

Advanced Teaching Methods for the Technology Classroom

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structional objectives in an isolated, albeit focused, way. In the remainder of this chapter, we address instructional methods, teaching styles, and learning styles.

Teaching Methods

General models and families of teaching methods are guides for designing educational activities, environments, and experiences. They help to specify methods of teaching and patterns for these methods. Instructional strategies, or teaching methods, depend on a number of factors such as the developmental level of students, goals, intent, and objectives of the teacher, content, and environment including time, physical setting, and resources. Imagine a course that challenges teachers to meet a number of objectives. A single method cannot meet all of our goals nor can a single method accommodate all learning styles at once. For example, demonstrations or projects are effective for meeting some goals but ineffective for meeting others. So we need a toolbox of methods, not merely a single tool.

In the most general terms, there are four or five different models of instructional strategies or teaching methods. Having spent years in schools, you will recognize each and probably have strong preferences for one or two models.

- **Didactic:** Direct teaching; Verbal and typically in the form of a lecture or presentation.
- **Modeling:** Direct teaching; Visual and typically in the form of demonstration and practice.
- **Managerial:** Indirect or Interactive teaching; Facilitation, individualization, and group management.
- **Dialogic:** Indirect Interactive teaching; Socratic Technique of dialogue, questions, and thought provocations.

In the direct instruction models, the teacher imparts knowledge or demonstrates a skill. In the indirect instruction models, the teacher sets up strategies, but does not teach directly; the students make meaning for themselves. In the interactive instruction models, the students interact with each other and with the information and materials; the teacher is organizer and facilitator. Experiential Learning models mean that the students experience and feel; they are actively involved. In independent study models, the students interact with the content more or less exclusive of external control of the teacher. Some theorists prefer to reduce these to three general methods: Transmissive, transactive, and transformative teaching. Transmissive teaching, or direct instruction, means that the teacher delivers *status quo* content *via*

some method such as lecturing or demonstrating. Transactive teaching, or indirect instruction, means that the teacher and students arrive at *status quo* content to be learned through transactions and dialogue. Transformative teaching, or a combination of direct and indirect instruction, means that the teacher and students reject *status quo content* and focus on a transformation of themselves or their world.

These general models help us to classify teaching methods and simplify our discourse for conversing about them. We also group methods by their “family” affiliations. Some methods lend themselves to encouragement of social interaction in students. Other methods encourage information processing and some facilitate behavioral modification. Still others support intrapersonal and interpersonal development. Each of these families offers different approaches to teaching, respond to different objectives and goals, and yield different results in students.

The following list provides definitions for a variety of different methods, including most of those listed above (Cruikshank, Bainer, & Metcalf, 1999). Every method has advantages and disadvantages. For example, cooperative learning allows for the participation of everyone, but the groups often get side tracked. Role playing

Table 1. Families of teaching methods (Adapted from Joyce & Weil, 1980, 1996)

<ul style="list-style-type: none"> • Social interaction family: Emphasizes the relationship of the individual to society or to other persons. Gives priority to the individual’s ability to relate to others. <ul style="list-style-type: none"> o Partner and group collaboration o Role playing o Jurisprudential inquiry • Information processing family: Emphasizes the information processing capability of students. Gives priority to the ways students handle stimuli from their environment, organize data, generate concepts, and solve problems. <ul style="list-style-type: none"> o Inductive investigation & inquiry o Deductive investigation & inquiry o Memorization o Synectics (techniques for creativity) o Design and problem-solving o Projects & reports • Personal family: Emphasizes the development of individuals, their emotional life, and selfhood. Gives priority to self-awareness. <ul style="list-style-type: none"> o Indirect teaching o Awareness training & values clarification o Role modeling o Self-reflection • Behavioral modification family: Emphasizes the development of efficient systems for sequencing learning tasks and shaping behavior. Gives priority to the observable behavior of students. <ul style="list-style-type: none"> o Direct instruction (demonstrations & presentations) o Anxiety reduction o Programmed instruction o Simulations
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introduces a dramatic problem situation, but some students are too self-conscious to project themselves into the situation. Large group discussions pool ideas and experiences from the group, but a few students may dominate. Values clarification allows students to clarify their values in a safe environment, but some students may not be honest in this environment. Projects allow for self-directed problem-solving and creativity and take advantage of intrinsic purposes, but too much focus is placed on the product and too little on the process. There is a pedagogy (art and science of teaching) to each method that is beyond the scope of this book. In the first chapter, we explained the pedagogy of demonstrations and presentations. In the next chapter, we will address problem-solving and design briefs. Chapters six and nine will deal with activities, projects, and units. Think about your teaching methods and the range that you use. Practice a variety, if only to make your practice interesting.

