

Advanced Teaching Methods FOR THE Technology Classroom



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Advanced Teaching Methods for the Technology Classroom

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Dedication

*To my mother, Helen Petrina,
and father, William M. Petrina*

Advanced Teaching Methods for the Technology Classroom

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Preface

Technology teachers need texts that are forward-looking in content and methods, but also cover the ground of proven, reliable techniques of curriculum and instruction (C&I). This book provides just such an encounter between “what to do,” “how to do it,” and “why to do it.” Theory and practice in technology studies have changed in unprecedented ways during the last twenty years. In design, engineering, technology, and information and communication technology (ICT), the conceptual changes in C&I are remarkable. At least conceptually, all the ingredients for a transformation from industrial (arts) education to technology education were in place. The same ingredients were put into place to transform audiovisual education and computer science in the schools to ICT or new media education. During the 1980s and 1990s, research into the cultural aspects of technology also went through a transformation of theory and method. At the same time, education (academic, vocational, etc.) and teacher education witnessed an immense reconceptualization, although this was not entirely born out in practice. Simply put, there were tremendous changes within technology studies over the past two decades.

Advanced Teaching Methods for the Technology Classroom is a guide for education *about*, *through*, and *for* technology. It is intended to help you teach and, by consequence, your students learn, *about*, *through*, and *for* technology. To simplify this intention, when we teach *about* technology, we are dealing with content and dispositions; when we teach *through* technology, we are dealing with processes and skills; teaching *for* technology refers to occupations and roles. By themselves, none of these three orientations provides an adequate education. A conscious integration of the three orientations is what differentiates the approach in this book from more narrow studies *about* technology or training *for* technology. Effective technology teaching requires that we balance these three orientations.

The operative theme of this book is technological pluralism: (1) an integration of pedagogical and philosophical *orientations* to learning about, through, and for a wide *range of technologies*; and (2) a synthesis of *disciplines* including design, engineering, ICT, technology education, and technical education. This explains, although not entirely, what is meant in the opening declaration that this book provides an effective encounter among the “what to do,” “how to do it,” and “why to do it.” The changes in teaching technology and related demands at this time are daunting *and* extremely exciting! We have the same feelings about teaching technology that our students have about learning technology—excitement and trepidation.

As a text or reference book, a wide range of discourses, methods, and techniques are provided and explained in detail. Chapters can be read in any order and used in any combination. The theory emphasis will appeal to some while the practice emphasis appeals to others. The curricular focus will serve teachers at times while the instructional focus will be helpful at other times. For example, in Chapter III, in an advanced section on technology and ethics, moral philosophy is used to provide a background to theories such as consequentialism. In the same chapter, instead of simply providing a functional section on how to develop skills, the psychology and sociology of skill acquisition are explained. This book is unique in its integration of mechanics (how to do it), pragmatics (what works), and ethics (what ought to be). This balance of the how, what, and why characterizes our mission as technology teachers.

Teaching Technology

The mere word “technology” provokes strong opinions and responses from the head, heart, hand, and feet. For some, the notion of technology produces fear and feelings of insecurity. Others feel power and security. Some feel excitement and others feel dread. Many stress out over the technologies they use. Similar emotions are provoked when most of us are forced to design something. Yet, this is what teaching technology is all about: excitement, dread, fears, hopes, insecurities, power, and intimidations. Teaching technology is about dealing with contradictions within technology itself. This is not an easy task. We have to know what design or technology is, or more specifically, what the *curriculum* of technology is, or ought to be. As well, we have to know how to teach technology, or more specifically, how to organize *instruction*. What should we learn? How should it be organized for teaching? More than questions of content and methods, these are the primary problems of C&I.

