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ABSTRACT

This Technical Paper focuses on the instructional philosophy and strategic direction of the PLATO[R] system. The paper examines current directions of change in education and training, and proposes a number of instructional purposes which computer technology can serve, including: direction instruction for declarative knowledge; a range of coached instructional simulations for well- to moderately-structured problem-solving; automated tools and resources, including the Internet, for loosely-structured problem-solving; and advanced assessment and instructional management systems to support a fully individualized, learner-centered approach to teaching and learning. The paper then summarizes the strategic direction of the PLATO computer-based system's evolution and explains how key features of the system specifically support the "information age" models of teaching and learning. Key features include: problem-centered architecture; sound instructional philosophy implemented consistently; whole curricula for adults and young adults, with emphasis on work and life contexts; flexible, modular structure incorporating a range of software types, such as coached instructional simulation, tools and resources, direct tutorial instruction, and practice; individualized competency-based placement, progress checking, and portfolio assessment for high accountability; instructional management system capable of flexible but close integration of all components to give instructors the leverage needed to manage a complex of individual learning plans; and "just in time" delivery via the Internet, local area networks, or stand-alone work stations located anywhere. (AEF)

PLATO®

Technical Paper #3: Instructional Philosophy and Strategic Direction of the PLATO System

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Executive Summary

This paper examines current directions of change in education and training. Together these changes have been characterized as a transition from an "industrial age" instructor-centered model, to "information age" learner-centered models of teaching and learning. The paper then proposes a number of instructional purposes which computer technology can serve, including:

- direct instruction for declarative knowledge (facts, concepts and principles),
- a range of coached instructional simulations for well- to moderately-structured problem-solving
- automated tools and resources, including the Internet, for loosely-structured problem-solving
- advanced assessment and instructional management systems to support a fully individualized, learner-centered approach to teaching and learning

Taken together, these roles for technology allow the teacher's role to transition from "sage on the stage" to "guide on the side," while allowing the learner's role to change from passive "customer" to active explorer and meaning-maker.

The paper then summarizes the strategic direction of the PLATO computer-based system's evolution and explains how key features of the system specifically support the "information age" models of teaching and learning. Key features include:

- Problem-centered architecture
- Sound instructional philosophy implemented consistently
- Whole curricula for adults and young adults, with emphasis on work and life contexts
- Flexible, modular structure incorporating a range of software types, such as coached instructional simulation, tools and resources (including access to the World Wide Web), direct tutorial instruction, and practice
- Individualized competency-based placement, progress checking and portfolio assessment for high accountability
- Instructional management system capable of flexible but close integration of all components to give instructors the leverage needed to manage a complex of individual learning plans
- "Just in time" delivery via the Internet, local area networks, or stand-alone work stations located anywhere

Part

1

A Learner-Centered Educational Environment

The Highest Use of Learners, Teachers, and Educational Technology

From the Industrial Age to the Information Age

Visionaries and professionals in education and training agree that the educational needs of employers and society have changed in our information-based economy. The changes include differences in the curriculum, but they also include important differences in the core processes of teaching and learning. To meet the new requirements, our education and training institutions must change their fundamental assumptions from those of an "industrial age" model to an "information age" model. This table one view of the changes envisioned:

Industrial Age	Information Age
Grade levels	Continuous progress
Covering the content	Purposeful accomplishment
Testing for competitive grades	Individualized testing for goals
Non-authentic assessment	Performance-based assessment
Group-based content delivery	Personal learning plans
Adversarial, competitive learning	Individual and Collaborative learning
Classrooms	Learning centers
Teacher as dispenser of knowledge	Teacher as coach or facilitator of learning
Memorization of facts out of context	Whole act of thinking, problem-solving skills and meaning-making
Isolated, specialized skills	Integrated, multidisciplinary, whole tasks
Books as tools	Advanced technologies as tools

Adapted from: Dr. Charles M. Reigeluth, Indiana University

We are in the midst of the biggest changes to reach education and training in a century. Leaders in the field are advocating changes such as these:

- We are moving from an emphasis on clustering learners by grade levels according to chronological age, to emphasis on continuous progress based on individual learning and readiness.

- We are moving from an emphasis on "coverage" of the (mostly factual) content of a given subject matter area bounded by a discipline, to emphasis on accomplishments which are meaningful work- and life-related tasks, and which often cross subject matter boundaries.

