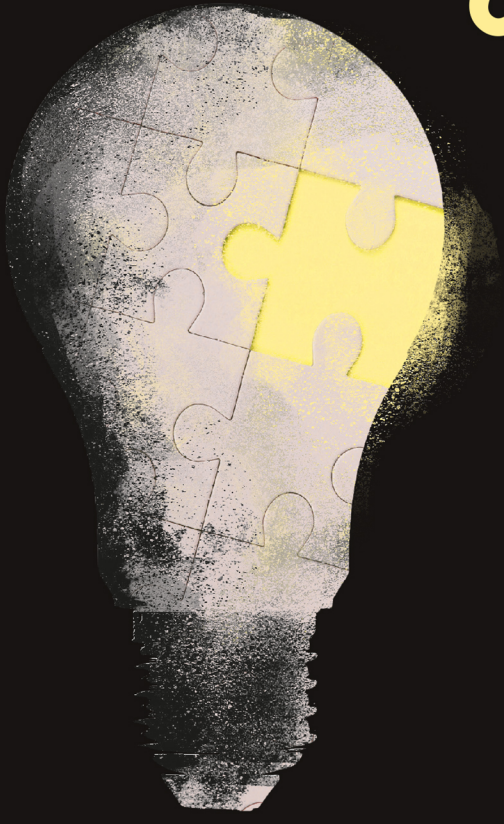
DECISION-BASED LEARNING



An Innovative Pedagogy that Unpacks Expert Knowledge for the Novice Learner

EDITED BY

Nancy Wentworth

Kenneth J. Plummer

Richard H. Swan

Decision-Based Learning

Decision-Based Learning: An Innovative Pedagogy that Unpacks Expert Knowledge for the Novice Learner

EDITED BY

NANCY WENTWORTH
Brigham Young University, USA

KENNETH J. PLUMMER
Brigham Young University, USA

AND

RICHARD H. SWAN
Brigham Young University, USA

United Kingdom – North America – Japan – India – Malaysia – China

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INVESTOR IN PEOPLE

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List of Abbreviations/Acronyms

ABET	Accreditation Board for Engineering and Technology
ACRL	Association of College and Research Libraries
ALA	American Library Associations
ANOVA	Analysis of Variance
ASA	American Statistical Association
CFA	Confirmatory Factor Analysis
COAST	Collect, Organize, Analyze, Solve, and Think
DBL	Decision-based learning
DDDM	Data-driven Decision-making
EDM	Expert Decision Model
EIME	Educational Inquiry, Measurement & Evaluation
GAISE	Guidelines for Assessment and Instruction in Statistics Education
GPA	Grade Point Average
IP&T	Instructional Psychology and Technology
JiTT	Just-in-Time Teaching
PIL	Project Information Literacy
SEM	Structural Equation Modeling
SPSS	Statistical Package for the Social Sciences
STEM	Science, Technology, Engineering, and Mathematics
TA	Teaching Assistant

Editors' Biographies

Nancy Wentworth (Emeritus) served as the Director of the Center for Teaching and Learning at Brigham Young University (BYU) and the former Chair of the Department of Teacher Education in the McKay School of Education. She was the Associate Dean in the McKay School of Education where she authored the TEAC Accreditation document for the Educator Preparation Program at BYU. Her research interests include technology integration in inquiry learning, and accreditation of teacher education programs. She has co-edited two books and authored several book chapters and articles. She retired from BYU in 2018 after 26 years of teaching, researching, and administrative work.

Kenneth J. Plummer is a Teaching and Learning Consultant at Brigham Young University. He has published numerous articles on assessment, religious education, and decision-based learning. He has been invited by universities in Peru, Japan, and China to conduct decision-based learning and course design workshops for faculty, teaching and learning consultants, administrators, and students. He teaches university courses in statistics, assessment, and student development. He has presented in academic conferences on course design all over the United States. As the manager of research and evaluation of a global educational institution, he trained field representatives on the use of assessments across unique settings and cultures worldwide. In addition to his academic work, he has consulted in corporate settings using innovative approaches to training.

