INTRODUCTION

From its very inception as a public venue, the World Wide Web (WWW) has been a space for intercommunications and the sharing of information. Its connectivity has made the world a virtual Wide Area Network. As this resource has evolved, it has figured more centrally into numerous human endeavors. Foremost is the transfer of learning and knowledge, particularly through spaces that archive, present, and share information.

On a superficial level, the various spaces of the Web have been designed for user awareness and attention, navigation, and usability through savvy user interface designs, information structuring, metadata labeling, personalized recommender systems, and a range of other design features. Search tools have been enhanced for more effective finding along with serendipitous offers. These spaces that are used for self-discovery learning include interactive websites; digital kiosks; open courseware; automated short courses; tutorials; databases; repositories and referatories; digital libraries; knowledge management systems (with informational taxonomies and ontologies); electronic publications; immersive virtual worlds and simulation spaces; collaborative knowledge-building spaces, shared and collegial work spaces; social networking spaces; and intranets and databases on the so-called invisible Web (those less easy to find via existing browsers). Online, there are many closed online discovery spaces. The so-called Deep (or Invisible) Web, which is estimated to be over 500 times the size of the publicly available Web, contains selectively discoverable contents. This level of user interface design has enabled much more intuitive use and has trained generations of users on how to use various sites and to communicate and collaborate effectively through them.

EMERGENT SELF-LEARNERS

Simultaneous with the popularization of these spaces, individuals have been acquiring skill sets to exploit these spaces for self-learning. Self-discovery learners are those who have high self-motivation and initiative to learn about particular domains of information and to acquire particular skill sets. They are self-driven, and they often self-learn. The concept of designing for self-discovery learners is necessarily learner-centered. This suggests the criticality of understanding who self-discovery learners are and when and how self-discovery learning happens.

Self-discovery learning has existed from infancy, with humans engaging the environment to learn about it. J. Holt long argued for supporting the natural initiative in children to pursue learning and discovery.
Children develop a theory-of-mind which allows them to ascribe intentional states (beliefs, desires, and intentions). They also develop meta-cognition, or the awareness of their own thinking and learning. In the same way, adults will engage in self-discovery learning. There are super self-discovery learners who are able to acquire new learning across a variety of fields with minimal external support. The ability to self-discover is critical for human endeavors given how much knowledge lies unknown and outside the limited reach of formal learning, beyond and in the wild. Self-discovery learning also implies the reality of equifinality—the reality of multiple paths to achieving a particular aim in learning; in other words, there may be many possible paths to acquiring a particular skill or knowledge set.

The tasks of self-discovery learners may be informal or formal. They may be ad hoc endeavors or lifelong learning pursuits. The learning may be simple or complex, obvious / defined or non-obvious. They may delve into questions which are closed-ended or those which are ill-structured and open-ended, many without pre-defined or clear answers. They may involve practical problem-solving learning or something as high-minded as self-actualization and personal growth. This learning may involve learning what is already in the world or even surfacing innovative discoveries that were previously unknown or un-observed.

The rationale for guided discovery-learning lies in cognitive load research, which observes that people have limited cognitive load capabilities. When novice learners enter a new learning domain, they use an excessive amount of their cognitive load to orientate themselves and to acquire learning; much of that learning—without guidance—will lead to errant inferential conclusions. The guidance, then, may lighten some of the cognitive load for learners—in order to allow them to apply more of their cognitive resources towards the germane load, which is directly applied to the learning. The guidance, too, may head-off potential negative learning, misconceptions, or incorrect mental models.

Such learners need varying levels of support to form an attraction to a topic; set learning goals (skills acquisition, self-improvement, hobby development, research, or innovations); create a learning strategy; follow-through on their learning; select learning methods and experiences; identify role models and experts; communicate with other co-learners; request appropriate help; assess their own progress, and continue evolving their own goals. Their skills in autodidaxy will vary based on the learner, their environmental affordances for such learning, and motivations (both intrinsic and extrinsic). Their autotelic experiences of flow (per M. Csikszentmihalyi) while engaged in self-learning tasks may motivate many, while others may need external rewards and acknowledgments (to help define the meaningfulness of their work).