C&I are inseparable. One implies the other. We could say that C&I are dialectically related: when we study curriculum, we find instruction, and when we study instruction, we find curriculum. Why then, you might ask, do we have two concepts for

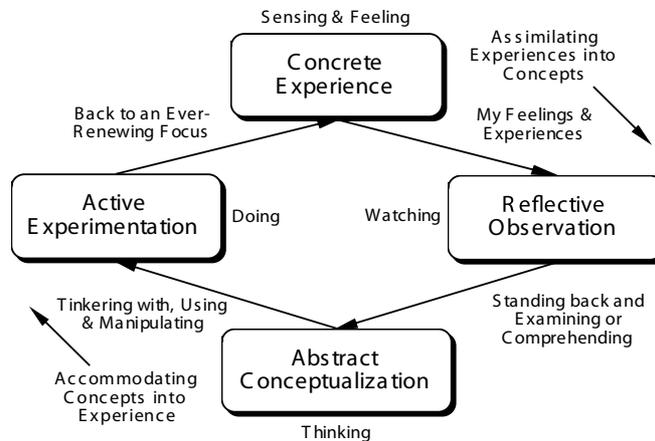
what is virtually one process? Can we actually teach without content or methods? Can we learn to instruct or teach without learning the curriculum? Can we prepare to teach technology without preparing the curriculum of technology? And so it goes. As we prepare the curriculum of technology, we prepare how to teach technology.

This book proceeds with the premise that we learn to teach technology just as we learn to practice technology. We learn best and become professionals through reflective practice. Sections in the book will help you to stand back to reflect and examine practices while other parts will help you to actively experiment with the practices of teaching. Reflective practice requires a process of introspection into our identities, clarification of our values and discourses, candid analyses of the state of education and the world, and an externalization and internalization of what we have learned (Kolb, 1984; Schon, 1983, 1987; Waks, 2001). This book will help you clarify your identity as a teacher by connecting you with a wide range of dispositions, practices, and representations of practice in education. Reflective practice involves cycles of socialization, externalization, internalization, and identification (Figure 1). In the process of becoming a teacher, we initially connect and empathize with certain practices; ultimately, we articulate and embody the practices we identify with. Reflective practice simply means that we fluctuate between immersion and reflection. We practice, reflect, and re-evaluate our practice, and return to practice again. Teaching is a cycle of reflective practice.

This book encourages you to think of reflective practice as cyclical (Figure 2). Reflective practice begins with who you are, your identity, and life history, and extends this knowledge to the meaning of teaching and teaching practices, to stories about teaching, to values and what is happening in education and the world. You have already generated a wealth of experience and knowledge, and the challenge is to help you focus this into the process of becoming a technology teacher. Empathize and identify with good practice, articulate this, and internalize what you learn. Reflective practice means that you think through and re-evaluate basic assumptions about education and technology.

Reflective practice also means that you pay attention to the difference between teacher education and school practices. We tend to overlook the difference between the way we are taught in teacher education and the way we teach in the schools. We develop assumptions about the symmetry of teacher education and school practices. For example, the technical component of teacher education is typically skills-based, justified by the notion that technology teachers should have a general breadth of skills and depth in one or two technical areas (e.g., ICT & graphic design). In most labs and workshops of teacher education, the focus is on skill development, whether it be problem or project driven. Pre-service teachers are often tempted to model this practice in the schools, overlooking the fact that the technical preparation of a technology teacher is designed to be different than the technical preparation of students in the school. The philosophies are different.

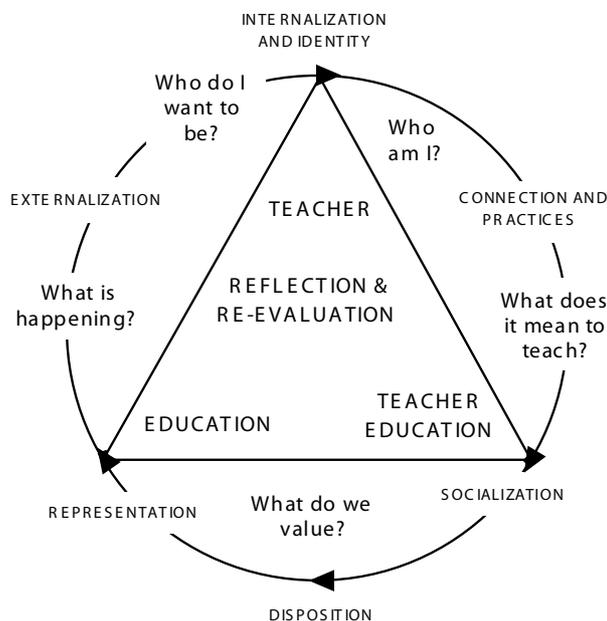
Figure 1. Cycle of experience (Kolb, 1984)