In the next few sections, a summary of some of the most commonly used methods in technology studies is provided. Other common methods are described in other chapters as indicated in the previous definitions.

Teaching Methods (Cruikshank, Bainer, & Metcalf, 1999)

1. **Academic games or competition:** Learners compete with each other one to-one or team-to-team to determine which individual or group is superior at a given task such as “spelldowns,” anagrams, technology trivia, Odyssey of the Mind, or project competition. Commercially available, academic computer games are also very popular.
2. **Activity:** A general teaching method (e.g., problem-solving, design challenge, field trips, role playing) based on planned, purposeful involvement of students.
3. **Brainstorming;** Order to generate creative ideas, learners are asked to withhold judgment or criticism and produce a very large number of ways to do something, such as resolve a problem. For example, learners may be asked to think of as many they can for eliminating world hunger. Once a large number of ideas have been generated, they are subjected to inspection regarding their feasibility.
4. **Case study:** A detailed analysis is made of some specific, usually compelling event or series of related events so that learners will better understand its nature and what might be done about it. For example, learners in a technology lab might investigate the wear and tear of skate boarding on public works. Another class might look at cases of digital technologies and privacy.
5. **Centers of interest and displays:** Collections and displays of materials are used to interest learners in themes or topics. For example, children may bring to school and display family belongings that reflect their ethnic heritage. The

intention may be to interest the class in the notion of culture. Or, the teacher might arrange a display of different devices used in measurement to prompt interest in that topic.

6. **Colloquia:** A guest or guests are invited to class for the purpose of being interviewed in order to find out about the persons or activities in which they are involved. Thus, a guest musician might serve as a stimulus for arousing interest in music and musical performance.
7. **Contract:** Written agreements entered into by students and teachers which describe academic work to be accomplished at a particular level in a particular period of time such as a week or month.
8. **Controversial Issues:** An issues-based, teacher-directed method that focuses on controversies. Students are directed through a process that assists them in understanding how to deal with controversial and sensitive issues and clarifies these issues in a group context. Involves critical thinking and discourse analysis (Chapter IV).
9. **Cooperative learning:** Learners are placed in groups of four to six. Sometimes the groups are as diverse or heterogeneous as possible. In such cases, group members are often rewarded for the group's overall success. Student groups might be given a teacher presentation on division of fractions. They would then be given worksheets to complete. Team members would first help and then quiz one another (Chapter IV). See also student team learning.
10. **Culture jamming:** A method used to empower students to "speak back" to mass advertisements and media images that enforce stereotypes and select representations of individuals or groups. Empowers students to mock or "jam" images of popular culture.
11. **Debate:** A form of discussion whereby a few students present and contest varying points of view with regard to an issue. For example, students could take different positions and debate an issue: "Should rights to free speech on the internet be extended to students in schools?"
12. **Debriefing:** A method used to provide an environment or platform for the expression of feelings and transfer of knowledge following an experience. Debriefing may come at the hands of a tragic event or may be used more generally following an intentionally educational experience. Debriefing relies on the skills of the facilitator to reframe an experience or event to appropriately channel emotions and knowledge toward understanding and transformation.
13. **Demonstration:** A teaching method based predominantly on the modeling of knowledge and skills. A form of presentation whereby the teacher or learners show how something works or operates, or how something is done. For example, a teacher could demonstrate how to use a thesaurus, how to operate a power drill, how to scan an image, or what happens when oil is spilled on water

as when an oil tanker leaks. Following that, students practice under teacher supervision. Finally, independent practice is done to the point of proficiency (Chapter I).