- We are moving from a system in which testing is viewed as a way of separating learners competitively along a "bell-shaped curve," to a system in which testing measures each individual learner's progress toward defined goals.

- We are moving from almost sole reliance on decontextualized test questions, to a system which combines the strengths of various assessment techniques to measure the learner's ability to perform meaningful whole tasks.

- We are moving from almost sole reliance on teacher-centered, group-based content delivery, to a system which supports personal learning plans which emphasize individualized learning experiences.

- We are moving from a system which places learners in competition with each other and makes the teacher and learners adversaries, to one in which learning is an individual responsibility and a shared cooperative enterprise

- We are moving from a system in which all learning activities must take place in a self-contained classroom, to one in which learners work in a variety of venues depending on the purpose.

- We are moving from a definition of the instructor's primary role is as the main dispenser of knowledge, to one in which the teacher's primary role is as a coach and facilitator of learning.

- We are moving from a system in which the learner is a passive receptacle, to one in which the learner makes his or her own learning

- We are moving from a system in which the emphasis is on memorization of isolated, out-of-context facts, to one in which the emphasis is on the whole act of thinking, problem-solving and meaning-making

- We are moving from a system in which knowledge and skills are taught in isolation from one another, to one which emphasizes integrated, multidisciplinary, whole tasks

- We are moving from a system in which the primary learning tool is the book, to one in which advanced technologies are the primary tool.

Taken together, these trends add up to a change from a factory model "industrial age" school/training to "information age" models of education and training. While no school or training organization is changing in all of these ways, we have found that virtually all of our clients are interested in PLATO because they want to move along the continuum away from the "industrial age" assumptions and toward the "information age" ones. The challenge for PLATO is to facilitate those changes.

Information Age educational processes, and the roles of those who do them, are a significant change from "business as usual" in today's traditional education and training institutions. Leaders know that making the changes needed will require significant new roles for teachers and learners. The instructor's role changes from "sage on the stage" to "guide on the side," while the learner's role changes from passive consumer to active maker of knowledge (see next section). The tools and resources available to them must change, and teachers and learners must learn to use them in new ways. The challenge for PLATO is to provide the instructional tools, resources and supporting services needed in these new roles.

Education and training leaders also understand that the time to make these changes is now. The expectations of stakeholders, including parents, employers and senior managers about the performance of our systems for education and training have escalated. Pressures for standards, accountability, and demonstrated return on investment are growing. The "bell shaped curve" of learner achievement is a result of the assumptions of the information age model of education and training, such as almost exclusive reliance on assessment of learners as compared with the group. In the information age model, it is increasingly viewed as an admission of failure by the system, rather than "normal." The "status quo" is no longer acceptable. We have to do *different,* not just *more,* education and training. The challenge for PLATO is to provide dependable solutions of proven effectiveness to meet these new standards and expectations.

A Learner-Centered Environment

Why is it that in a typical classroom at any age level, the hardest-working person is the teacher? Industrial Age classrooms are often described as "teacher centered," with the teacher in the role of "sage on the stage." There often seems to be more of a focus on what the teacher is doing than what the learner is doing. Large group instructional methods often lead to a passive role for the learner, whose job seems to be to "absorb" the content presented by the teacher. Studies of time in conventional large-group classes have shown repeatedly that even in the best of classes, each learner answers only one or two questions in a period; a typical learner spends only 20% or less of the day actually studying the curriculum. It's scarcely surprising that learners often react with boredom and disinterest.

But we know that learning is the result of what learners do and make, not what you tell them. "Telling isn't teaching." Information, no matter how entertaining, is not instruction. Everything in the educational or training environment contributes to learning only if it causes learners to make or create something: a new understanding expressed in a dialog or work product. Only the learner can integrate knowledge into his or her understanding of the world and how it works. This principle means that our challenge is to:

- place the learner in a highly interactive environment,
- with appropriate, interesting and relevant learning tasks,
- supported by useful tools and resources
- with sound coaching on both content and the learning processes themselves
- which empowers the learner to take responsibility for, and do, the hard work of making ideas, knowledge structures, and things.

In the Information Age learning environment, the hardest-working person must be the learner.

The learner-centered environment has a number of additional key characteristics:

"Just in time" instruction. It's never true that all the learners in a class actually need, and are ready for, the same instruction at the same time. There are many individual differences in what learning is actually needed and when it is needed. In addition, research on individual differences shows that learners of the same chronological age vary in their learning rate over a ratio of 6:1 (one learner will need 6 hours to learn what another can in one hour). These differences mean that the Information Age learning environment must have the flexibility to help each learner work individually, with time, place and content all determined by the needs of the individual learner.

