

LearningCloud:

A Database of Learning Objectives and Resources

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Abstract

LearningCloud is a searchable relational database of learning objectives that specify learning outcomes to be achieved in all the areas a complete education encompasses, along with links to suggested learning resources for achieving those objectives. It helps teachers increase the individualization, personalization, or differentiation of the education they provide by giving them fast and convenient access to the learning objectives that fit any particular student's abilities, needs, and stage of progress. The Mechner Foundation has been developing and using LearningCloud in its own Queens Paideia School. LearningCloud's larger implications for education reform, accountability, implementation of Common Core Standards, and curriculum modernization are discussed.

LearningCloud is also intended for eventual use by independent learners of all ages, in non-classroom situations. Websites and books offer information/content, while LearningCloud will offer the means to learn it via associated learning objectives and resources. Contributions to expand the database are made by educators and subject matter experts, with the quality of the contributions controlled by qualified curators. The long-term goal is for LearningCloud to serve as a free, open-source facility for all learners—including those in college and beyond—and to make the vast stores of human knowledge more accessible to learners everywhere.

Key terms: individualization; personalization; differentiation; learning objectives; learning outcomes; learning activities; learning resources; Paideia Individualized Education; school reform; school renewal; Common Core Standards; curriculum modernization; learning paradigms; independent learning.

WHAT IS LEARNINGCLOUD?

LearningCloud is a tool that enables teachers to increase the individualization, personalization, or differentiation¹ of the education they provide. To do this, they need fast and convenient access to a large database of learning objectives from which to select ones that fit each student's unique and ever-changing abilities and learning needs. LearningCloud is such a database, with a theoretically unlimited number of learning objectives.

An education is individualized to the extent that it is responsive to differences among students, both in the academic and non-academic aspects of their development. Because no two students are alike in ability, preparation, learning style, culture, language skills, or motivation, a one-size-fits-all education is necessarily inadequate for many.

A Learning Paradigm of Individualized Education

The general principle that school reform or renewal requires individualization of the education provided has many advocates (e.g., de la Fuente, 2013). The cost of failure to reach some students is paid by the entire education system in the form of discipline problems, teacher morale problems, remediation requirements, and dropouts. And our entire society loses the potential fruits of the talents of those who could progress faster.

Is there a learning paradigm that implements individualization in a way that provides a complete education to a diverse student population? LearningCloud makes such a learning paradigm available. Mechner, Fiallo, Fredrick, and Jenkins (2013) describe its practical implementation, along with the Paideia Individualized Education technology that LearningCloud makes possible. The learning paradigm's main elements—learning objectives, learning outcomes, learning activities, learning resources, and learning plans—and their interrelationships, are explained below.

¹ While these terms have recently been used in somewhat different ways, the differences in usage have no implications for LearningCloud. The term "individualized," as used in this article, is broadly defined as including the meanings of personalized, individualized, and differentiated.

Learning Objectives and Learning Outcomes

The basic unit of LearningCloud is the learning objective. A learning objective² describes and specifies a learning outcome in a way that allows different parties, including the learner, to agree on whether it has been achieved.

A learning *outcome* is the actual achievement of a learning objective. Learning outcomes take different forms, depending on subject matter, type of skill or knowledge, and the learner's level. They can be made up of a mix of text, graphics (images, diagrams, graphs), and ancillary materials. Academic learning outcomes may take the form of demonstrating a skill, explaining a concept, answering a question, solving a problem, labeling a diagram, or creating a work product. Non-academic learning outcomes may consist of exercising a self-management skill or applying self-query heuristics that define certain thinking skills (e.g., "Have I seen a similar problem before?" Mechner, Fredrick, & Jenkins, 2013). The LearningCloud database contains learning objectives for diverse types of learning outcomes.

In LearningCloud, learning objectives are usually organized into "learning units"—a set or sequence of learning objectives relating to a given topic. A learning unit can be a series of related learning objectives that function as an instructional program or a set of exercises that teach a concept, so that achievement of the set results in the achievement of a larger learning objective, like mastery of a particular skill or type of knowledge.

