

The Paideia Individualized Education Technology

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Abstract

If we take stock of what is known today about education, the learning process, the management of organizations, and psychology, and the implications of this knowledge for K-12 education, it is evident that a very different and better approach is now available. Such an approach was introduced in 1968 at the Armonk Paideia School and has been receiving further refinement at Queens Paideia School. Termed “Paideia Individualized Education” (PIE), the approach features a team of 4 learning managers and 2 interns with long-term charge of the education of about 30 children of diverse ages, backgrounds, and abilities—in effect, a 6:1 student-teacher ratio. There are no grades or classes—every student is educated differently, as a unique individual, with a customized learning plan consisting of learning objectives. Learning plans cover the academic subjects as well as self-management skills, learning skills, thinking skills, and social skills.

Most students advance more rapidly than one would normally expect, academically as well as in their social and self-management skills. Failure patterns are eliminated because students always work at their actual level of achievement and at their personal best pace. They take increasing ownership of their education as they make daily explicit commitments to achieving specific learning objectives. Many who might be categorized as “special needs” are integrated and mainstreamed. The learning environment created by these features, in concert, is stable, safe, supportive, stimulating, respectful, and non-punitive, thereby averting most discipline problems and providing teachers with the satisfaction of productive interaction with individual students.

The PIE technology is applicable to the reconfiguration of large schools as well as small ones. Preliminary studies suggest that when a number of PIE schools are aggregated to form a larger school in which the small schools operate as self-contained units, the benefits of the PIE technology are preserved, at a per-pupil cost below that of most present-day public schools.

Search terms: Individualized instruction, personalized education, IEP, special needs, school reform, Common Core Standards, social skills, self-management, learning paradigms, Paideia, K-12 schools.

Introduction

The Paideia Individualized Education (PIE) technology is a team approach to providing a K-12 education that integrates modern knowledge of educational theory, the learning process, psychology, and organizational management theory. The PIE approach originated at the Paideia School that operated in Armonk, New York, from 1968 to 1973, and has been receiving further development and refinement since 2009 at Queens Paideia School located in Long Island City, New York.

This paper describes the PIE technology's features, its benefits to all of the education system's stakeholders, and its potential as a generally applicable approach to K-12 education and school reform. The use of the term "individualized" includes the meanings of "personalized" and "differentiated" education. The PIE technology assumes that the most learning objectives—reading, writing, arithmetic skills, self-management and social skills—should be similar for most students, though they may achieve these at different rates and by different paths, while many other learning objectives reflect differences in students' interests and learning styles.

Defining Features of the PIE Technology

The basic features

If an education is to be responsive to every child's unique needs and potentialities, it must be individualized (in the broadly defined sense of the term), and if the education is to be complete it must cover the basic academic subjects as well as the social-emotional and self-management aspects of behavior. Individualization is necessary not only because children differ in important ways, especially when the student body is diverse, and also because a fully effective education must focus on the details of each student's learning processes and progress. Only individualized attention to every student can achieve such a focus.

These are the technology's basic features:

The team approach. Given that a complete education must cover language arts, math, science, and social studies, no single teacher (referred to here as “Learning Manager”¹) would be sufficiently proficient in all four of these areas to provide a complete 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 the four areas.

The low student-teacher ratio. For every K-6 student to receive a truly individualized education, with the required amount of personal attention and support, the student-staff ratio cannot exceed 6:1, a ratio that is consistent with four Learning Managers, two interns or learning aides, and approximately 30 students. The students are of diverse ages, cultures, backgrounds, and abilities.

Learning plans, learning objectives, and LearningCloud. Learning Managers provide each student with a customized learning plan comprised of learning objectives that cover the 4 major academic areas (mathematics, science, language arts, social studies), as well as self-management skills, thinking skills, social skills, and learning skills. Learning Managers obtain these learning objectives by accessing a large, searchable, relational database, termed LearningCloud (Mechner, Jones, & Fiallo, 2013). The skills variously called critical thinking, inquiry, or creativity are targeted directly as specified learning objectives, rather than as vague goals (Mechner, Fredrick, & Jenkins, 2013). Instruction in foreign language, the arts, and physical education is provided by part-time teachers of those subjects.

The customized learning plans replace formal grades and classes. Students advance along their learning plans at their personal best pace, in steps of the right size for smooth progress, always working at the level at which their stage of progress places them. Students who have special gifts or talents in certain areas can move ahead

¹ To emphasize that their function is to create conditions in which learning will occur, rather than just to present information.

without constraint and excel, but all students move forward at whatever pace is most comfortable for them.

The number of students in the school. The degree of individualization provided by the PIE technology requires continuous attention to, and detailed knowledge of, every student's unique learning status. A safe upper limit of the number of students to whom a team of four Learning Managers can provide such a level of attention is in the general range of 30, assuming that the four Learning Managers are assisted by two interns or learning aides. A student body of approximately 30 also provides a sufficiently rich and diverse social environment for adequate social learning to occur.