Richard H. Swan currently serves as an Associate Director of the Center for Teaching & Learning at Brigham Young University. He has worked in the field of educational development and instructional design for over 20 years. He recently served on the Core Committee (similar to Board of Directors) of the POD Network, the nation's largest professional organization for educational development. He has been a member of the design/development team for several published instructional technology products including the award-winning Virtual ChemLab Series. He received his doctorate in Instructional Psychology and Technology; his research interests include learning theory, design theory, engagement, and the role of agency in learning.

About the Contributors

Lane Fischer currently serves as faculty in the Department of Counseling Psychology and Special Education in the David O. McKay School of Education at Brigham Young University. He is a member of the Open Education Group researching the outcomes of open education resources and open pedagogy (http://openedgroup.org/people).

Jason Godfrey is a PhD Student at the University of Michigan's (UM) Joint Program in English and Education. His research focuses on the impacts modality and multi-modality have on student learning outcomes. Particularly, he is interested in the ways that instruction migrates to different spaces, modalities, and audiences. This research has molded pedagogy praxis in his classroom and beyond, as can be seen in Ysearch, an open-source pedagogy initiative from Brigham Young University's academic library. Beyond his research at UM, he is a 2020–2021 Open Education Research fellow, a member of Language and Rhetorical Studies Workshop's steering committee, and a Research Assistant for the Mellon-funded research project *College and Beyond II*.

Shiloh James Howland is a Doctoral Candidate in educational inquiry, measurement, and evaluation at Brigham Young University. She holds master's degrees in Geology and Instructional Psychology/Technology. Her research interests include structural equation modeling, especially measurement invariance.

Ana Katz is a Doctoral Student at the University of Utah in the Department of Educational Psychology, Reading and Literacy. She earned her MA in Rhetoric and Composition from Brigham Young University and her BA in English and American History from the University of California, San Diego. She also works as Adjunct Faculty at Brigham Young University as a Professor in Rhetoric and Composition.

Degan Kettles received his PhD from Arizona State University. He teaches on topics including systems analysis and design, software development, data communications, and IT leadership. His research areas include enterprise social media, IS teaching pedagogy, e-commerce, and analytics. Prior to a career in academia, he worked for several software development firms where he managed development teams.

Ross A. A. Larsen, PhD, is an Associate Professor at Brigham Young University with specialization in measurement and structural equation modeling. He completed his PhD in Educational Psychology with an emphasis in research and measurement at Texas A&M University. Following his PhD, he worked as a Postdoctoral Researcher at the University of Virginia and as an Assistant Professor at Virginia Commonwealth University.

Emily R. Mills, MEd, currently teaches in Salt Lake, Utah. She formerly worked as an intern with the Utah State Board of Education.

Sara E. Moulton is a research analyst in the office of Assessment and Planning at Brigham Young University (BYU). She earned her PhD in Educational Inquiry, Measurement, and Evaluation from BYU and completed a postdoctoral fellowship with the Institute for School Reform at the University of South Florida. Prior to returning to BYU, she worked as a District-level Program Evaluation Specialist and later as a Research Associate at the Center of Applied Research for Educational Improvement at the University of Minnesota. Her research interests include scale construction and development, item response theory modeling, data-based decision-making in educational settings, and implementation and evaluation of multi-tiered systems of support.

Todd G. Nelson is an Assistant Professor of Engineering at the University of Southern Indiana. He received his BS and PhD in Mechanical Engineering from Brigham Young University. He has been a Guest Researcher at Delft University of Technology in the Netherlands. His research includes origami-inspired mechanisms and compliant mechanisms.

Michael A. Owens, PhD, does research on leadership and followership in schools and other educational organizations that serve youth in cities. He teaches courses in qualitative research, multicultural education, and educational leadership. He has taught in the Educational Leadership and Foundations Department at Brigham Young University's David O. McKay School of Education since 2017.

David S. Pixton is an Associate Faculty Member at Brigham Young University and serves as a Subject Librarian for the engineering and technology disciplines. He holds degrees in Mechanical Engineering and Library and Information Science and provides research training and assistance to students and faculty. Prior to joining the university, he worked extensively in industry as a Research & Development Engineer and Engineering Leader. He has published and presented research in both engineering and education domains; his current research focus is on improving learning in a library environment.