Learning Resources

A learning resource is any material, situation, or facility that can aid in the achievement of a learning objective. LearningCloud users can view lists of learning resources for a particular learning objective by clicking on its "Applicable Learning Resources" link. For each resource shown, there may be comments, suggestions, and/or reviews regarding its quality and usefulness for a particular purpose.

Learning resources consisting of materials can be entered by their creators and by marketers, subject to approval by a curator. Marketers will have an incentive

² The related term "standard" is used in a different way, as discussed further on.

to provide useful information relating to their products—how the product can serve as a useful learning resource for a targeted learning objective(s) or unit(s). Teachers will write reviews of their experiences when they used the listed learning resources. LearningCloud’s policies regarding reviews will likely draw on the related experience of Wikipedia and other web-based enterprises. LearningCloud has the potential to turn into a giant clearing house for users and marketers of educational materials.

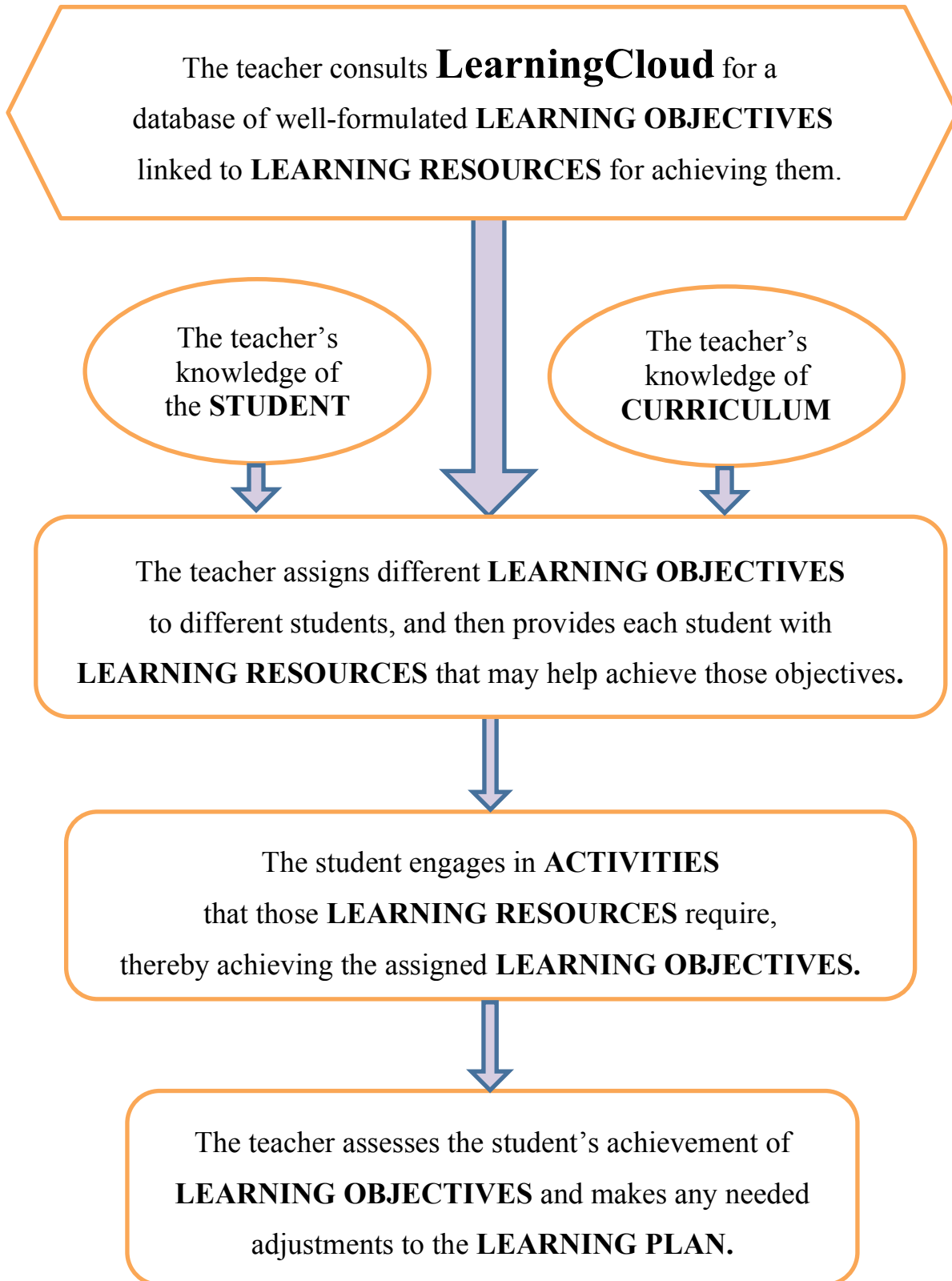
Here are some common learning situations described in terms of the relationships among learning objectives, outcomes, resources and activities.

