meet some pretty stringent deadlines.

It may help for me to explain that whenever I put out a call for chapter proposals, I know that I am speaking not to a world of individuals who can speak to a particular issue with singular expertise and voices; I am speaking to an elite few with the rigorous higher education, the skill sets, the interest, and the good will to actually pursue the hard work and then ultimately to deliver solid chapters.

Anywhere along the way, writing teams have fallen apart. Projects have fallen to the wayside. Other priorities have intruded. Behind every work is a back story. These are the authors who persisted and turned out excellent chapters. I am grateful for their contributions.

Further, many at IGI Global have contributed to this text. Monica Speca served as editorial assistant to the project throughout most of its development cycle. Christine Smith came on during the production phase and saw the work through to its completion. I am grateful to them all for their kind support.

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