14. **Direct instruction:** A term used to describe explicit, step-by-step instruction directed by the teacher. The format or regimen advocated is demonstration, guided practice, and independent practice. Thus, the teacher might teach a reading, mathematics, geography or technology concept or skill. Following that, students practice under teacher supervision. Finally, independent practice is done to the point of mastery.
15. **Discovery or inquiry:** Discovery learning is used when students are encouraged to derive their own understanding or meaning for something. For example, Students are asked to find out what insulation acts as the best barrier for cold or hot environments. Experiments that are not teacher demonstrations are part of discovery learning (Chapters II, V).
16. **Discussion:** Discussions occur when a group assembles to communicate with one another through speaking and listening about a topic or event of mutual interest. To illustrate, a group of learners convenes to discuss what it has learned about global warming (Chapter IV).
17. **Drill and practice:** A form of independent study whereby, after the teacher explains a task, learners practice it. After Students are shown how to use Ohm's Law, they are asked to make calculations of current, resistance, and voltage.
18. **Feedback:** A semi-formal mode of communicating to students constructive criticism regarding their performance during an activity (Chapter I).
19. **Field observation, fieldwork, field trip:** Observations made or work carried on in a natural setting. Students visit the local museum of natural history to see displays about dinosaurs, or they begin and operate a small business to learn about production and marketing.
20. **Independent study or supervised study:** Described in this chapter, independent study occurs when learners are assigned a common task to be completed at their desk or as a home study assignment.
21. **Individualized instruction:** Any of a number of teaching maneuvers whereby teaching and learning are tailored to meet a learner's unique characteristics.
22. **Installation:** Students present material within a formal structure for displaying audio, multimedia, or visual artifacts.
23. **Module:** A module is a self-contained and comprehensive instructional package, meaning that basically everything that the student needs is in the module. A form of individualized instruction whereby students use a self-contained package of learning activities that guides them to know or to be able to do something. Students might be given a module containing activities intended to help them understand good nutrition (Chapter IX).

24. **Mastery learning:** As a class, students are presented with information to be learned at a predetermined level of mastery. The class is tested and individuals who do not obtain high enough scores are retaught and retested. Those who passed undertake enrichment study while classmates catch up.
25. **Mixed-mode instruction:** A combination of “face-to-face” and online methods.
26. **Online instruction and learning:** A self-directed and automated approach that utilizes hypermedia (internet browsers, etc.) for communication that generally provides independence from the architectural constraints of classrooms.
27. **Performance:** Students act out through dance, drama, music or other expressive forms.
28. **Presentation and lecture:** Students listen to a person who talks about a topic. To illustrate, the teacher, or a guest speaker, tells the class all about the invention of the transistor.
29. **Problem:** A general teaching method and organization of curriculum and knowledge where students work purposefully toward a solution, synthesis, or cause. Often called problem-based learning (Chapter V).
30. **Programmed and automated instruction:** A form of individualized instruction whereby information is learned in small, separate units either by way of reading programmed texts or using computer-based programs (See Online instruction).
31. **Project:** Students work through a series of activities and problems culminating in the completion of something tangible (e.g., artifact, media, performance). A form of individualization whereby learners choose and work on projects and activities that facilitate and support the development of skills and knowledge. Often, learners not only choose topics but also the means of their conduct and production. (Chapters VI, IX).
32. **Protocols:** Learners study an original record or records of some important event and then try to understand the event or its consequences. They might watch a film depicting actual instances of discrimination and then consider its causes and effects.
33. **Recitation:** Students are given information to study independently. They then recite what they have learned when questioned by the teacher. For example, students read about what causes pollution, and the teacher, through, questioning, determines the extent and nature of their knowledge and understanding.
34. **Reports, written and oral:** Individuals or groups of learners are given or choose topics. For example, each may be asked to find out about one planet in our solar system, or about solar powered vehicles. What they learn is shared with other class members by way of oral or written presentations.

35. **Role playing:** Learners take on the role of another person or character to see what it would be like to be that person or character. Thus, a student could play the role of an imaginary student no one likes or a news reporter.
36. **Simulation game:** Students play a specially designed, competitive game that mirrors some aspect of life. For example, they might play the Ghetto Game to find out about the problems and pressures that ghetto dwellers face and to sense how difficult it is to improve one's lot in life. Another commercially available simulation game is Gold Rush (life and adventure in a frontier mining camp). Many simulation games, such as Sim City, are automated.
37. **Simulation:** Learners engage with something intended to give the appearance or have the effect of something else. Thus students may engage in a simulation of the United Nations General Assembly in order to have "first hand experience" with how it works and what its delegates do.
38. **Synectics:** The use of specific techniques to foster creativity in students. For example, the students may be asked to develop metaphors to describe mobility across different terrains (Chapter V).
39. **Tutoring:** A form of individualization whereby either a teacher, or perhaps a fellow student, provides a learner or small group of learners with special help, usually because they are not learning well enough with only conventional instruction.
40. **Unit:** An intentionally designed, integrated, thematic organization of curriculum and knowledge through combinations of demonstrations, discussions, activities, problems, and projects (Chapter IX).
41. **Values clarification:** Teachers lead students through a series of moral and ethical dilemmas, such as birth control or clear-cutting forestry practices, to assist them in clarifying their values and moral choices (Chapter IV).