In this “use case,” individuals or groups (tightly or loosely coupled) co-learn, collaborate, co-create, and build new knowledge and specific identities and ties. Even a cursory look at this challenge reveals the complexities of these challenges. Humans, the very human learning endeavors, and the world are all complex.

**DESIGN FOR GUIDED DISCOVERY**

This text proposes a broad design approach to help the Web and Internet further fulfill its potential for human use. This text explores a deeper level of user-focused design—this time for effective self-discovery learning—which is learner-initiated and learner-driven. At one end of the “directed discovery” continuum may be simple and current affordances of the Web—with the fixed clustering of topical information in repositories, the dynamic searches of related topics (albeit with some serendipity for chance learning and branching out), the proper sequencing (and cognitive scaffolding) of learning, and the structuring of
knowledge spaces using taxonomies and ontologies. User interface design would continue to enhance site usability, so the site itself will not demand much in the way of cognitive resources. New digital ways of conceptualizing (visualizing) information and new tools for discovery of new information will enhance the potential depth of learning—both in the respective mental modeling and in actual surfacing of new data and patterns. There are online and virtual venues for the sharing of new knowledge. There are supportive designed spaces for human learning communities. At the other extreme end of a theoretical continuum would be even more directive discovery for more complex long-term learning. There could be elite expert-led learning communities with privy access to information and high-functioning analytic tools. There could be highly fixed and intensive learning sequences and opportunities for hands-on practice.

Not only would the building of self-discovery learning spaces and tools online benefit the general act of self-discovery learning, and trained self-discovery learners, but it could potentially build up the self-regulation skills in general learners—for more efficient and effective learning. This approach may enhance the overall learning usability of the WWW and the Internet by making its contents more widely accessible and learnable.

Based on the research literature, self-discovery adult learners begin with a general sense of curiosity, enthusiasm, inquiry, or ambition; the learning itself is understood to be practical, with some application to the individual life, others, and potentially even the larger world. They pursue information and learning purposively, based on intrinsic and extrinsic goals. Such learners may be pursuing authentic (applied) learning goals in some cases and artificial (theoretical or arbitrary) ones in others. Self-discovery learners self-regulate. They are self-reliant and independent, and they maintain their own executive functions. Some would come as amateurs and novices; others may be subject matter experts who want to develop knowledge and skills in unique aspects of a field. On one level, self-discovery learning affects all individuals who take initiative to learn for work, for play, for personal enrichment, and for lifelong learning. Discovery learning also affects those autodidacts who are mature and sophisticated learners who are able to acquire broad domain fields of knowledge and skills by their own initiative.

POTENTIAL DESIGN EXPLORATIONS

While many in academia support the concept of some level of guided discovery, the actual amount will vary between learners and between those in different learning contexts. Some early design explorations suggest the importance of the following:

- attracting and engaging self-discovery learners to particular fields
- orientating self-discovery learners into particular fields, professional values, and practices through situated (contextualized) learning
- defining the learning context
- enhancing guided discovery and tailored feedback (preferably explanatory vs. merely corrective feedback alone per R. Moreno)
- providing relevant examples, worked examples, and cases
- helping learners surface prior knowledge and to capture and document acquired knowledge and reflect on the learning
- establishing self-learner meta-cognition at every stage of the learning process
• focusing learner goal-setting and planning (and relevant inquiry) and helping them surface and articulate these goals and plans
• supporting learner self-regulation, self-management, and follow-through
• contextualizing and sequencing the learning
• enabling appropriate learner profiling and monitoring for customized support and direction
• providing proper and accurate metadata and labeling of digital learning objects and online learning experiences
• ensuring high-trust distance intercommunications and collaborations
• managing archival and new knowledge
• crediting and rewarding learner innovation (both extrinsically and intrinsically)
• building up self-learner confidence, skills, and sense of self-efficacy in self-learning
• maintaining learner attention and engagement for the long-term

To maintain user attention, discovery learning sites must continue changing; they must remain relevant and offer participant value; they must have a positive Internet profile. Such spaces also need to maintain a high level of human expertise as well as new membership—particularly high-value participants who collaborate effectively in virtual spaces (and do not bring in the disruptive aspects like leadership struggles, dampened communications, social sabotage, or security compromises).