- A workbook is a *learning resource*. The associated *learning activity* is going through the workbook, which can result in desired *learning outcomes* if *learning objectives* focus the learner on those outcomes.
- A laboratory can serve as a learning resource for learning activities like experiments or exercises. For these activities, LearningCloud can suggest learning objectives that describe desired learning outcomes.
- Lectures or video presentations are learning resources. The associated learning activities may be listening or note-taking. If learning objectives are offered, these activities can focus on desired learning outcomes.
- Museums, zoos, and libraries are learning resources. Visits to them are learning activities. LearningCloud can help focus them on specific learning objectives that specify desired learning outcomes.
- Reference books, Wikipedia, and other websites are learning resources. LearningCloud can help focus search activities by suggesting learning objectives that describe desired learning outcomes.

LearningCloud links learning objectives to applicable learning resources. The teacher or user can click on the resource link associated with each learning objective. These resources may be available at the school or online, or may need to be procured. Many learning resources developed in recent years incorporate some of the learning objectives whose achievement they may support.

The relationships among learning objectives, outcomes, resources, and activities are shown in the following flowchart:

Flowchart of the Learning Paradigm Made Possible by LearningCloud



Examples of Learning Objectives and Their Modifiers

LearningCloud's learning objectives consist of a descriptive statement and criteria that define achievement of the learning outcome. Learning objectives are most effective when stated in a way the student can understand, because otherwise she or he can't recognize when and if it has been achieved. LearningCloud offers a range of learning objectives and formulations so that teachers can find ones that fit each student's level of understanding.

Every objective in LearningCloud has attached tags and modifiers:

- Search terms for finding the learning objective or unit.
- The general level (K-12 or beyond) for which it is appropriate.
- Prerequisite skill or knowledge, when applicable.
- References to other learning objectives or units to which it may be related.
- An accompanying list of applicable learning resources.
- Information about its origin (authorship) and editorial history.
- Utilization feedback—empirical data regarding usage.

These tags make it possible to find the needed learning objectives and their associated learning resources quickly and efficiently; and for a teacher to ascertain the objective's appropriateness for the need being addressed. The examples below are intended solely to illustrate the basic format.

Math example

Learning objective: Multiplies any pair of numbers from 0 to 12.

Achievement criteria for the learning outcome: Gives 95% correct answers within 3 seconds.

Level: Grade 3 and up.

Science example

Learning objective: Given a 2-column/6-row table, makes a graph to show the relationship between the two variables.

Achievement criteria: Draws and labels the x and y axes; shows a linear numerical scale on each axis; plots the six coordinate pairs; connects them with straight lines; and writes a title above the graph, referring to the two variables.

Level: Grade 5 and up.

Social studies example

Learning objective: Given a topic (e.g., an important invention or discovery; a war; a culture; a work of art; an empire), writes a 300-word essay about it, including its significance.

Achievement criteria: States when and where it took place or existed, who was in-

volved; primary and secondary sources of evidence that it happened; how it affected peoples' lives at that time and/or today; and what else was happening in the world at that time.

