First Principles of Instruction

revised edition

M. David Merrill

Editor: Terry R. Cortese
Book Design, Layout & Cover Design: Terry R. Cortese
New Learning Concepts, Inc.
Bloomington, Indiana.

Published by
Association for Educational Communications and Technology
(AECT)
320 West 8th Street, Suite 101
Bloomington, Indiana 47404-3745
www.aect.org

ISBN: 978-0-9970755-5-7

To Phil Harris
and my AECT friends and colleagues

Table of Contents

Foreword

This revised edition of David Merrill's *First Principles of Instruction* is chocked full of detailed prescriptions that will help you implement the First Principles in your own teaching and instructional design. There are numerous examples illustrating a wide range of subject matter. The book is easy to navigate and follows its own advice to not simply *Tell* the reader about *First Principles of Instruction*, but to *Show* the principles in action and to apply them to *real world problems*.

My introduction to *First Principles of Instruction* was at the Association for Educational Communications and Technology (AECT) Conference in 2000. As I recall, Dave Merrill and I arrived for breakfast at about the same time, early one morning at the conference hotel. We decided to sit together, and as we were catching up, Dave mentioned his recent work on 5-Star Instruction (which he later renamed, *First Principles of Instruction*). He was highly enthusiastic about those five principles of instruction which were common to numerous instructional design theories. I could immediately see the connection with the important literature on learning theory and instructional design. I recall being very impressed by how Dave had arrived at such a clear synthesis—parsimonious and consistent with empirical research on what promotes student learning. 5-Star Instruction just made sense to me, from the get-go. I could see the connections with various streams of research on student learning achievement, going back to the early 1960s.

Five years later, I had found how valuable *First Principles of Instruction* were in my own teaching. I had incorporated First Principles into graduate level courses I was teaching, including R690, which is an introduction to research in instructional systems technology. In R690 I was pairing doctoral student research teams with faculty mentors to help those faculty carry out their own research. By 2005, we faculty in Instructional Systems Technology (IST) at Indiana University Bloomington had revised our Ph.D. program. The success students and I were experiencing my R690 course was a motivating factor to formalize research teams throughout our IST doctoral program. Students chose faculty they wanted to work with; and faculty recruited students as well. Very importantly, students received credit for participating in research groups by enrolling in a 3-credit course for each of 4 semesters. This kind of structure also allowed research projects to span semesters longitudinally, which is an important structural program element—because research projects seldom fit neatly into a single semester.

Some of my own research teams began to investigate the effectiveness of *First Principles of Instruction*, starting around 2005. We had modified and expanded the 5-Star Rating Scale, forming a new instrument that consisted of nine scales for assessing Teaching and Learning Quality (TALQ). TALQ Scales were formed for each of the 5 First Principles (activation, demonstration, application, integration, and sequences of authentic tasks or problems from simple to complex); student academic learning time (successful engagement); student self-assessment of their own learning progress; student satisfaction with the course and instructor; and overall ratings of course and instructor quality.

These six TALQ studies published between 2009 and 2018 included a wide range of subjects taught to college freshmen through graduate students. Based on ratings of 40-45 randomly ordered TALQ items, students who agreed that their instructors used First Principles *and* who also agreed that they experienced ALT were

between 3 and 5 times more likely to be high masters of course objectives, when compared with students who disagreed that their instructors used First Principles *and* who disagreed that they experienced ALT. In one of the 2010 studies, instructors independently judged student mastery of course objectives with no knowledge of student TALQ ratings at that time, near the end of semester.

Now I share a preview of the Big Study, currently in progress as I write this foreword.

If you were an investor, and you could choose a successful company which is 4 to 5 times more likely to use effective business strategies than is one which is not successful, where would you put your money? Likewise, if you could use methods of education that were 4 to 5 times more likely to help students succeed in their learning, would you?