Kenneth J. Plummer is a Teaching and Learning Consultant at Brigham Young University. He has published numerous articles on assessment, religious education, and decision-based learning. He has been invited by universities in Peru, Japan, and China to conduct decision-based learning and course design workshops

for faculty, teaching and learning consultants, administrators, and students. He teaches university courses in statistics, assessment, and student development. He has presented in academic conferences on course design all over the United States. As the manager of research and evaluation of a global educational institution, he trained field representatives on the use of assessments across unique settings and cultures worldwide. In addition to his academic work, he has consulted in corporate settings using innovative approaches to training.

Rebecca L. Sansom is an Associate Teaching Professor at Brigham Young University. Following her training as a Chemist at Boston University (BA, 2001) and Harvard University (MA, 2005), she taught high school chemistry and biology for eight years. In 2013, she was selected as an Albert Einstein Distinguished Educator Fellow and served for a year at the National Science Foundation in the Division of Undergraduate Education. In 2014, she joined the faculty at Brigham Young University in the Department of Chemistry and Biochemistry, where she supervises the general chemistry laboratories, and teaches general chemistry and preservice chemistry teachers. She completed her PhD in Educational Inquiry, Measurement, and Evaluation from Brigham Young University in 2019. Her research focuses on improving STEM teaching and learning by supporting faculty change and studying strategies that improve student learning.

Richard H. Swan currently serves as an Associate Director of the Center for Teaching and Learning at Brigham Young University. He has worked in the field of educational development and instructional design for over 20 years. He recently served on the Core Committee (similar to Board of Directors) of the POD Network, the nation's largest professional organization for educational development. He has been a member of the design/development team for several published instructional technology products including the award-winning Virtual ChemLab Series. He received his doctorate in Instructional Psychology and Technology; his research interests include learning theory, design theory, engagement, and the role of agency in learning.

Stephan Taeger is an Adjunct Professor in the Department of Ancient Scripture at Brigham Young University in Provo, Utah. He also teaches religion courses at the LDS Utah Valley University Institute in Orem, Utah. His main research interests include homiletics and narrative instructional design.

Heidi A. Vogeler holds a PhD in Counseling Psychology and completed her Pre-Doctoral Internship at Brigham Young University Counseling and Psychological Services. She earned additional graduate degrees in Public Health (MPH), Social Work (MSW), and Educational Inquiry, Measurement, and Evaluation (PhD). Her research interests include psychological assessment, psychological outcomes, and teaching and learning.

Nancy Wentworth is a retired Faculty Member from Brigham Young University (BYU). She served as the Director of the Center for Teaching and Learning

at BYU and the former Chair of the Department of Teacher Education in the McKay School of Education. She was the Associate Dean in the McKay School of Education where she authored the TEAC Accreditation document for the Educator Preparation Program at BYU. Her research interests include technology integration in inquiry learning, and accreditation of teacher education programs. She has co-edited two books and authored several book chapters and articles. She retired from BYU in 2018 after 26 years of teaching, researching, and administrative work.

Steven G. Wood worked as a Research Chemist for Dow Chemical before returning to Brigham Young University to pursue a PhD degree. After completing his graduate work and finishing a two-year postdoctoral fellowship at the Friedrich Miescher Institute in Switzerland, he returned to Brigham Young University as a Research Associate. It was during this time that he taught his first class and realized that teaching was his true passion. He was hired into a tenure-track faculty teaching position in the Department of Chemistry and Biochemistry in 2001 and has taught a wide variety of courses ranging from both one- and two-semester general chemistry courses to an upper-division biochemistry course. He is constantly seeking ways to help students grasp and visualize key chemical concepts and principles. He has received both college and university awards recognizing his teaching as well as a National Science Foundation grant to produce innovative instructional materials.