Ideally, self-discovery learning not only leads to enhancements in individuals’ and groups’ respective lives, but they benefit the larger community through the sharing of new insights, true innovations, and pure discoveries. This assumes that the self-discovery systems must protect innovator intellectual properties or at least be able to definitively define the moment of creation. It also suggests that there must be a system to preserve knowledge and digital creations over time, with all the attendant assumptions of proper metadata labeling, findability, archival, digital accessibility, and potential for re-use. This text begins with a basic premise of the necessarily pro-social nature of teaching and learning, including self-discovery learning.

The goal of *Constructing Self-Discovery Learning Spaces Online: Scaffolding and Decision Making Technologies* is to provide some early thoughts and research in this area. Ultimately, the idea is to make the WWW much more widely usable in a greater variety of ways. This approach aims to enhance efficiencies in human learning by aligning the technologies with human capabilities and objectives.

**CHAPTERS IN THE TEXT**

A text is a focused effort to capture the culmination of human expertise on a particular subject matter in a condensed period of time. Efforts at recruiting talented professionals to write started in 2010. The following authors faithfully followed through on their research and writing work. There were some other very promising works; however, they did not make it to press in this endeavor. Ultimately, I am hopeful that those works will eventually see the light of (published) day. While I have worked with some of these authors before on other projects, others were totally new to me. I am grateful for the kind considerations and patience of these authors. I appreciate their sharing with me their discoveries in self-discovery learning and design.

The works in this text cover a broad range of concepts and practices. The chapters are lightly summarized in the following section.
Section 1: A Foundation for Discovery Learning

To set the context, Brent A. Anders opens this text with Chapter 1: “Human Motivations and Discovery Learning.” He reviews some of the literature on discovery and self-directed learning, particularly in light of human motivations. He directly explores methods to improve intrinsic and extrinsic human motivations for discovery learning, within a technologically enhanced framework.

Chapter 2: “Who are Discovery Learners...Online? A Literature Review,” by Shalin Hai-Jew, offers a look at the parsimonious literature on contemporary self-discovery learners, and what their learning needs may be. Further, this chapter explores who self-discovery learners are online and how they behave in those spaces. Given the sparseness of the research data, this work proposes questions of how future researchers may further define self-discovery learners online. Finally, this work offers some suggestions for how those online spaces may be evolved to more closely meet the needs of self-discovery learners.

Section 2: Discovery Learning Environments and Tools

Authors Sarah D. Kirby and Debra M. Sellers, in Chapter 3: “The LiveAbility House: A Collaborative Adventure in Discovery Learning,” describe the efforts of a community-of-practice who are focused on supporting family caregivers. Their case study focuses on The LiveAbility House, a space in Second Life® they’ve designed as a virtual demonstration home—it embodies universal design principles, which may better enable aging-in-place, even in light of aging, illness, or disability. Their work offers insights on both the uses of the virtual to complement learning in-the-real and ways to harness virtual immersive spaces for deep learning.

Debra C. Burkey-Piecka, Laurie Ruberg, Christopher Ruckman, and Dynae Fullwood’s Chapter 4: “NASATalk as a Discovery Learning Space: Self-Discovery Learning Opportunities” highlights NASA-Talk (www.nasatalk.com), an interactive discovery space of K-16 educators to discuss the self-discovery learning opportunities at the National Aeronautics and Space Administration (NASA) to promote STEM (science, technology, engineering and math) learning.

In Chapter 5: “Knowledge Spaces for Online Discovery Learning,” Roger W. McHaney offers a very timely piece on how emerging digital infrastructures have enhanced constructivist learning through virtual environments. He explores knowledge spaces for online discovery learning in a variety of applied contexts: case-based learning, incidental learning, learning by exploring/conversing, learning by reflection, and simulation-based learning. This chapter offers both a solid theoretical grounding and applied uses of extant Web 2.0 and other tools to design online discovery learning.