In our Big Study, we use the illustrative case of the Indiana University Plagiarism Tutorials and Tests (IPTAT), an extensively used website on how to recognize plagiarism at https://plagiarism.iu.edu. We document how we redesigned the IPTAT to employ Merrill's *First Principles of Instruction* and the resulting extraordinary effectiveness of the IPTAT for promoting online learning. Our results indicate that successful students were 4 to 5 times more likely to choose instructional activities designed with First Principles, when compared with unsuccessful students. These findings are based on over 275,000 students located in 205 countries worldwide, mostly between ages of 14 and 44. IPTAT is designed to be highly flexible, so that students can pick and choose parts of IPTAT that they expect to help them learn enough in order to pass a difficult Certification Test. Students are free to navigate the website in many different ways that include embedded hyperlinks, navigation menus, a sitemap, and links to view pages sequentially. Successful students had passed a randomized Certification Test, whereas unsuccessful students had registered for IPTAT but had not passed one of trillions of Certification Tests. The last chapter of this book provides more information about IPTAT and design elements that illustrate *First Principles of Instruction.*

I'm a pragmatist. I do not teach students skills and ideas unless I've first tried them myself and I am convinced that they are worthwhile skills and ideas. That has been my *modus operandi* for the past five decades. In other words, I do not come to believe ideas just because others do, or to do things because others do. First, I want to see for myself and try for myself. Call me a skeptic. If I'm convinced, then I'll adopt; if not, then I drop.

Based on my own experience over 20 years, the *First Principles of Instruction* work. Applying these principles to your instructional design will result in better teaching and that will lead to quality learning. I recommend that you start small and see how it goes. Choose an element that you can implement easily and quickly in your own teaching or instructional design, and then observe how well it works. Then add something new the next time you teach the same content and repeat your assessment. In other words, make incremental changes that don't require a huge amount of effort or risk. Keep the stuff that works well; and discard the stuff that doesn't work. Before you know it, you'll likely discover how much better your students are learning. You may also notice how highly motivated they are to learn more. I did.

Theodore W. Frick | Professor Emeritus
Indiana University | Bloomington, Indiana
https://tedfrick.sitehost.iu.edu

Prologue[1]

My career in education had its origin in my missionary experiences for the Church of Jesus Christ of Latter-Day Saints. Like many young men in our society at the age of 20 I was called to serve two years sharing information about the founding and doctrines of the church. My field of labor was not some foreign country but here in the United States in the states of Indiana, Ohio, and Michigan. In those days, our approach was to go door to door, introduce ourselves and try to set up an appointment to come back and teach some simple lessons about the founding and doctrine of the church. I'll never forget the day during the first week of my mission that marks the beginning of my educational career. It was my companion's turn to make the approach because I was still a "greenie". A gentleman opened the door and my companion introduced us as representatives of the Church of Jesus Christ of Latter-Day Saints. Then he gave our usual introduction: "Mr. Brown, have you ever wondered why there are so many different churches in the world today?" "I've never thought about it in my whole life!" was his gruff reply. "Well just like you", my companion continued, "many people have had this important question." Mr. Brown shut the door. I was in shock! Why did my companion continue with our canned dialogue when it was obvious that Mr. Brown had no interest in this question? There had to be a better way to teach than this. I spent much of the rest of my two years as a missionary studying and trying to help other missionaries be more effective teachers. My attempts as a very young man were very primitive, but they created a burning desire to find out how we could make our teaching more effective and engaging. Today, many years after my experience, the church has made wonderful progress in the training of missionaries. Missionaries of the church today are much better prepared.

Prior to my mission I had pursued a course in electrical engineering. My grades in physics, chemistry, and calculus were less than inspiring, and based on my missionary experiences I decided to pursue a career in secondary education. I must confess that the education courses I pursued were very disappointing. I wanted to learn how to make a lesson effective and engaging, but instead I learned about school law and how to avoid getting sued, an even more important skill in today's schools, but it did not contribute to my understanding of effective teaching. I also learned how to pass out papers to avoid confusion. I created a resource file which I never again opened and finally discarded years later. I had a wonderful time in my student teaching. I was assigned to teach American history and reading in a junior high school in a small Utah town even though my major was psychology and mathematics. The principal did not find my very unconventional approach to teaching consistent with his expectations and he threatened to fire me twice during the 6 weeks of this experience, once for holding a political rally in my class (this was during the Kennedy-Nixon election year) and once for having the students read *The Communist Manifesto* and compare it to the U.S. Constitution, both of which I thought were great ideas for my students.