List of Contributors

Lane Fischer	*Brigham Young University, USA*
Jason Godfrey	*Brigham Young University, USA*
Shiloh James Howland	*Brigham Young University, USA*
Ana Katz	*Brigham Young University, USA and University of Utah, USA*
Degan Kettles	*Brigham Young University, USA*
Ross A. A. Larsen	*Brigham Young University, USA*
Emily R. Mills	*Brigham Young University, USA*
Sara Moulton	*Brigham Young University, USA*
Todd G. Nelson	*University of Southern Indiana, USA*
Michael A. Owens	*Brigham Young University, USA*
David S. Pixton	*Brigham Young University, USA*
Kenneth J. Plummer	*Brigham Young University, USA*
Rebecca L. Sansom	*Brigham Young University, USA*
Richard H. Swan	*Brigham Young University, USA*
Stephan Taeger	*Brigham Young University, USA and LDS Utah Valley University Institute, USA*
Heidi A. Vogeler	*Brigham Young University, USA*
Nancy Wentworth	*Brigham Young University, USA*
Steven G. Wood	*Brigham Young University, USA*

Introduction to Decision-based Learning

Kenneth J. Plummer

This book provides a starting place for faculty interested in using decision-based learning (DBL). DBL is a promising pedagogy designed to catalyze novice-to-expert learning. Whether theoretician, practitioner, or both, we hope that there is something for all groups in this book who are looking for a way to better catalyze student learning in their courses, units, schools, colleges, universities, or in corporate training. As you read through the chapters that interest you the most, we encourage you to take note, of how you might adapt DBL to your teaching and/or research goals.

In Chapter 1, Dr Richard H. Swan discusses the literature on the development of expertise and the need for a focus on a type of knowledge called *conditional knowledge*. Simply put, conditional knowledge is the knowledge of *when* concepts, ideas, procedures, etc. are relevant in performing given task(s). Dr Swan includes a review of other more familiar knowledge types that function in the practical world under the direction of conditional knowledge. He asserts that the development and use of these knowledge types constitute *expert knowledge*. With this foundation in place, he discusses the importance of instructional strategies for the development of what we call a conditionalized schema or the interconnected decision-making process used to solve a vast array of problems. He articulates the limitations of contemporary instruction including deductive and constructivist pedagogies. He further discusses the impact this kind of learning can have on students affectively or in terms of their self-concept as it pertains to their decision-making abilities with the content.

In Chapter 2, Kenneth J. Plummer describes the genesis and development of DBL as described in this book. In addition, he outlines the process he uses to help faculty/experts explore their own thinking process, to discover their expert blind spots, and use DBL to create learning experiences that fill in learning gaps created by these same expert blind spots.

Chapters 3–12 are narratives of faculty members teaching courses from a variety of content areas. As the instructional designers of DBL, we have our own idealized notion of how a DBL lesson, unit, or course should be designed but as experienced faculty members begin to use DBL in their courses various natural constraints create differing types of implementation. These factors include the

stage of DBL development of a course and the degree to which our design recommendations fit within an instructor's existing approach to teaching. The authors of Chapters 3–12 report their journey designing, implementing, and evaluating the use of DBL pedagogy in their courses. Table Introduction.1 is a summary of the chapters' information including discipline category (business, social science, STEM, and writing), course content (chemistry, information systems, mechanical engineering, qualitative inquiry, religion, statistics, and writing), academic level (graduate and undergraduate), instruction type (blended, F2F, and online), class size (15–250), number of semesters implemented (1–10), research data collection (performance and survey), and academic reporting of authors' research on DBL (conference presentation and publication). This table can be found at the end of this book introduction.

A final chapter explores the common themes and lesson learned from implementing DBL including issues and effectiveness as evidenced by the experiences presented by the authors of the narrative chapters. We analyze the narratives looking for the value that using DBL brought to the instructors as they rethought teaching their content area. We explore the challenges for the instructors and the students. We summarize the lessons we learned in this qualitative analysis so that instructors beginning the process of using DBL have a sense of where to start, what aspects take the most time and bring the most value, what to expect from the students as they engage in a unique learning experience, and what methods of assessing students seem most effective.

Preview of Narratives

Chapter 3

Authors: Lane Fischer, PhD; Kenneth J. Plummer, PhD; Heidi A. Vogeler, PhD; and Sara Moulton, PhD

Title: I Am Not A Real Statistician; I Just Play One on TV

Content area: Statistics

Summary: This DBL statistics course has gone through eight iterations using DBL over the course of six years. This course was the first course to experiment using DBL back in 2014. The instructors began by implementing the approach without DBL software and in the last several years have implemented the approach with the software. Several instructors have taught this course bringing their unique styles and teaching predispositions to the DBL structure. The course is more unique among DBL courses in that the decision model encompasses almost the entire semester of instruction. More typically DBL implementation may occur periodically or during a specific unit or lesson within the course. Initially the students enrolled in this course were from graduate education programs. In recent years, graduate students from TESOL, micro-biology, dietetics, and other programs have enrolled in the course to improve their functional abilities with statistics.