Controversial Issues

The controversial issues method deals with the processes of critical thinking and working through controversies. As the world gets smaller through the globalization of culture, economics, media, and controversial issues proliferate. As we grow more sensitive to the interdependence of cultures, individuals, races, religions and species, we assume more responsibility for sensitivity when dealing with issues. As technology is made more invasive and pervasive in our lives, it becomes more critical to make wise choices for what we create, buy, or sell. Students at younger and younger ages are finding themselves entangled in Webs of economics, politics, sex, technology, and violence. The controversial issues method will not help

us reduce the number of controversies in our lives but it does help us to deal with controversies critically and sensitively.

Controversial issues are quite topical and can typically be directly related to students' lives. Controversial issues are an essential part of the curriculum if the schools are to fulfill their mandate to prepare citizens for democratic participation. Controversies provide students and teachers with opportunities to comprehend, reflect, practice, and make commitments and act. They are crucial for helping students to develop their ethical and moral reasoning and to become critical thinkers. Controversial issues are likely to challenge students' beliefs, values, and worldviews. This can be threatening and confusing, and can cause some students considerable emotional distress. Hence, if controversies are not properly addressed in the classroom, students often resist engaging with the issues because they are angry or feel threatened. What is a controversial issue?

Criteria that characterize a controversy:

- There are competing views and interests.
- People disagree strongly about statements, assertions, or actions.
- There is sensitivity.
- Emotions become strongly aroused.

Controversial issues form around:

- What has happened
- The cause of the present situation
- The desirable ends to work towards
- The appropriate course of action to be taken
- The likely effect of action

Controversies are complex. Working through controversies requires knowledge of what the controversy is about, an awareness of one's own values and a sense of identification with the controversy. Teaching with the controversial method requires balance, disclosure of commitment, and taking a stance without coercion or indoctrination of others. Teachers are responsible for establishing ground rules, moderating any classroom incivilities, moderating one's own and the students' over-attachment to content or an overreaction to criticism. Teachers are responsible for moderating negative thinking and strong emotional reactions in their students. Ground rules are necessary to govern classroom procedures and to moderate the nature of the contributions to understanding the controversial issue. Ground rules should enable the free

Table 2. Tips for teaching controversial issues (Street Law, 2003)

<ol style="list-style-type: none"> 1. Recognize the general legitimacy of controversy. Controversy is part of society and students must learn to discuss the issues and problems presented. 2. Establish ground rules for proceeding. Create and agree on effective rules. 3. Use the framework provided for dealing with controversial issues. 4. Concentrate on evidence and information. 5. Represent opposing positions accurately and fairly (balance). 6. Clarify the issue so that students understand where there is agreement and disagreement. 7. Identify core issues. 8. Make the issues concrete before launching into levels of abstraction. 9. Allow students to question authority (i.e., question the teacher's position). 10. Admit doubts, weaknesses, and difficulties in your position. 11. Teach understanding and active listening by re-stating the perspective of others. Have students paraphrase what others said to gain this skill. 12. Demonstrate respect for all opinions. 13. Establish a means for closure. Examine consequences and consider alternatives. Do not leave the class suspended in neutrality or inaction.
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flow of information in a safe, non-threatening environment. Classroom incivilities include teacher and student behaviors that distort the classroom atmosphere and negatively affect learning. Teacher incivility can include rudeness, prejudice and the neglect of the needs or emotions of individual students or groups of students. Teachers can actually stimulate student incivilities by appearing neglectful of students' welfare. Student incivility can include disruption, rudeness, and distractions during an activity. When using the controversial issues method, teachers must be vigilant about behaviors that stimulate incivilities. Moderating an over-attachment to ideas and an overreaction to criticism will help students move from black-white thinking to complex understandings. Students use a range of strategies to deliberately cling to a certain view. Students will discount information that is not congruent with their opinion or distort and revise this information to become congruent. Teachers must help students keep these practices in check by encouraging a fair analysis of multiple aspects of a controversial issue. Moderating negative thinking and strong emotions involves the reframing of negative thoughts and irrational feelings. Teachers must reframe into positive terms what students say in negative terms. They have to help clarify issues that might underlie irrational feelings (Flinders University, 2001).