Reflective practice also means that we recognize that technology has ecological-natural, ethical-personal, existential-spiritual, socio-political, and technical-empirical dimensions (see Chapter VI). Whether we are learning to teach design, engineering, technology, or ICT, there are fundamental commonalities. By definition, design, engineering, ICT, and technology education *deals with knowledge in designing, creating, using, maintaining, managing, regulating, and recycling technologies (information, products, processes, and services)*. This includes a concern for deliberately balancing the technical-empirical dimensions of technology, or technique, with its ecological-natural, ethical-personal, existential-spiritual, and socio-political dimensions. Another way of stating this is that we value and balance knowing, caring, feeling, and doing, or the head, heart, hand, and feet. We value learning *about, through, and for* technology. The mission of technology studies, from this perspective is to provide experiences for young people to develop and question feelings, knowledge, and skills that empower them to participate in all facets of technological endeavor—from the practical to the political. This means constructing and sustaining a vision for inclusion, ecological sensitivity, and justice for the common good in leisure and work. This mission means that we *demystify technology and its applications as well as resensitize students to the implications of their technological decisions and surroundings*. This means that we balance the head, heart, hand, and feet in our lessons, activities, projects, and courses.

To meet the mission of technology studies, we differentiate between small “t” or plural technologies and big “T” or singular technology. We also stick to technologies that we use in the schools. Rather than overwhelming students with the impacts of big “T” technology, we concentrate on the implications of the small “t” technologies that we use everyday in the laboratories and workshops. Think about a technology

Figure 2. *Reflective practice in teacher education*



that you will be dealing with in the schools, such as a hammer, microprocessor, mp3 file, CAD application, or CNC router. Are you prepared to teach both the *applications* and *implications* of this technology? Can you demystify it and resensitize your students to its implications? Are you familiar with the history, politics, psychology, or sociology of this technology? Are you prepared to deal with ecological issues or the role of this technology in workplace innovation? How will you prepare resources that deal with the specific technologies? This book will play a significant role in assisting you to deal with the new challenges of technology studies.

Although we often organize schools as isolated rooms for disciplines or single subjects, subjects do not really exist in isolation. There are interconnections among the subjects. And although there is a hierarchy of subjects in the schools, all subjects have their place and reasons for existence. It is extremely important that technology teachers understand their role in the schools and the process of education. Technology teachers do not merely fulfill isolated roles and tasks. Technology labs and workshops are not merely places where technical skills are developed. Each day, technology studies plays a part in the whole development of students and their cognitive, emotional, physical lives. Whether it plays a role in their spiritual lives is dependent on how expansive technology is interpreted in the schools. E-ligion and transcendental materialism are just two of the more recent ways in which technology, religion, and spirituality converge.

Organization of the Book

This preface provided an orientation to technology teacher education as well as the field of technology studies. A variety of positions on teacher education and technology studies were presented. These positions underwrite the remaining chapters in this book. C&I were described as interrelated practices that are fundamentally important in the process of learning to teach *about*, *through*, and *for* design and technology. The cycle of reflective practice was described as a framework for teacher education. The primary intention of this preface was to provide a broad picture of technology studies and inspire you to make commitments that will ground your philosophy. The secondary intention was to prepare you for the remaining sections of the book.

The book is organized into eleven chapters, a brief conclusion, and a glossary for definitions. Each chapter addresses distinct aspects of C&I for technology teachers, whether pre-service or in-service. Each offers something for both beginning teachers and those seeking professional development. Some are practice oriented (Chapters I-II), some are oriented toward theory (Chapters III, VI), and others are a blend of practice and theory (Chapters IV-V, VII-XI). The chapters are divided into sections with the last section containing activities for reflective practice and projection to the next phase or chapter. The last section defines technology studies and affiliated disciplines. Although the glossary is included as a reference, it is a good idea to consult this early on for definitions.