Since my classes were very disappointing and not giving me any of the skills I thought I needed to be a more effective teacher, and since it was pretty obvious that my innovative approach to teaching was obviously not going to endear me to the public schools, I decided that I had made a mistake and that I better find another

1 The stories in this prologue were originally published in *Merrill 1994*.

career. I expressed my displeasure and decision to change careers to Asahel Woodruff, one of the professors whose work I did find valuable. He validated my concerns but suggested that, instead of giving up, I should go to graduate school, get an advanced degree, and see if I couldn't be an agent of change in education. Not being one to shy away from a challenge, after he assured me there were PhD programs I could enter directly from my bachelor's program, and many had generous scholarships or fellowships which would pay for my education, I decided to pursue a PhD. He recommended several possible programs, I applied to three and was fortunately accepted into all three. I chose to pursue a PhD at the University of Illinois and was offered a full-ride, 3-year fellowship that would cover all my expenses. This was probably the wrong reason for choosing a graduate school, but serendipity prevailed, and I was privileged to work with some of the most outstanding professors in educational psychology.

In my final semester of undergraduate work, a check with the registrar showed I was short one hour of credit for my minor in mathematics. There was no one-hour math class, so it was necessary to enroll in a three-hour class. The University of Illinois had already awarded me a fellowship for my PhD study, therefore the completion of the additional math class assumed considerable significance for my future.

A class in Number Theory appeared, on the surface, to be the easiest path to the necessary credit. The year was 1961. New mathematics in the public schools was still in the future. Computers were just coming on the scene. Binary arithmetic, base 8, base 16, and other representations of numbers were not in the repertoire of a small-town undergraduate student scrambling to complete his bachelor's degree. This particular class in number theory was, for this student, a unique math class: no problems to work, no homework, a very small textbook. At the end of each lecture the professor merely said, "Think about it!" Think about what? How do you think about mathematics? In desperation, and as a substitute for thinking, I read the textbook every week. It wasn't difficult; it had only 97 pages and a bright yellow cover. However, the concepts presented floated over my head like clouds in the sky. I had no idea what the course was about or what the text was about. Each week we had another lecture, the injunction to "Think about it!" and another read through of the text. The midterm exam was a disaster. It had no problems to work, only a single question: "Invent a number system." Invent a number system? What in the world does that mean? In true survival mode I wrote for the whole two hours. However, it didn't fool the professor. There were seven students in the class; there were seven F's on the midterms. When we objected, the only explanation from the professor was, "Think about it!"

My anxiety was at an all-time high. My graduate career was about to be terminated before it began by the unnerving command, "Think about it!" I tried every avenue of escape: Another class? Getting the registrar to waive the credit? Home study? There were no other options. My bachelor's degree, and hence my entrance to graduate school, were both riding on a class in which I had received a failing grade on the midterm and worse, a class that was, to me, completely incomprehensible! Somewhere in the thirteenth week the light came on. Number systems are inventions. They are not natural phenomena. Number systems are like any other invention: an assembly line, an organization. A number system is merely a system of logic consisting of premises and conclusions. Base 10 is only one of many possible number systems. Base 10 numbers are useful for many everyday things, but other systems might be equally useful. The day of the final arrived. My anxiety

was still high, but at least I thought I understood. You guessed it, only one question, "Invent a number system." Either I understood, or it was too late. My future graduate studies depended on my ability to invent a number system. So, I wrote, "Let there be an oar and a rubber boot." I proceeded to define a binary number system with two elements, an oar and a rubber boot. I was in the professor's office the next day to see if I was going to graduate school or not. He handed me my paper with a large red A written across the top. I thanked him, breathed a sigh of relief, and vowed to never take another math class as long as I lived.

My first year of graduate school was very difficult. Not only was there a tremendous amount of work, but there also seemed to be too many contradictions. The content of learning psychology challenged many of my fundamental beliefs. There were numerous contending systems, each claiming to explain learning. I struggled for days trying to explain how a person learns the concept "green" using only S-R (stimulus response) bonds. I found myself in the basement of the psychology building feeding rats that were on a deprivation schedule. Why was I feeding rats when I wanted to know how to teach children? I was about ready to give up and look for a real job!