Level: Grade 5 and up.

English language arts example

Learning objective: Summarizes an article of 500 to 2,000 words.

Achievement criteria: States main points or arguments, with one reference to the author's objective or style; 80-120 words long.

Level: Grade 4 and up.

Self-Management example

Learning objective: When faced with an adversarial situation, invokes applicable verbal self-queries (e.g., what do I want to achieve? What is the other party trying to achieve?).

Achievement criteria: Does not react in an aggressive or dysfunctional way; states an appropriate heuristic.

Level: Grade K and up.

Advantages of Focusing on Learning Outcomes

Most traditional learning paradigms involve students engaging in activities: using a workbook, listening to a lecture, taking notes, practicing a skill, studying a textbook, watching a video, going on a field trip, writing a report, or doing a project. The implicit assumption and hope is that such activities result in some learning, but the learning outcomes are often not the intended ones. The activity is typically the means *and* the end, with insufficient focus on *what* is being learned.

Specifying the learning objectives to be achieved through an activity puts the focus on the learning outcomes, and reflects the broader principle that desired outcomes are rarely achieved without clearly stated objectives. Learning is efficient and relevant to the curriculum to the extent that it is focused on the learning objectives that describe the desired outcomes. Subsequent testing for hoped-for outcomes will not put them in place.

In short, it is advantageous to establish the learning objectives prior to initiating an activity because:

- (a) It gives the teacher vital feedback on what students are *actually learning* (intended outcomes) rather than just on what they are *doing*.
- (b) Most students, when performing an activity, become more engaged when they focus on the objective to be achieved.

- (c) Desired learning outcomes are achieved more efficiently and surely if the learning objectives are defined before the activity is initiated.
- (d) Learning objectives achieved provide a valid definition of the education the student received. The activities that were performed do not. Learning objectives can be achieved or not achieved, but the mere performance of an activity leaves open the question of what was learned.

Expansion and Upkeep of LearningCloud

LearningCloud's content will be expanded by contributions from educators and subject matter experts who have appropriate credentials in the various disciplines covered. Qualified curators will monitor and review all proposed contributions before they are accepted and added. Teachers, because they are in direct contact with the actual learning needs of students, will provide vital advice and utilization feedback. The Cambridge Center for Behavioral Studies, pursuant to an agreement with the Mechner Foundation, will help recruit contributors and curators through its large network of trustees and advisory board members.

Commercial, academic, and private developers of innovative educational resources—learning programs, electronic lectures and videos, films, workbooks, textbooks, equipment, and games—will be able to enter their products, always with links to learning objectives they may help achieve.

As LearningCloud becomes more widely used, it will be able to function as an efficient advertising medium for marketers of educational products. LearningCloud may then be able to charge commercial marketers advertising fees to help fund LearningCloud's growth and maintenance (e.g., compensation for contributors and curators).

APPLICATIONS OF LEARNINGCLOUD

LearningCloud originated as the driving resource of the Paideia Individualized Education (PIE) technology (Mechner et al., 2013; see also a summary in Appendix A). PIE was first implemented at the Armonk Paideia School in 1968 and is currently being upgraded at Queens Paideia School—the development laboratory and proving ground for the enhancement of LearningCloud's functionalities and scope as a very large, readily accessible, and searchable relational

database of learning objectives and learning resources.

At the Armonk Paideia School, LearningCloud took the form of typewritten lists of learning objectives (PCs did not yet exist). More recently, at Queens Paideia School, it exists as spreadsheets housed in Google docs. The teachers use LearningCloud to create customized learning plans for each student that consist of learning objectives for the major academic content areas as well as for the arts, social skills, self-management skills, thinking skills, and learning skills. All learning objectives are selected to fit each student's learning style, stage of progress, and abilities. As a result, students always work at levels that are appropriate for them, in every subject area. The learning objectives are usually selected by the teacher, but can also include ones that the student chooses based on personal interests.