Chapter 4

Author: Rebecca L. Sansom, PhD

Title: Make Thinking Explicit to Support Student Learning

Content area: Chemistry

Summary: The author of this chapter was one of the first to use a smaller decision model that did not cover an entire course but two lessons within a unit of instructions. This was an undergraduate course of roughly 200 students. She compared test results on six heat and enthalpy problems across two semesters she taught. Instead of using the software she used a PowerPoint presentation that combined a visual depiction of the decision model along with problems. The results showed a significant difference in performance that favored the DBL group. Student comments were mostly positive about the experience. This author explains that DBL leverages student skill at identifying the underlying features/structure of a problem and satisfies students' desires to know which equation to use, while reinforcing and framing those decisions using key disciplinary concepts.

Chapter 5

Author: Steven G. Wood, PhD

Title: Creating an Expert Decision Model Designed to Improve Student Learning in First-year General Chemistry Courses

Content: Chemistry

Summary: Unlike the previous chapter this author created a decision model that covered the entire course. He plans on fully implementing the DBL approach in upcoming semesters. His experience is unique in that while he has not used the DBL approach as explicitly as the other authors in this book, the principles of DBL have dramatically influenced his teaching. He describes the depth and breadth of this influence in the same introductory chemistry course level as his colleague who we introduced in the previous paragraph.

Chapter 6

Author: Todd G. Nelson, PhD

Title: Exploring Decision-based Learning in an Engineering Context

Content area: Mechanical Engineering

Summary: In this mechanical engineering course, two smaller expert decision models were used to facilitate the mastery subtopics in the course. The first model was used for the first two weeks of the course to provide a thorough review of topics from a prerequisite course typically taken during the junior year, Strength of Materials. A mastery of this material was deemed critical to the success of students in performing analysis of machine elements and in the learning of more advanced techniques for machine design. The students were assigned to work through a review set of

problems using the model. The intent of this practice was not only to review topics, but also give students a strong understanding of where the topics from the prerequisite course fit into what they have learned over the past three years as engineering students and where it fits in this course (a strengthening of conditional knowledge).

Chapter 7

Author: Degan Kettles, PhD

Title: Decision-based Learning in an Information Systems Course

Content area: *Information Systems*

Summary: The author of this chapter was concerned that his course, "Systems Analysis and Design," had been traditionally taught as a series of techniques. Students learned these techniques but not the conditions in the real world that would suggest or trigger their use. As is the case with several other authors' models in this book, his decision model did not fan out like other decision models (see Fig. 7.3) but looks more like a straight line. This occurs when, regardless of the option students choose at one decision point, both options will lead to the identical subsequent decision point. The author describes a critical feature of a DBL implementation that was missing from his course, namely, that he did not have assessments aligned with the DBL material and therefore students were not incentivized to invest in using it. He describes plans to improve implementation which as editors, we believe, illustrates the iterative nature of creating an effective DBL component of one's course.

Chapter 8

Authors: Shiloh James Howland, MS and Ross A. A. Larsen, PhD

Title: Decision-based Learning in Multiple Regression and Structural Equation Modeling Courses

Content area: *Advanced Statistics*

Summary: The authors of this chapter describe two graduate level courses where DBL was implemented. These courses are generally taken in sequential order with the DBL course in Chapter 3 being a prerequisite course for both of them. The students used the software mainly during the first half of the course. Their decision models were the first to incorporate the idea of looping. Looping is a feature within the DBL approach where students can check and see if certain assumptions within a problem or data have been met. If those assumptions are not met the decision model permits students to either end their analysis at that point or perform a transformation on the data. Once the transformation is complete, students must check the assumptions on the new transformed data set. This required that decision model loop back on itself to permit a rechecking of assumptions. The professors reported that the stepwise integrative nature of DBL made it possible for students to successfully navigate which traditionally has been a very complex process for them.