The key to the controversial issues method is a framework for handling the controversy (Clarke, 1993). Success depends on whether participants communicate and methodically work through the issue. Werner and Nixon (1990) developed a comprehensive framework for teaching controversial issues that orients the method towards clear communication and critical thought (Table 3). As well as setting the tone as we described, teachers have to assume responsibility for clarifying the issues, arguments, assumptions, and manipulations contained in the controversy itself. They

Table 3. Controversial issues framework (Adapted from Werner & Nixon, 1990)

What is at issue?		
Identify and clarify central value questions	Identify and clarify central empirical questions	Identify and clarify central conceptual questions
What should be done? What is the alternative? Is X better than Y?	What is the case? What was the case? What will be the case?	What is X? How is X to be defined? What is the meaning of Y?
What are the Arguments?		
Clarify the value claims	Clarify the empirical claims	Clarify conceptual claims
What is the argument for X? What is the argument against X?	What evidence is there for X? What evidence is there against X?	Does the evidence for X match the argument for X? Does the evidence against X match the argument against?
What is Assumed?		
What attitudes are assumed?	Whose voice is heard?	What points of view are assumed?
Are prejudice attitudes present? Ethnocentrism? Racism? Parochialism?	Insiders? Outsiders? Experts? Lay public?	Personal? Institution? Region? Academic subject area?
How are the Arguments Manipulated?		
What groups are Involved?	How are the media involved?	What strategies are used?
What are their interests? What are their rationalizations?	News? Documentary? Internet? Alternative media?	Unfairly attacking opponents? Reducing complex issues? Using loaded language or exaggeration?

have to assist their students clarify the values contained in the issue and their own values effected in response to the issue. The values clarification method is provided in the next section. Werner and Nixon's framework is provided in Table 3.

Controversial issues can be combined with the values clarification method or with sociologics (Chapter V). This method can also be designed into a module (Chapter IX), which is student directed, or a unit (Chapter IX), which combines activities and projects with discussion. Controversial topics in technology studies include: Acid Rain, Alternative Medicine, Cancer & Risk, CFCs & the Ozone, Crime & DNA, Deforestation & Jobs, Disease & Treatment, GMOs, Habitat Preservation, Organic Farming, Privacy & the Internet, Racing, Recycling, Rights and New Technologies, SUVs, Wildlife Management, and War.

Values Clarification

Values clarification (VC) is a method that deals with the *process* of valuing and challenges students to formulate and test their values against a range of issues. VC is intended to help students communicate their beliefs, feelings, ideas and values, as well as empathize with others. It is a method that assists students in holding and using consistent beliefs and values. There are four general phases in the VC method: (1) the comprehension phase, (2) the relational phase, (3) the valuational phase and (4) the reflective phase. Similar to the first stage of the controversial issues method, the comprehension phase involves clarifying and interpreting the issue. The second phase challenges students to define how, if at all, they relate to the issues. In the valuing stage, students are challenged to make ethical judgments (good or bad, right or wrong, fair or unfair, etc.) on the issue. They are challenged to choose and elaborate preferences. In the reflective stage, students assess potential consequences to and conflicts with their choices. They face the imperatives of their choices. The VC method aims to move students from a process of identifying and prizing to choosing and acting on beliefs and values (Raths, Merrill, & Simon, 1966):

Prizing one's beliefs and behaviors:

1. Prizing and cherishing
2. Publicly affirming, when appropriate

Choosing one's beliefs and behaviors:

3. Choosing from alternatives
4. Choosing after consideration of consequences
5. Choosing freely

Acting on one's beliefs:

6. Acting
7. Acting with a pattern, consistency and characterization

Values clarification in technology studies involves helping students become aware of their beliefs about technology and technological practices they prize and would stand up for (Prizing and Affirming). VC allows students to consider alternative ways