Instructional Management. Teachers see this need for learner-centeredness as a problem of organization because they face 25 or more learners at once. We are so used to managing instruction with the conventions of the Industrial Age classroom that we may not even realize how central instructional management is to the processes of learning, and how instructional management must change in Information Age learning environments. The promise of learner-centered education and training requires the ability to track progress of each individual learner, assess and prescribe what's needed on a day-to-day basis. The management system must allow each individual learner to work at his or her own time, place, and rate. It must allow the instructor and the learner to share the responsibility of managing learning in a way which is appropriate to the learner and the learning task. To do so, the instructor must have the ability to allocate to the learner just those self-management decisions which are appropriate, while retaining control over other key management decisions as necessary. It is the problem of instructional management, as much as any other, which inhibits the wide-spread implementation of true individualization in most education and training.

Learner-Centered Assessment. In both Industrial Age and Information Age education and training, the integrity of the system rests on the quality of its assessment systems. But in the learner-centered environment, the requirements for assessment become much more complex. First, the emphasis on learning outcomes and meaningful learning mean that the criterion tasks of assessment must be as close as possible to complex, real-world tasks such as problem-solving. Second, knowledge tests must assess the learner's knowledge structures and understanding of concepts, principles and mental models, rather than testing only for isolated facts. Third, the assessments must be capable of being used in a "just in time" environment, without compromising security or imposing undue work on the instructor. Fourth, assessment needs to be a tool by which learners learn to make their own assessments and monitor their own progress, rather than solely as a tool for instructors and administrators.

Technology as a Lever for Change

Many of the features of learner-centered, Information Age education and training can be implemented using technology. But appropriate technology is more than a "nice to have" addition in a fully-realized learning environment with these characteristics. Technology can be one of the principal levers for change which are available to professionals making the transition.

But it does not follow that *any* investment in technology will serve this purpose. Education and training professionals must be careful to acquire and implement *appropriate* technologies, and see to it that they are used in *appropriate* ways. More specifically, technology can serve the roles in an Information Age learning environment described in the following table.

Information Age Change	Appropriate Role of Technology
Continuous progress	Modular, self-paced, individualized learning environment
Purposeful accomplishment	Curricula centered on interesting and realistic problems, using simulations and project-based tools; supported by information resources and instruction for declarative knowledge and component skills, all structured by precise definitions of purposeful accomplishments.
Individualized testing for goals	Modular, individually constructed and delivered, competency-based self-tests, to monitor and prescribe component knowledge and skills.
Performance-based assessment	A portfolio of simulation-based and project-based assessment techniques, all structured by the same learning outcome definitions as the instruction, to assess ability to integrate knowledge and skills into performance of realistic tasks of creating or making.
Personal learning plans	Structured and implemented through a computer-managed instruction system
Individual and collaborative learning	Collaborative learning environments supported by intra-work group communications and a common set of tools, resources and purposes
Learning centers	Ability to use computer networking and the Internet to deliver rich and diverse set of instruction and tools in a managed environment, any time and anywhere, thus allowing learners mobility of space and time.
Teacher as coach or facilitator of learning	Primary instruction and information delivered technologically, using a management system which can communicate the status of individual learners in real time to instructors, who then are freed up to act as "guide on the side" in classroom or distance learning environments, as the learners work or asynchronously.
Learner as maker	Dialogs with the learner which include prediction, hypothesizing, and argumentation; problem- and project-centered tool-rich environments which require sense-making, allow exploration, and creation of knowledge and work products.
Whole act of thinking, problem-solving skills and meaning-making	Problem-centered curricula, with emphasis in declarative knowledge teaching on structures of facts, concepts and principles synthesized into meaningful mental models.
Integrated, multidisciplinary, whole tasks	Cross-disciplinary problems and projects, supported by collaborative learning tools and environments, such as discussion groups, e-mail, and group writing tools
Advanced technologies as tools	Use of World Wide Web and data bases as sources of information on demand, all integrated via the management system

Four key conclusions emerge from this table:

- The "core" of information age education and training is the whole act of thinking, which includes problem-solving skills and meaning-making. This is best done in problem-based simulation and project environments, with appropriate coaching.
- Declarative knowledge (facts, concepts and principles) plays an important but supporting role in information age education and training. This kind of teaching is best done with a combination of tutorial and reference tools.
- Instructional management is essential to integrate and manage all components at the required level of individualization.