Nicoletta Adamo-Villani, Kari L. Clase, Robin J. Heyden, and John Wiecha’s Chapter 6: “Web-Based 3D Virtual Learning Environments” sets the groundwork for the uses of three-dimensional virtual environments for self-discovery learning. They update the research literature on cutting-edge technologies and platforms for the building of virtual environments, and then they introduce two engaging cases of their own: the Interactive 3D Tour of MSHHD and The pilot postgraduate medical education program in Second Life.

Brent A. Anders, in Chapter 7: “A Case Study on Using Discovery Learning within a Learning Management System: Axio Learning™,” shows how a learning / course management system is designed to enhance discovery learning using a variety of design tools. This work highlights how the building of a socio-technical space may be enhanced for more effective user acclimation and usage.
Section 3: Types of Self-Discovery Learning

Ya-Chun Shih’s Chapter 8: “The Meeting Point of Second Life and Web 2.0: Self-Discovery for Writing” highlights a practical approach to the use of the Second Life® virtual world to support computer-assisted language learning (CALL). The author combines a range of approaches—including blog-writing, exploration of Second Life, and effective teaching—to draw out writing from EFL (English as a Foreign Language) graduate students.

In Chapter 9: “Applied Informal Problem-Solving through Self-Discovery Online: An Approach,” Shalin Hai-Jew uses a problem-solving framework for the design of self-discovery learning spaces online. She introduces the popular informal problem-solving through information access and crowd-sourcing, but she also highlights the more in-depth informal problem-solving that may be more complex and time-intensive.

Section 4: Design Strategies for Self-Discovery Learning

If self-discovery learning is about learner empowerment, then one critical feature of that empowerment must be the ability to self-assess the learning. Maria Menendez Blanco, Gerrit C. van der Veer, Laura Benvenuti, and Paul A. Kirschner’s Chapter 10: “Design Guidelines for Self-Assessment Support for Adult Academic Distance Learning” explores problems that students at the Open University of the Netherlands have in self-assessment and meta-cognition. The authors base their insights on a literature review and student data from their teaching research center—from which they created a conceptual framework. They tested this framework with a questionnaire study and interviews. From this work, they developed guidelines for self-assessment in a distance learning environment.

Kanubhai K. Patel and Sanjay K. Vij introduce their innovative treadmill-style locomotion interface, which they call the “unconstrained walking plane” with a virtual environment, in order to enhance spatial learning. In Chapter 11, “Unconstrained Walking Plane to Virtual Environment for Non-Visual Spatial Learning,” these authors explore the phenomenon of non-visual spatial learning using a locomotion interface—to help discovery learners engage the virtual through the physical in new ways—that have implications for accessibility design.

Ramesh C. Sharma and Paul Kawachi, in Chapter 12: “Engaging Learners in Digital Age through Self-Discovery Learning,” propose a model that emphasizes the need for providing online learner experiences for self-discovery learning through reflection. Their four-stage model highlights the uses of a variety of technologies to achieve various learning goals. This model also integrates some of the latest technologies in social networking, Web 2.0, and virtual worlds.

Finally, Shalin Hai-Jew posits that self-discovery learning spaces and tools may be used to drive long-term persistence in acquiring complex skills sets. In Chapter 13: “Addressing the ‘Commitment Problem’: Driving Long-Term Persistent Focus in Self-Discovery Learning (A Thought Experiment)” draws on the extant educational research literature and existing technological affordances to carry out a thought experiment about how effectively such spaces may be used to support human persistence in difficult learning. A draft survey is proposed for further learning about long-term informal discovery learning online.
FUTURE RESEARCH

Next-generation self-discovery learning spaces will necessarily meld human needs along with the affordances and constraints of the new technologies. The potential for important research discoveries in this area is many-fold.

Theoretical Groundings

More research on pedagogical theories and validated observations about self-discovery learning would enhance the conceptual bases and practices in self-discovery learning space and tool designs. Only a small slice of the current pedagogical research deals with issues of self-regulated, inquiry-based, and discovery-based learning—and the above are not synonymous but highlight different aspects of self-driven learner-based discovery learning (with various levels of guidance, from no guidance to full structured learning). The necessary avoidance of “negative learning” from intuitive self-learning experiences will be critical for the successful deployment of self-discovery learning endeavors.