Teachers update students' learning plans to reflect actual progress by adding and deleting learning objectives. They search LearningCloud for learning objectives and units that will meet a student's needs of the moment, along with related instructional resources.

Use of LearningCloud in Large Classrooms

Although developed in this laboratory setting, LearningCloud can also help teachers achieve a certain degree of individualization in large classrooms. Teachers usually know who is falling behind and who is capable of more, but even when they would like to act on that knowledge, they are unable to do so for lack of time and resources. They would need a practical way to obtain learning objectives and applicable learning resources that fit any particular student's needs in any subject. LearningCloud enables them to find these conveniently by putting at their disposal a sufficiently large, readily accessible, and searchable database of learning objectives from which to select the ones that fit the need, in the core academic subjects as well as for social-emotional and self-management skills.

Ways LearningCloud Can Be Used

In-school scenarios

- A classroom teacher, observing that a student can't keep up (or could move

ahead faster), searches LearningCloud for learning objectives and related resources to match his or her level of preparation and ability.

- A homeschooling parent (who is usually not a teacher) searches for learning objectives and applicable resources.
- A college student writing a paper on Africa enters search terms for the history, populations, cultures, economies, and governments of the countries.
- A high school math teacher's student is interested in number theory. The standard textbooks are too advanced for that student. In LearningCloud, she finds instructional resources that are right for that student's level.
- A college professor searches for learning objectives, learning units, and associated learning resources to provide remediation for a student whose writing skills are inadequate.

Non-School Scenarios

In the scenarios below, the user, having found the information offered in Wikipedia, scholarly articles, or other sources too technical, turns to LearningCloud and enters search terms related to the topic so as to find learning objectives and learning resources that will make the knowledge accessible.

- A doctor, in considering the potential of a new drug, wants to acquire relevant background knowledge in chemistry or neurobiology.
- An insurance company executive, hoping to advance to a higher position, believes that more knowledge of actuarial mathematics, which requires some background in probability theory and statistics, will help him get there.
- A public official seeks to understand the scientific basis for a proposed piece of legislation on which he will be voting.
- A lawyer in a patent case needs an understanding of a particular concept on which the case rests.

LearningCloud as a Management System

LearningCloud can also serve as a management system for schools. With access to current data on every student's performance in all of the subject are-

as—learning objectives achieved and being worked on—teachers and the school’s managers can find out what a particular student recently learned and did. Thus, if a student has difficulty in an area, the teacher can determine if the problem is limited to one particular subject or occurs across the board, and whether the problem is with the quality of the learning resource, the student’s ability, or the appropriateness of the student’s learning plan. Similarly, parents, and even students (all with password-protected access to different types of information), can keep abreast of that student’s progress.

LARGER IMPLICATIONS OF LEARNINGCLOUD

Implications for School Reform and Renewal

Most educators and teachers agree that school reform and renewal depends on the individualization of instruction as part of a reconfiguration of schools, classrooms, and the roles of teachers (Mehta et al., 2012; Ravitch, 2010); that one-size-fits-all approaches must be replaced by customized learning plans; that modern technologies must be brought to bear; and that learning paradigms must be designed to engage and motivate the student (de la Fuente, 2013). By making such a school feasible, as demonstrated by Queens Paideia School and the PIE technology on which it is based (Mechner et al., 2013), LearningCloud has the potential to contribute to school reform.

As more schools—public, charter, and private—seek to individualize the education they provide and make progress toward that goal, they may find LearningCloud to be an indispensable tool.

The Issue of Accountability

Efforts to improve education by holding students, teachers, or schools accountable for educational outcomes must define outcomes over which they have a reasonable degree of control. Test scores, though conveniently quantitative, are rarely traceable to specific agents or events that may have been responsible.

Learning objectives, unlike periodic and broad-brush tests, are achieved multiple times per day, and performance results are always traceable to specific agents and events. Because the achievement of learning objectives defines

what students have actually learned and thus the education they received, learning objectives offer a valid and ideal target for accountability.