- Therefore, in information age education and training, computing and network technologies play multiple roles, which change as the instructional purpose changes. There is no single "best use" of technology.

Finally, it is clear that skilled instructors with small groups of learners *could* realize most of the information age changes with only minimal use of technology. However, implementing these changes cost-effectively on a large scale almost certainly requires heavy use of appropriate technologies.

Part
2

The PLATO® System

Technology for Learner-Centered, Information Age Education and Training: Overview

With a 30-year heritage of research and development, the PLATO® System is constantly evolving and growing to realize the vision of learner-centered, Information Age education and training. To those familiar with the PLATO of the 1970's, today's system would be scarcely recognizable. The table below provides an overview of current key PLATO components and their purpose:

Information Age Change	Role of Technology	PLATO® Component
Continuous progress	Modular, self-paced, individualized learning environment	• Modular architecture, with over 5,000 individually selectable/assignable learning activities as small as 15-minute lessons • no larger than 90-minute problem-solving acitivities. • All self-paced, individual instruction. • Can be selected, grouped and sequenced in any way.
Purposeful Accomplishment	Curricula centered on interesting and realistic problems, using simulations and project-based tools; supported by information resources and instruction for declarative knowledge and component skills, all structured by precise definitions of purposeful accomplishments.	• Entire curriculum structured and managed by precise learning outcome statements. • Problem Solving Activities (PSA's) and projects incorporating authentic tasks at the core of most curricula. • Tools, World-Wide Web and offline resources integrated in a managed environment. • Declarative and procedural knowledge lessons form comprehensive curricula in core skills.

Information Age Change	Role of Technology	PLATO® Component
Individualized testing for goals	Modular, individually constructed and delivered, competency-based self-tests, to monitor and prescribe component knowledge and skills.	• Progress (mastery) tests for each lesson. • PCAT custom comprehensive test construction tool. • Placement testing system with automated prescription for core curricula. • All tests individually prescribed, delivered on-line, and most are individually constructed by sampling from item pools. • All tests competency-based and criterion-referenced.
Performance-based assessment	A portfolio of simulation-based and project-based assessment techniques, all structured by the same learning outcome definitions as the instruction, to assess ability to integrate knowledge and skills into performance of realistic tasks.	• Portfolio Assessment activities built into problem-solving activities (PSA's). • Support for instructor-defined assessment activities and results entry in Pathways management system. • Integrated Work Keys Locator assessment system.
Personal learning plans	Structured and implemented through a computer-managed instruction system	• Pathways computer-managed instruction system supports creation of learning paths for individual learners or groups defined in any way, with automatic prescription and progress monitoring and real-time reporting to learners and instructors.
Individual and collaborative learning	Collaborative learning environments supported by intra-work group communications and a common set of tools and resources	• Collaborative learning supports in PSA's and other project-based activities. • Collaborative learning tools such as the Daedalus collaborative writing system. • Ability via Pathways to support "wrap around" instruction centered on instructor-defined problems/projects, for use by collaborative teams. • Collaborative asynchronous discussion group system in PLATO® on the Internet.
Learning centers	Ability to use computer networking and the Internet to deliver instruction and tools in a managed environment, any time and anywhere, thus allowing learners mobility of space and time.	• Delivery via stand-alone CD-ROM, Local Area Network (LAN), and the Internet. • Rich curriculum and tool set capable of supporting a wide range of individual learning needs. • LAN and Internet store learner records centrally, allowing learners to work at any time and log on from any work station with system "memory" of their personal records and most recent stopping points. • Collaborative asynchronous discussion system and e-mail in PLATO® on the Internet.