About this time, B. F. Skinner visited the campus. Like my fellow classmates, I went to hear this great man speak. I don't remember any details of his lecture, but his response in the question-and-answer period changed my life. A member of the audience said, "Dr. Skinner, in your book (which he named) you said such and such (some detail of Skinner's theory), but tonight you seemed to contradict yourself by saying such and such"—he quoted a part of Skinner's speech. "Hell," said Skinner, "do you think I believe everything I ever wrote?" This was a great insight for me. Here was a great author saying he changed his mind and now disagreed with his earlier self. However, what he said next changed my life. "What I've tried to do," continued Skinner, "is to make only a few assumptions and then see how much of human learning we can explain with only these assumptions." He went on to defend his theory and the point he made in his speech. I stopped listening before he ended his explanation. Good grief, I thought, psychology is just an oar and a rubber boot as well. Psychological systems are not reality either, but merely logical systems that try to explain what we observe in the real world. Behaviorism is merely one logical system that is tested against reality to see how good a match can be found. Just like there can be many different number systems, there can be many different psychological systems. Each is tested against reality to see how closely it fits, but none are reality, merely inventions!

I returned to my studies with renewed enthusiasm. I looked upon all theories as artificial systems and found them fascinating. I stopped trying to make all theories agree and force them to form one great truth. It became a game to see if I could identify the theorist's assumptions and conclusions. It was fascinating to observe that some systems were carefully constructed and logical, while other systems were very loosely constructed and often violated the canons of logic. I realized that theory building is our puny attempt to understand our world by inventing artificial systems and trying them out. Later in my graduate career I had one additional insight. We were studying learning and some instructional theories. It was apparent that learning theories tended to explain how persons acquire and store knowledge, but they have very little to say about how an instructor should structure and sequence knowledge to promote efficient and effective learning. It occurred to me one could build a logical system, a theory, about instruction. So, I said, "Let there be an instructional oar and a rubber

boot." This statement led me to pursue the development of instructional design theory as the primary focus of my academic career. *Component Display Theory* was my first attempt at an instructional design theory (see Merrill 1994) and was the underlying theory for the design of Two-way Computer Controlled Information Television (TICCIT), a computer-based instruction authoring system (Merrill, Schneider & Fletcher 1980).

I had the opportunity to chair the PhD committee for Charles Reigeluth. While completing his degree, Charlie organized a symposium of prominent professors, titled *Instructional Design Theories and Models*, for the annual convention of the American Psychological Association. Following the conference, he served as editor for an anthology that published each of the papers from this symposium (Reigeluth 1983). He subsequently edited two additional volumes under the same title but with different authors (Reigeluth 1999, Reigeluth & Carr-Chellman 2009). When the second book was published, Charlie indicated in the preface that there were many different instructional design theories and models, and that designers should learn many of these different approaches and use the approach that was most appropriate for a given situation. I thought that most of these different approaches were all based on the same underlying principles and that they differed mostly in implementation details. Charlie challenged me to demonstrate my assumption.

I set out to determine the fundamental principles that were common to many of these different approaches. The result of this effort was a set of principles that I called "*First Principles of Instruction*" (Merrill 2002a). Over the next few years, I tried to elaborate, clarify, and explain these principles and to demonstrate their presence in other instructional design theories and models (Merrill 2006a, 2006b, 2007a, 2007b, 2009a, 2009b, 2013). I also proposed a content-first alternative to the classic Analysis Design Development Implementation Evaluation (ADDIE) instructional design model called A Pebble-in-the-Pond Model for Instructional Development (Mendenhall et al., 2006; Merrill, 2002b, 2007b).

My 2013 book, *First Principles of Instruction: Identifying and Designing Effective, Efficient, and Engaging Instruction,* was available until 2019. This revised edition is completely rewritten and is a significant modification of the first edition. I have tried to make the book more accessible, more readable, and more concise than the original publication. It still presents and illustrates the five principles and the Pebble-in-the-Pond model for instructional design, but it is my hope that it does so in a more efficient, effective, and engaging manner. I hope you find this revised edition an important addition to your instructional design library.

M. David Merrill

All proceeds from the purchase of this book go toward the AECT David Merrill Convention Scholarship Fund.