As indicated, the book moves from instruction to curriculum. *Advanced Teaching Methods for the Technology Classroom* is divided into three major sections, seen as follows.

Section I: Analyzing and Designing Technology-Based Instruction

Chapter I introduces communication and preparation for instruction. It begins with basic issues regarding effective teaching: communicating with confidence, preparing lesson plans, and addressing the full range (i.e., cognition, emotion, action) of objectives in the curriculum.

Chapter II continues with basic issues and focuses on organizing knowledge for instruction. It begins with theories of intelligence and explains the place of practical or procedural knowledge in these theories. Chapter II emphasizes the necessity of organizing knowledge, whether procedural or sociopolitical, for students. Advance organizers are crucial to learning about, through, and for technology.

Chapter III deals with the interrelationships among feelings, values, ethics, and skills. This chapter challenges conventional wisdom concerning skill acquisition in isolation of ethics, feelings, and values.

Chapter IV describes the relation between teaching methods and learning styles. This chapter identifies over fifty instructional and research methods for technology teachers.

Chapter V connects instructional methods to creativity, design, ingenuity, and problem-solving. Some technology educators argue that creative problem-solving and design are the essences of technology studies.

Section II: Analyzing and Designing Technology-Based Curriculum

Chapter VI deals with one of the most basic premises of technology studies, which is “doing leads to knowing.” However, this chapter avoids the trap of cliché by exploring theories of learning and cognition. It is a theoretical chapter and serves as a transition from instruction to curriculum.

The final five chapters are oriented toward the content of technology studies and the challenges of assessment, classroom management, and safety.

Chapter VII provides ten significant justifications for technology studies, from technological literacy to gender equity to design and engineering.

Chapter VIII describes a comprehensive set of standards for the study of technology in the schools. These standards are extremely important, a point that cannot be over-exaggerated.

Chapter IX introduces strategies for instructional design and curriculum development. This includes basic principles as well as advanced techniques for organizing curriculum. This is the companion to Chapter II and the organization of instruction.

Section III: Implementing and Evaluating Curriculum and Instruction

Chapter X explains common approaches and philosophies of assessment and evaluation. This chapter offers details for both qualitative and quantitative assessment.

Chapter XI completes the textbook with an analysis of the challenges and difficulties of classroom management, facilities design, and safety. It can be reasonably argued that without adequate techniques for classroom management, C&I are hopeless. This final chapter concentrates on neglected aspects of technology teaching, such as equity and assistive technologies, legal dimensions of technology teaching, and ergonomics. The book ends by raising questions of class sizes and philosophical ideals for effective, safe practice in the schools. Technology teaching is exhilarating

but it is also challenging. This book makes a point of both characteristics of this extremely rewarding area of teaching.

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Section I

Analyzing and Designing
Technology-Based
Instruction

Chapter I

Communicating and Planning for Instruction

Introduction

A great irony in this age of information technologies is that communication skills for many people have atrophied. Students take low levels of communication and high levels of information overload for granted. This state of affairs has dire consequences for education, where clear, cogent communication is a prerequisite to learning. While it is tempting to “get with the times” by reducing communication to brief, sloppy exchanges, our challenge as teachers is to contradict these trends by modeling formal communication and information skills. This chapter begins with a description of an effective teacher to remind us that teaching involves a wide range of dispositions, knowledge, and skills. The remainder of the chapter focuses on demonstrations, lesson planning, and instructional objectives. Lesson plans and objectives are fundamental tools for demonstrating the applications, explanations, and implications of technologies to your students. Demonstrations are the single most effective method for technology teachers. Organization and communication are the keys to effective demonstrations.

The intent of this chapter is to provide you with the instructional tools that ground the practice of teaching technology studies. Communication, demonstrations, and lesson planning. These are the tools that will help you to immerse yourself in the craft of teaching. Recalling the model of reflective practice explained in the preface,