Designing to Humans

A number of academic fields (psychology, neuroscience, education, advertising, and marketing and others) have made insightful observations about human perception (for example, sight, hearing, touch, taste, smell, and proprioception); cognition (for example, awareness, attention, short-term and long-term memory); affect (for example, human emotions), and learning. There is already some knowledge about autodidaxy or self-learning. The application of this design research will be critical for the creation of automated as well as human-facilitated self-discovery learning spaces and tools. In this area, it will be important to know more about what works (and what doesn’t) for self-discovery learners—at various ages, in various cultures, in various contexts, and with various technologies.

Federated Learner Identities

As the Web becomes more sentient, with increased uses of personally identifiable information (PII) and more complex tools for tracking and identifying participants, there may well be the creation of federated identities that help employers and employees keep track of their own trainings and formal / informal learning online. These identities would be persistent, and learner preferences, professional interests, and needs may be read by various systems in order to customize learning experiences to different learners’ “self-systems” of understanding. There would be need for controlled and designed anonymity for those who want to learn without the trappings of their real-world identities.

Melding the Real and the Virtual

With the popularization of wireless fidelity (WiFi) connectivity, self-discovery learning extends well into physical spaces—into mobile learning, ambient intelligent (“smart”) spaces, augmented reality, and augmented virtuality. The interactive devices that enhance discovery learning may be haptic ones that convey touch information. Or live human movements, body language, and gestures may be the interface, with the popularization of motion-control interfaces. These technological advancements connect the
virtual and the real and enable more in-depth explorations of the physical universe with the augmentation of digital information in a location-sensitive way.

**Adaptiveness and Customization**

For self-discovery learning to work—whether learners are participating as individuals or as groups—online systems will need to be learning systems that can adapt to changing learner needs (whether the learners themselves may be aware of their respective needs or not). The level of analytical depth of various online systems enables crowd-sourcing to identify optimal learning paths for particular types of learners or those with particular learning profiles, and those may become more popular over time. In the same way that digital intelligent tutors adapt to learner needs, whole systems may be able to reconfigure around unique learner needs. This customization may well extend over lifelong learning, and learners’ life spans. Additional adaptiveness would most certainly come from human research and *in vivo* and abductive observations.

**Acculturation to Professional Fields and Understandings**

Some self-discovery learning sites help learners acclimate to particular simulated environments (including those which are very hostile to human existence like undersea or deep space environments). They also help learners acculturate into particular fields, such as those that enable individuals to communicate in a foreign language with digital avatars or to role play particular social communications. These spaces may help self-discovery learners acquire a particular habit of mind in terms of information acquisition, learning, analysis, trouble-shooting, problem-solving, decision-making, and innovation.

**Enhanced Virtual Teaming**

With the popularization of distance collaborations and connections between people, many types of self-discovery learning involve various “selves.” Virtual teams have evolved for different types of apprenticeships with experts. There is shared or evolving leadership; there are cases of dispersed non-defined “leadership.” The findings of effective virtual leadership for self-discovery learners will certainly add to the literature.

**Domain Field Specifics**

Domain fields will vary in terms of the types of discovery learning designs that will be used and how efficacious these endeavors are. The creation of dedicated spaces for autodidaxy-type learning may not only enhance a field but cross-field acquisition of knowledge.

**Self-Discovery Learners’ Self-Management Tools**

Different types of learners may find particular self-management tools more effective for their executive functions. The types of tools that may enhance human decision-making about their own learning will also offer value. The unique evaluations of these will provide plenty of promising directions for research.
Certainly, there will be other research directions that have not even been anticipated here. The rising expense of human facilitated learning and the non-scalability of human research and attention will mean that the uses of self-discovery learning will have to suffice for some types of learning. Extant websites, repositories, socio-technical spaces, virtual worlds, and other virtual spaces will benefit from designing for this group of self-motivated self-discovery learners. This book shows that a majority of people use the Internet for informal discovery learning and simple problem-solving. There’s much more of human endeavors that may be supported with some adjustments to the site and information and user-interface designs of various Web spaces and Internet-related. This text offers a look at the design of online spaces for self-discovery learners’ acquisition of information, knowledge, and skill sets.

It is my hope that you enjoy this text.

Sincerely,

Shalin Hai-Jew
Kansas State University, USA