Social-emotional development. Given that the PIE technology considers social-emotional development and self-management skills no less important than academic achievement, the PIE school environment must provide the Learning Managers with a steady flow of opportunities to provide coaching and immediate feedback. Incidents of unacceptable behavior are handled by coaching and conflict resolution methods rather than by punishment, so as to avoid punishment's pernicious effects—fear, anger, aggression. The Learning Managers must be skilled in developing the social and self-management skills of children of a wide range of ages and levels of functioning.

The tight-knit and cohesive community of a PIE school, in which the student body and the Learning Managers stay together over a number of years, tends to generate valuable long-term bonds.

Students become proactive learners. This happens naturally when students routinely make daily explicit commitments to achieving specific learning objectives, setting goals for themselves and then striving to achieve these. This feature results in students taking increasing ownership of their education and becoming motivated by the achievement of learning objectives rather than by competitive grades or rankings.

Meaningful Assessment. Student achievement and progress is assessed continuously, 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 in which each has a permanent personal desk, like a little office. Students may move around independently, provided they don't disturb others.

Parent Involvement. Learning Managers make proactive efforts to engage parents in the details of their children's education, often in the context of discussing homework, behavior management, sleep patterns, or nutrition. The team structure and low student-to-staff ratio enables Learning Managers to try to motivate parents to become engaged in their children's education.

Inclusiveness and Diversity. Because the education that the PIE technology provides is individualized, it is appropriate for students of all backgrounds, including those whose native language is not English.

Special Needs and IEP students. Since the PIE technology provides an individualized education by definition, and therefore considers every student's needs unique and special, it meets the needs of many students who would be categorized as "IEP" or "special needs" in most other schools. It meets their needs in the normal course of operating a PIE school. Educators agree that it desirable to mainstream and integrate special needs students whenever possible so as to avert the stigma and self-esteem damage that such diagnoses often foster (Forest, 1988; Roach, 1995; Rogers 1993; Stainback et al., 1992). The individualization inherent in the PIE technology makes inclusion of most such students automatic.

College readiness and high standardized test scores. These are by-products of the PIE education rather than primary targets. The overarching goal is to prepare students to function effectively beyond school, in the world of their adulthood.

The joint effect of the above-listed features is a school culture that is, itself, an important feature of the PIE technology—a culture in which the focus is always on the behavior of individual students—their academic achievements and non-academic behavior. It is this set of features that generates the benefits outlined in the sections below—benefits to students, teachers, and families. The features work together synergistically—their combined effect is greater than the sum of their individual effects.

Teachers who have the basic skill set can quickly learn to perform job of the Learning Manager—a job in which success is achieved far more easily than in traditional teaching situations.

Background of the Underlying Philosophy

The component ideas of the PIE technology are not new. In the early 1900s John Dewey was already advocating education and curriculum reform, arguing that the goal must be to prepare students for a changed and changing world. (Dewey, 1897, 1900, 1902, 1938). Some decades later, Jerome Bruner of Harvard University wrote that learning should be active and interest-driven (Bruner, 1960, 1961, 1966; Bruner, Goodnow & Austin, 1956), a thesis later expanded in Howard Gardner’s influential work on multiple intelligences (Gardner, 1983). Bruner’s contemporary at Harvard, B. F. Skinner, argued that effective instruction requires focus on the details of the individual learner’s behavior—including successive approximation strategies for achieving desired learning outcomes, active responding, immediate feedback, and the acquisition of self-management skills (Skinner, 1968).

In the 1960s Fred S. Keller of Columbia University demonstrated how a personalized system of instruction (PSI, also known as the Keller Plan) could be implemented in school settings, with teachers functioning as “learning managers” rather than purveyors of knowledge (Keller, 1968). Students work through learning modules independently, at their own pace, with occasional assistance from

learning managers or other students.

These are some of the ideas that stoked the educational reform movement of the 1960s, a time of new openness to educational innovation due in part to the launching of Sputnik in 1957 with its suggestion that the Soviet Union might be surpassing the United States technologically.

But existing schools were not in a position to integrate and implement these ideas. Over time, it became clear that doing so would require a radically new and reconfigured type of school (e.g., (Ravitch, 2010; Fullan, 2011; Mehta et al., 2012; de la Fuente, 2013).