Acknowledgment

As with the first edition, the principles, prescriptions, and suggestions in this book have been influenced by many sources. While it is impossible to acknowledge everyone I would nevertheless like to recognize some of the most obvious influences. I have tried to represent what I have learned from the theories, research, and practice of the many instructional professionals with whom I have interacted all over the world. It has been my great pleasure to have presented and discussed effective, efficient and engaging instruction in instructional environments found in business, government, the military, and all levels of education. These interactions have shaped my thinking and influenced what is presented in this book. This revised edition has been significantly influenced by feedback from readers of the first edition.

Perhaps the greatest influence on my thinking is the interaction I have had with the hundreds of students it has been my pleasure to mentor and to learn from. I have often been asked why I stayed in higher education when I had many opportunities to enter the training world in business for considerably more salary. My answer has always been the same: because of the opportunity each school year to interact with another group of very intelligent future leaders.

The work of a few of these students is represented here. Letter Press Software is an award winning developer of outstanding instructional materials. Mark Lacy, Leston Drake, and Mike Peterson and their associates have consistently applied, modified, and experimented with the ideas I tried to help them understand when they were my students and in consulting with their company. Their courses under the copyright of The Furniture Training Company and Download Learning represent some of the examples included here.

Anne Mendenhall served as an instructional designer working with me at Brigham Young University Hawaii. She directed the faculty and students who designed the Entrepreneur course which is the example of problem-centered instruction described herein.

Students and colleagues at Brigham Young University, Utah State University, Florida State University, Brigham Young University Hawaii, and the University of Hawaii all designed modules and course segments that have provided illustrations a few of which are included here. I only wish that there were room to include all of these excellent examples for you to explore. Thanks to David Bybee, Michael Cheney, Justin Smith, Greg Francom, Christopher Gardner, Gregory Gibson, Ross Jung, Dallen Miller, Micah Murdock, Michael Shoneman, Robert Tennyson, for permitting me to show some of their work as examples of e^3 instruction.

I have also included examples of e^3 instruction from other designers who were not students but who nevertheless have implemented the ideas represented by *First Principles of Instruction* in their work. Thanks to Martha Legare of the Gantt Group for the Gantt Chart module and Robert Booty for his wonderful valve gear animation.

As these ideas have evolved over the past almost 20 years, I'm most grateful to the many questions, comments, discussions, and correspondence from participants in my presentations and workshops on these ideas. I'm also most grateful for the opportunity that AECT has provided for me to present my ideas and for the many members of this association who have promoted *First Principles of Instruction*. I'm particularly grateful to

Phil Harris for his invitation to allow AECT to publish a second edition of *First Principles of Instruction*. As this work began, he suggested that we might need a 10% revision to obtain a new copyright. Those of you who have read the first edition will note that this small revision got multiplied many times resulting in a new and hopefully more effective presentation of these ideas.

This second edition might have been a mere 10% revision of the first edition but for the insightful suggestions from Terry Cortese who was assigned to be the production editor for this work. Inspired in part by her work on the publication of *Write Your Dissertation First* she suggested that as a storyteller, I should take a more personal approach and start with a demonstration and let the formal presentation follow it. This revised edition is the result of both my efforts and her very perceptive guidance and invaluable editorial assistance.

I must also credit my colleague Ruth Clark for this revised edition. While Ruth was not directly involved, she was a reviewer of the first edition. Her books are probably the most readable presentations of complex instructional design ideas. We discussed a possibility of collaborating on a revised edition of *First Principles of Instruction*. Unfortunately, circumstances prevented this collaboration. However, Ruth's body of work served as an inspiration for me to try and write a more readable version of *First Principles of Instruction*.

Finally, a debt of gratitude to my wife Kathleen for her patience and the serious neglect of her "Honey Do" list during the writing of these books. Without her encouragement, the 2013 book and this book may never have been written. I am grateful for her gentle prompting after a presentation where I had promised the participants that I was writing a book. "You've been telling folks that you are writing a book," she said, "but I don't see you doing any writing," and then, "You're not getting any younger." Her observation was the stimulus I needed to get serious and actually write the first edition. She is also grateful that writing this revised edition has kept me occupied while being confined to home during the recent pandemic. Thank you, Kate, for your encouragement and patience!