When used in conjunction with the PIE technology (Mechner et al., 2013), learning objectives are nearly always achieved. If a student has trouble with a learning objective, it's the wrong learning objective for that student in that subject at that time, and is replaced or supplemented. Because failure is thus ruled out, this learning paradigm makes accountability rewarding rather than threatening.

When every student is achieving the curriculum's learning objectives in the ordinary course of the education being provided, at the fastest pace feasible for that student, the urgency of standardized testing is diminished.

Implications for the Common Core Standards

Teachers can use LearningCloud to help students learn what they need to meet and exceed the Common Core Standards.

The wording of Common Core Standards often requires interpretation. Some begin with words like "Understands..." and "Knows..." LearningCloud provides the means for translating the Standards into sets of learning objectives that specify the actual performance or behavior that can be considered *evidence* of "understanding" or "knowing," along with the achievement criteria for those objectives. LearningCloud thus provides *operational definitions* for the Common Core Standards: clearly specified learning objectives that serve as both instructional and assessment tools, and thereby as the specification of mastery.

Learning activities by themselves cannot provide such definitions or specifications. LearningCloud thus has the potential to become one of the sought-after missing links between the Common Core Standards and their achievement.

Implications for the Curriculum Concept

LearningCloud provides a new way to formulate a curriculum, in terms of the learning objectives to be achieved. Because of how LearningCloud's content is generated—by diverse subject matter experts and thinkers—the breadth of its curriculum approaches and philosophies (the Common Core Standards being but one) will continue to expand. Educators will be able to select the learning

objectives that fit their particular orientation. These are some of the curriculum approaches used at Queens Paideia School:

- The learning objectives in the life sciences, physical sciences, and technology cover not only content knowledge, but also scientific inquiry skills, analytical skills, and heuristics that are useful in problem-solving and for applications of the scientific method at various levels of sophistication.
- Learning objectives for social studies cover human history in terms of the entire world's diverse cultures and social institutions, from 5,000 BC to the present, the impacts of important discoveries and inventions, and inquiry heuristics students can apply to understanding and describing these.
- Critical thinking skills, inquiry skills, analytical skills, and creativity are targeted directly as specified learning objectives, rather than as general goals (Mechner, Fredrick & Jenkins, 2013).

Long-Term Goals

LearningCloud's development process has been focused on expanding its database and increasing its functionality through software development. This functionality will include use by networks or aggregates of schools, and management of the complex relationships among the various types of users, contributors, curators, and administrators. Additional schools will be invited to participate in the beta testing process, and additional creators of educational resources will be invited to list their products. When the utilization of LearningCloud and its listed learning resources reach a certain volume, commercial vendors may be charged appropriate advertising fees.

LearningCloud will function as a free open-source facility for use by schools, teachers, and independent learners everywhere. It has the potential to become a key tool for individualizing education—a necessary condition for the reconfiguration of schools and classrooms, and thereby for school reform and renewal.

LearningCloud's long-term significance reaches beyond school settings. As its database continues to expand and it becomes a universally accessible open source, it will also become useful to independent learners at the college and adult education levels and to any educational endeavor, whether individual or

institutional, elementary or advanced. The vision is for it eventually to serve as a general educational interface between the world's repositories of knowledge and the minds of learners.

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Appendix A

The Paideia Individualized Education (PIE) Technology

Background

Since 2009 the Mechner Foundation has been operating a prototype model of a novel type of school, Queens Paideia School, in Long Island City, New York. The PIE technology on which the school is based originated as the Paideia School in Armonk, NY, in 1968.³ Its underlying educational tenets reflect the ideas put forward in the past century by leading thinkers like John Dewey, Jerome Bruner, Howard Gardner, Lev Vygotsky, B.F. Skinner, and Fred S. Keller. The PIE technology combines these ideas to deliver a complete and individualized education to all students within a school setting. The overarching goal of the PIE technology is to prepare students to function effectively beyond school, in the world of their adulthood.

The practical realization of such a school poses major technological challenges, and LearningCloud meets one of these.