Table Introduction.1. Features of Narrative Chapters 3–12.

Chapter	Discipline Category	Course Content	Academic Level	Instructional Type	Class Size	Number of Semesters Implemented	Research Data Types	Academic Reporting
3	STEM	Introductory Statistics	Graduate Students	All three	50	10	Survey	Conference Presentation
4	STEM	Introductory Chemistry	Undergraduate Students	F2F	250	1	Performance and Survey	Conference Presentation and Publication
5	STEM	Introductory Chemistry	Undergraduate Students	F2F	250	1	None	Conference Presentation
6	STEM	Mechanical Engineering	Undergraduate Students	Blended	30	3	Survey	Conference Presentation
7	Business	Information Systems	Undergraduate Students	Blended	150	1	Survey	Neither
8	STEM	Advanced Statistics	Graduate Students	Blended	20	3	Survey	Neither
9	Social Science	Qualitative Inquiry	Graduate Students	Blended	15	2	Survey	Conference Presentation
10	Social Science	Religion	Undergraduate Students	Blended	Each class was approx. 50-60 students	3	Survey	Conference Presentation Publication
11	Writing	Introductory Writing	Undergraduate Students	Online	30	1	Performance and survey	Conference Presentation
12	Writing	Advanced Writing	Undergraduate Students	Online	100	4	Performance and survey	Neither

Chapter 9

Authors: Michael A. Owens, PhD; Emily R. Mills, MS

Title: Using Decision-based Learning to Teach Qualitative Research Evaluation

Content area: Qualitative Inquiry

Summary: In this chapter, authors present a unique approach to using DBL for building the analytical and evaluative skills of students new to research. Specifically, they outline a process for using DBL to teach master's and doctoral students in qualitative research courses how to evaluate qualitative research articles and develop their own skills at communicating their own research design choices. For many of the DBL courses instructors will pose problems that range from one sentence to a paragraph length. These authors presented students with full length research articles that were annotated based on where students were in the decision model.

Chapter 10

Author: Stephan Taeger, PhD

Title: Implementing Decision-based Learning in an Introductory Religion Course

Content area: *Religion*

Summary: The expert decision model used for this course was designed to help students learn the historical content of a book of scripture conditionally. Ideally, using this approach, students would be organizing the book's major historical content by noticing patterns, organizing the information, and developing conditionalized knowledge. Approximately 110 undergraduate students were introduced to the expert decision model on the first day of a basic 100 level scripture class at a private religious university. The questions centered around the nature of the text, the spiritual and/or political leader at the time of the text, date, geographical location, and relevant historical events within the text with the hope that students would be guided to develop a rich conditional schema of this information. The author describes an implementation that used PowerPoint and then software.

Chapter 11

Author: Ana Katz, MS; Jason Godfrey, MS

Title: Using Decision-based Learning to Teach Source Evaluation in One-shot Library Sessions

Content area: *Introductory Writing*

Summary: The authors in this chapter compare DBL and another methodology to determine which is more effective at teaching freshman writing students source evaluation skills. This implementation was unique in that the DBL activities were

part of a 50-minute session in the library as opposed to being part of a larger course. The authors acknowledge that an ideal implementation would be for students to use the decision model outside of the 50-minute session in an integrated way in their regular writing courses. This chapter highlights lessons learned that can inform the breadth and depth of DBL implementation in like courses.

Chapter 12

Author: David S. Pixton, ME

Title: Information Literacy and Decision-based Learning

Content area: *Advanced Writing*

Summary: This author implemented DBL under the same conditions as Chapter 11 authors. However, this training session was with third year engineering as opposed to first year freshmen writing students. The author considered the various decision points involved with each step and built a model from there. This process was straightforward; however, at a few points in the process the author encountered situations where the order of decision points was not clear because of interdependencies between the steps. His initial choice of ordering turned out to be less ideal as scenarios were written and applied. For this reason, in future iterations he found it helpful to consider scenarios in tandem with building the model. He found the ability to loop and make the scenario adapt to the progress within the decision model quite useful, particularly since research activities are iterative.