Information Age Change	Role of Technology	PLATO® Component
Teacher as coach or facilitator of learning	Primary instruction and information delivered technologically, using a management system which can communicate the status of individual learners in real time to instructors, who then are freed up to act as "guide on the side" in classroom or distance learning learning environments, as the learners work or asynchronously.	• Through Pathways management system, instructor selects and sequences all learning and evaluation activities for individual learners and groups. • Assigns self-management rights to learners as appropriate. • System reports learner progress and flags problem areas to learners and instructors, in real time or asynchronously.
Learner as maker	Dialogs with the learner which include prediction, hypothesizing, and argumentation; problem- and project-centered tool-rich environments which require sense-making, allow exploration, and creation of knowledge and work products.	• Multi-level dialogs built into PSA architecture; some use neural net inference to structure the dialog. • Projects integrated across some curricula. Pathways system and tools support project-based work created and assigned by instructors.
Whole act of thinking, problem-solving skills and meaning-making	Problem-centered curricula, with emphasis in declarative knowledge teaching on structures of facts, concepts and principles into meaningful mental models.	• Declarative knowledge lessons include extensive application practice and feedback. • Procedural knowledge lessons include scenario-based exercises. • Problem-Solving Activities (PSA's) require integration of knowledge and skills to solve realistic, complex, multi-step, multi-path problems in multimedia simulations of real contexts, with strategic and tactical coaching.
Integrated, multidisciplinary, whole tasks	Cross-disciplinary problems and projects, supported by collaborative learning tools and environments, such as discussion groups, e-mail, and group writing tools	• Interdisciplinary projects in the curricula • Projects may be created using World Wide Web references. • *Daedalus* group writing environment. Internet system supports discussion groups, e-mail.
Advanced technologies as tools	Use of World Wide Web and data bases as sources of information on demand, all integrated via the management system	• World Wide Web sites and any non-PLATO software can be launched by Pathways management system. • Integrated data bases such as those for social studies and vocabulary. • Data capture and representation tools built into science and math project modules.

Using the full rich set of resources in PLATO and the PLATO Pathways management system, an instructor can effectively manage an extremely wide array of individual and collaborative learning experiences simultaneously. Furthermore, the system can be used for this purpose whether the learners are all in the same classroom at the same time, or dispersed geographically and in time. This makes possible effective distance learning and close integration of projects or work with education or training activities.

Now, let's look at the key instructional features of the PLATO system: the problem-centered curriculum structure, the core instructional principles of the system.

PLATO® Problem-Centered Curriculum Structure

Our language does not do well at distinguishing ways of knowing a given subject. Curriculum designers need to pay particular attention to describing precisely both *what* learners are to learn, and *how* they are to know it. Many cognitive scientists argue that a complete curriculum needs to include *declarative* and *procedural* knowledge, with underlying *mental models* of the world. Each type of knowledge requires a different instructional strategy, with its own kind of information presented to the learner, and its own kind of learner activity to understand, integrate and use the knowledge and skills taught. This principle forms the foundation of the PLATO® curriculum structure.

Declarative knowledge includes *facts, concepts,* and *principles*. This table explains the distinction:

Declarative Knowledge Type	Definition	Example	Typical learner activity
Facts	"Knowing that"	Names of the planets	Given a picture and description of a planet's characteristics, state its name.
Concepts	"Knowing which"	Characteristics of planets vs. stars, moons, asteroids	Given a picture and description of a newly discovered body in space, identify it as a planet, star, moon, or asteroid.
Principles	"Knowing why"	If a planet orbits a star, then it is held in orbit by gravitational attraction between them.	Given a description of a planet orbiting a star, predict what would happen to the planet's orbit if a large asteroid passes by.

To use declarative knowledge, the learn must synthesize related knowledge components into a special kind of knowledge structure called a *mental model*. A mental model fits together the facts, concepts and principles into a "working" structure which emulates the behavior of some part of the "real world." The learner's ability to construct and use appropriate mental models underlies most kinds of problem-solving.

Procedural knowledge is "knowing how." It is the step-by-step problem-solving which is part of nearly any complete job or life task. It is often useful to think of problems on a continuum of how well structured they are, like this:

Well-Structured — Moderately Structured — Ill Structured

Source: A. Newell & H. Simon

The degree of structure in a problem determines the nature of the learner's task, in learning and doing problems of that type. This table explains the distinction:

Procedural Knowledge Problem Structure	Definition	Example	Typical learner activity
Well-Structured	Step-by-step procedure, always done the same way, has one "right" answer.	1-column addition	Given two numbers 0-9 to be added, recall and use the procedure to add them.
Moderately-Structured	Step-by-step procedure has to be invented by the learner to solve a problem with a clear "right" answer. Often more than one way to solve the problem.	Predict motion of 2 balls when one strikes the other on a pool table.	Given the position, mass, velocity and direction of movement of two balls on a (frictionless) pool table, predict how they will move after one strikes the other.
Ill-Structured	Problem for which there is no unique right answer, and there are many ways to solve the problem (or the way is unknown).	Design a winning car for a "pinewood derby"	Given a block of wood and 4 wheels, design a model car which will go the farthest on a standard course.