Features of the PIE Technology

Schools based on the PIE technology are fundamentally different from traditional schools in structure, staffing, and mode of operation. The PIE features are logical corollaries of the premise that if an education is to be responsive to every child's unique needs and potentialities, it must be individualized, and if the education is to be complete, it must cover not only the academic subjects but also the social-emotional and self-management aspects of behavior.

³ Dr. Francis Mechner testified before the Senate Finance Committee at the hearings for the Comprehensive Child Development Act of 1971, which was passed by Congress in late 1971 but vetoed by President Nixon in 1972. In that testimony, Mechner described how the PIE approach (then implemented at the Armonk Paideia School) is applicable to early childhood development (Congressional Record for the 92nd Congress, September 1971, excerpted at <http://mechnerfoundation.org/category/downloads/interviews-book-reviews-and-commentaries/>).

The Team Approach.

Given that a complete academic education must cover language arts, math, science, and social studies, no single Learning Manager (teacher) would be sufficiently proficient in all of these areas to provide such an education even to a single student, even if the situation were one-on-one. It takes a team in which each member is proficient in at least one of these four core areas.

Learning Plans, Learning Objectives, and LearningCloud

Learning Managers provide students with customized learning plans comprised of learning objectives drawn from LearningCloud. Every student's learning plan reflects his or her current learning needs, abilities, or special talents. All students work at the level at which their unique stage of progress places them. They advance at their personal best pace in steps small enough for smooth progress. This approach replaces formal grades and classes.

Low Student-Teacher Ratio

An adequate degree of individualization requires attention to every student's learning status and detailed familiarity with every student. This requires a student-teacher ratio of not more than 6:1.

Social-Emotional Development

Social-emotional development and self-management skills are considered as important as academic achievement. Learning Managers continuously respond to student interactions with coaching and feedback, and when required, with conflict resolution methods.

Students Make Commitments and Set Goals

At the start of every learning session students commit to their day's goals, including the learning objectives they will strive to achieve, and review their success at the end of the session. They reflect on their own experiences during the day, and share these with the group and the learning managers.

Meaningful Assessment

Student achievement and progress are assessed on an ongoing basis, daily and in multiple ways, in every academic subject area as well as in the social and self-management skills.

Mixed-age Grouping

Students of diverse ages share a common space where each has a personal work station. Students may move around independently, provided they don't disturb others.

Parent Involvement

Learning Managers regularly try to engage parents in their children's education and to share responsibility for it, often in the context of discussing homework, sleep patterns, or nutrition.

While each of these features has been described by educators previously, it is the synergistic effect of their integration that makes the PIE technology's benefits so great. Their joint effect is a school culture in which the focus is always on the achievements and behavior of individual students.

Benefits

The total of nine years' experience gained in the Armonk and Queens Paideia Schools have shown that the benefits are not confined to the academic area—they are also seen in the non-academic aspects of personal development, including social and self-management skills. Discipline problems are largely averted by constant personal attention, a socially embracing environment, and instruction in positive coping strategies.

These benefits accrue to students, teachers, families, and the communities in which they live.

“Special Needs” Students

The individualized format of the PIE technology considers every

student's needs unique and special, thus its normal mode of operation meets the needs of many students who would be categorized as "IEP" or "special needs" in most other schools, and is able to mainstream them. There is broad consensus that inclusion and integration of such students averts the damaging effects to self-esteem often associated with the stigma of such classifications.

Inclusiveness and Diversity

The individualized approach makes the PIE education appropriate for students of all backgrounds, including students whose native language is not English.

The Common Core Standards

Meeting and exceeding them is viewed as an important byproduct of the PIE education, but not as a direct target. LearningCloud is an important tool for defining them in terms of their component learning objectives and thereby making them achievable.

Implications for Public School Reform

Financial studies suggest that PIE schools, because of their special features, become economical when a number of them are aggregated to form a larger school within which the small PIE schools operate as self-contained units. When aggregated in this way, the benefits of PIE schools are preserved, at a per-pupil cost below that of most present-day public schools.