All problem-solving uses declarative knowledge, and all problem solvers use a mental model of the system they are manipulating. The challenge for curriculum designers is to:

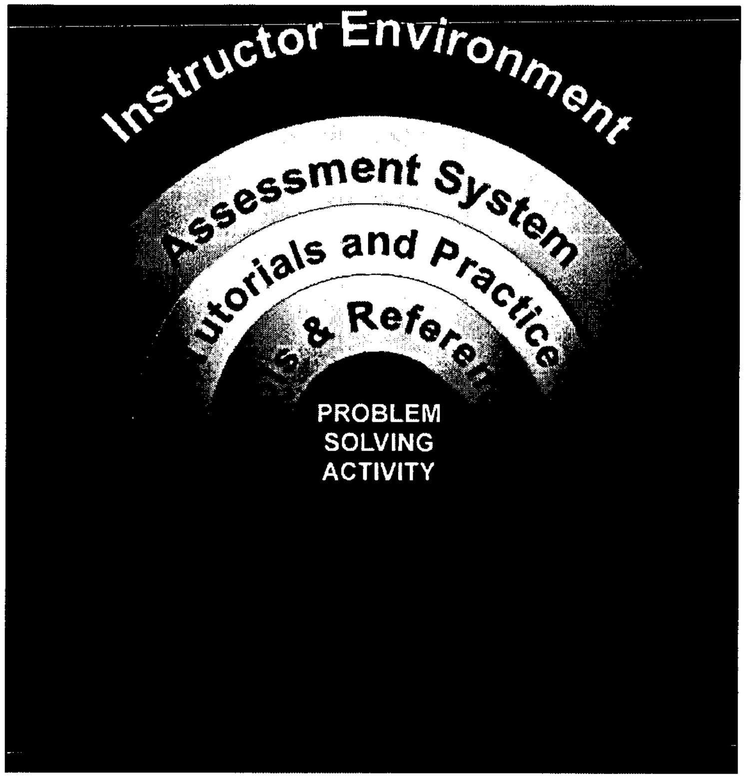
1. Identify an appropriate set of representative problems for the learner to solve, which are typical of the desired learning outcomes, and interesting and appropriate for adults and young adults.

2. Identify the procedural knowledge and mental models needed to solve these problems.

3. Identify the underlying declarative knowledge which the learner will use.

4. Develop instructional explanations, learner activities and assessments which will teach and test each of the component knowledge types effectively.

The PLATO core curricula are rapidly evolving toward a design which combines declarative and procedural knowledge in a *problem-centered* structure. This diagram shows the relationship of the main components of the structure:



The entire structure is implemented using the *Pathways* management system, which is under control of the learner and the instructor.

While the components shown above are designed to work together, there is no requirement that they all be used. This is entirely in the control of the instructor and the learner.

This table explains the purpose of each component in the problem-centered curriculum structure:

Component	Definition	Purpose	Example
PSA (Problem -Solving Activity)	Scenario-based exercise using procedural knowledge to solve a problem. Different types for well-, moderately- and ill-structured problem-solving.	1) Helps learner apply declarative knowledge to build mental models & solve problems 2) Models, gives practice & feedback on procedural skill	• PSA's in *Advanced Reading Strategies* treat reading as a moderately-structured problem-solving task; include realistic documents with questions requiring inference. • *Applied Math Problem Solving* is a set of multimedia problem scenarios in realistic contexts which require creation of a problem-solving strategy & provide strategy- and tactical-level coaching on the process. • *Projects for the Real World* provide scenario-based, open-ended exploratory problem solving environments for use by teachers & learners. • *Problem-Solving Skills* teach moderately- and loosely-structured problem solving skills using a range of work-based problem scenarios and contexts. • *Story Problems* in Math Application lessons give practice on well-structured problem-solving
Tools & References	Support exploration & problem representation, supply facts.	Accessed from within PSA's and tutorials, or directly by launching from *Pathways*	• WWW sites provide facts & tools coordinated with curriculum. • Discussion groups in *PLATO on the Internet* support collaborative learning • *American Heritage Dictionary* integrated into all new WinPLATO courseware • Graphing tools built into math PSA's & tutorials • *Daedalus* collaborative writing environment

Component	Definition	Purpose	Example
Tutorials & Practice	Teach declarative knowledge, mental models, some well-structured problem-solving procedures	Modules and courses can be assigned a pre- or co-requisite to PSA's, or used without PSA's if appropriate.	• Basic math curricula teach arithmetic concepts and skills, relate to real-world experience & mental models • Writing curriculum teaches mechanics of grammar & syntax, introduces basic concepts of style and writing process.
Assessment System	1) Individualized tests for declarative & well-structured problem-solving 2) PSA's often generate work products for portfolio assessment, for moderately- and ill-structured problem-solving	Mastery tests for each tutorial module can be used before or after tutorial to regulate progress. Course-level testing system used for placement & summative assessment Work products output for use by instructors doing portfolio assessment	• Module mastery tests provide custom progress test for self-monitoring by learners and for instructor management if desired • PCAT constructs individualized, custom course-level assessments which correspond to an individual instructor's defined curriculum • FASTRACK provides a quick, approximate assessment of a learner's skills for placement in the basic skills curricula • WORK KEYS LOCATOR provides initial placement using ACT's Work Keys framework • PSA's print work products with rubrics and learner logs for portfolio assessment

To reiterate, the PLATO Pathways management system is the "glue" which makes all these components work together seamlessly, and gives the instructor the power needed to effectively manage this complex and rich instructional environment.

PLATO® Instructional Models

The structure described above shows that no single instructional model can most effectively teach every needed curriculum component. In addition, professionals are implementing the vision of learner-centered, Information Age education and training in a wide range of settings, with a wide range of learners who have a wide range of needs. It's obvious that there is no "one best way" to educate and train.

The challenge for the PLATO® system is to be true to its core principles, while being flexible enough to support an appropriately wide range of learners, needs, instructor roles and settings, while retaining the focus needed to achieve the highest quality in the industry.

Core Principles of PLATO® Instructional Models

At the core of the PLATO system are these basic principles of instruction:

- All PLATO courseware is built expressly for adults and young adults. It is conceived from the beginning for these learners, and is not designed for elementary-age learners. This is reflected in the way in which courseware establishes and maintains motivation, the selection of authentic tasks for problem-solving, the frame of reference used for explanations, examples and exercises, and the overall visual style of the system.

- All PLATO instruction is learner-centered. This means that the courseware is designed for direct use by learners. The assessment and management systems allow learners to monitor their own learning progress against personal goals. The user interface is designed to provide the maximum appropriate degree of learner control, and the style of the system constantly reinforces the image that the learner, not the computer, is in charge. This is particularly important for adult and young adult learners.

- All PLATO courseware incorporates rigorous assessment. Education and training professionals are accountable for the learning outcomes achieved by their learners, so they require powerful, rigorous, and valid assessment systems for placement, regulation of progress, and evaluation of results. Every PLATO instructional component is built with rigorous and valid assessment as a prime requirement, to meet the requirement for effectiveness and accountability. The system incorporates a combination of competency-based, criterion-referenced testing and portfolio assessment techniques which instructors can customize.

- All PLATO curriculum structures are coherent, comprehensive and standards-based. PLATO curricula are designed and built in large-scale projects, so that professionals can be assured that the components fit together without gaps, lapses or internal inconsistency. Each curriculum is guided by an advisory panel of internationally-recognized experts in the field, leading PLATO clients, and actual learners. Curricula are designed to reflect the state of the art in national and state standards and tests.

- All PLATO curriculum structures are open. The system is highly modular, and instructors have complete control over what components to use and how to sequence and use them. Assumptions about sequence and prerequisite knowledge and skill are kept to a minimum, to facilitate maximum flexibility of use. Non-PLATO on- and offline instructional and assessment activities can be easily integrated at any point. PLATO activities can easily be integrated into non-PLATO on- and offline curricula wherever appropriate, to serve a complementary or supplementary role.

- PLATO is validated and continuously improved. Most PLATO courseware is designed to assume a primary role in instruction, and its effectiveness is rigorously controlled. In the initial development process, industry-leading instructional design standards and methods are used, emphasizing rapid prototyping and trials with actual learners. Throughout the life of the course, effectiveness is evaluated and the products are continuously improved.

- PLATO supports a range of roles for instructors. There is no such thing as "teacher proof" instruction. The optimum instructor's role depends on the type of instructional activity, the characteristics of the learner, and the learning environment. PLATO courseware and management systems are designed to give the instructor maximum choice in how to integrate PLATO into the curriculum, how manage the instructional environment, and what role to assume within it. The system includes a full range of support to allow the instructor to assume the role of "guide on the side."

- PLATO supports managed instruction. Professionals in high-accountability education and training environments require powerful instructional management. While individual curriculum components of the PLATO system can be launched and used independently, all are designed to work with the *Pathways* instructional management system. *Pathways* itself is designed to interface with administrative school and training program management systems. It generates a full range of administrative reports, and allows administrators to control the rights allowed to each level of user.

- PLATO views hardware and software technology as a means to an end, not an end in itself. The PLATO system is designed to run on current-generation industry-standard hardware and software. It will require no proprietary or exotic investments in hardware and system software technology by its clients.

Some Common PLATO Instructional Models

The flexibility of the PLATO system allows it to be integrated into a wide variety of instructional models. This table summarizes examples some of the most common ones. Numbers in parentheses are typical student:computer ratios.

Model	Goal	Learner's Role	Instructor's Role	PLATO Support
Skill Development System	Develop or remediate basic skills with assured mastery, immediate feedback on success, high motivation.	Self-paced interactive study (1:1 for whole group), with start points set by placement tests, progress regulated by mastery tests	Manager, mentor, supplementary tutor (optional/recommended), certifier of results. In "live" skill lab or asynchronous distance learning setting.	• Assessment & placement system • Tutorials & practice modules • PSA's with full coaching components • On-line discussion groups • Pathways management
Supplementary Knowledge/ Skill Enrichment	Additional on-demand learning experiences for special needs, advanced or specialized learners, often	Self-paced interactive study (1:1 for learners involved), with topical assignments keyed to core classroom	Manager, mentor, supplementary tutor (optional). Can be done with in-classroom/ media center computer cluster or with home use.	• Tutorials & practice modules • Mastery tests optional • Pathways

Model	Goal	Learner's Role	Instructor's Role	PLATO Support
	in exploratory context	curriculum; progress synchronized to main class activities. Peer tutoring optional.	Assessment typically offline.	management
Primary problem-based curriculum with declarative learning	Progression of problem-solving projects on- and/or off-line, with supporting declarative knowledge/skill development	Alternates between self-paced (1:1) interactive study of core declarative knowledge/ skill, and self- or collaborative (1:4) problem solving projects	Instructional manager, supplementary tutor for declarative components, mentor & counselor for problem-based components; assessment & progress by portfolio combination of testing & work products	• PSA's (individual and collaborative modes) • Assignment of non-PLATO on- and offline problems via *Pathways* • Tutorials, practice & mastery test modules for component knowledge/skill development • WWW, PLATO and non-PLATO online tools and references to support projects • Discussion groups for asynchronous collaborative learning • Instructional management & record-keeping via *PLATO Pathways*
Complementary Problem/ Project based	Progression of problem-based activities to develop previously-acquired knowledge & skills	Collaborative projects (1:4)	Manager, mentor; assessment using work products in portfolio by instructor and peers	• *Daedalus* collaborative writing system • *Applied Math Problem Solving* • *Problem Solving Skills* • Project-based

Model	Goal	Learner's Role	Instructor's Role	PLATO Support
				courseware • Reference tools (*World View, American Heritage Dictionary*, WWW sites) for support. • Discussion groups, e-mail for distance collaborative learning work.

Part

3

PLATO Curriculum Structure

The PLATO curriculum implements the learner centered, Information Age instructional philosophy through a flexible, modular structure of curricula. All curricula are designed for adults and young adults. Knowledge and skills taught in the curricula are commonly taught in:

- Secondary and post-secondary academic settings
- Workplace settings
- Pre-employment and adult basic education settings
- Homes and supplementary educational settings

Each curriculum's component courses are carefully planned to provide a rich set of instructional experiences of appropriate types. These fit together into a comprehensive solution which implements the curriculum standards and tests commonly used for that curriculum. International advisory panels of major PLATO clients and widely recognized subject-matter experts consult throughout the development process to help specify learning outcomes and review content completeness, accuracy, and learner-appropriateness.

Each curriculum teaches:

- Specified subject matter
- At a specified level of difficulty
- An appropriate combination of declarative and procedural knowledge types

For details, refer to current descriptive literature.