Implementations of the PIE Technology

In 1968, Mechner, with personnel and funding from his company UEC Inc., founded such a school, the Paideia School in Armonk, NY, to develop and demonstrate the PIE technology. This school, together with UEC's related projects in the pre-school field, stimulated wide interest² and received regular visits and encouragement from Columbia University faculty members—particularly Professors Phil Lange of Teachers College and Donald A. Cook of Barnard College. Thom Verhave, who had been a professor at Arizona State University, contributed valuable ideas when he worked with the Paideia School in 1968-69 after moving his family to Armonk. In the following years, the Paideia name came into wider use.³

² In September of 1971, Mechner testified before the Senate Finance Committee in the hearings for the Mondale-Brademas Comprehensive Child Development Act of 1971, which was passed by Congress in late 1971 and vetoed by President Nixon in 1972. In his testimony, Mechner described how his PIE ideas (which he was implementing at the Armonk Paideia School) should be applied to early childhood development (Mechner, 1971).

³ In 1982 Dr. Mortimer Adler of Columbia University published his book *The Paideia Proposal* (Adler, 1982), and then formed the Paideia Group. His proposals, directed mainly at the education of older students, advocated increased focus on the classics and seminar discussion skills. Also unrelated to the Armonk Paideia School or the PIE technology is the Paideia School in Atlanta Georgia, which was founded in 1971.

In 2009, the Mechner Foundation founded Queens Paideia School (QPS) to corroborate the Armonk experience and to demonstrate the potential of the PIE technology.

Experience and Observed Results

The experiences of QPS and the Armonk Paideia School are similar. Many students advance by more than one grade level per year in several academic areas, and do work typically done in higher grades. The benefits, both academic and social, usually become fully evident after approximately one year in the school. Students take increasing control of their education. As their ability to make good choices regarding ways to achieve learning objectives improves (an important aspect of “learning to learn”), they pursue their studies with growing independence and enthusiasm. Many produce remarkable work products, and the Armonk students who later took the standardized SATs scored in the top percentiles.

The schools’ small size generates the continuous stream of social interactions that enables Learning Managers to provide frequent immediate, on-the-spot coaching and feedback. The emotional and behavioral problems that many students sometimes bring with them gradually come under control. The types of discipline problems often seen in schools, such as bullying and aggressive behavior, are rarely seen. The dynamics seen are more akin to those of functional families—collaborative relationships, small but easily resolved squabbles, and strong bonds.

These reports are, of course, qualitative. The Armonk Paideia School closed in 1973, before collection of quantitative data could be implemented.

Most students who had been at QPS for more than one year performed in the upper percentile ranges of their age group on the Terra Nova standardized test (published by McGraw Hill), despite having received no preparation with regard to test taking. All students make progress in their ability to forge and manage friendships, their writ-

ten and oral communication skills, collaboration skills, and their ability to cope with the interpersonal challenges that normally arise in group situations.

Parents receive daily as well as periodic reports on their children's learning activities and progress. A striking feature of QPS is its warm, student-centered culture and mind-set. The Learning Managers' attention is constantly focused on the details of the academic achievements and non-academic behavior of individual students.

Benefits of PIE Schools

Educational benefits

- Most students make rapid progress in the academic subjects. Some move ahead to advanced work in areas that interest them.
- Failure patterns are eliminated because students always work at their actual level of achievement and at their own best pace, in every subject (rather than at levels imposed by classroom pacing or age-linked achievement standards).
- Students make progress in their self-management skills, social /interpersonal skills, and learning skills.
- Students who have been in a PIE school for several years tend to become independent self-motivated learners.
- The interactions between students of diverse ages produce benefits for all, in the categories of social learning, modeling, and self-esteem enhancement.
- The team approach creates a mutually supportive and satisfying environment for the Learning Managers.
- The PIE school environment leads to students enjoying school and averts most discipline problems.
- The school's small number of students and the Learning Managers form cohesive social units and develop meaningful long-term relationships.

Benefits to teachers

With the PIE technology's team approach, the burden of teaching a classroom of students no longer falls on one teacher, and no longer depends on that teacher's skills, disposition, and energy level. The quality of the education students receive depends on the collaborative efforts of a close-knit team of learning managers. When functioning as members of such a collaborative team, teachers feel supported and don't burn out. The experience of being in constant touch with the impact of their frequent small decisions on the lives and education of their students provides them with the sense of satisfaction the prospect of which attracts many teachers into the profession. Many teachers chafe at being held accountable for standardized test scores they can't control, or that define educational achievement too narrowly or even invalidly. The PIE technology, on the other hand, defines student achievement in terms of the learning objectives that comprise a complete education, and that Learning Managers control daily and directly—a learning paradigm that makes accountability challenging and attractive.

Community and social benefits

The educational benefits described above have far reaching societal ramifications. When children do well academically, never fail, are not stigmatized for inadequacies, and are engaged socially, they are less likely to engage in delinquent behavior, drug use, crime, or to drop out of school. And the effects of parent involvement are positive and stabilizing.

Implications for Public Education

There is now widespread agreement that school renewal and reform will require a reconfiguration of schools, of classrooms, and of the roles of teachers, and that one-size-fits-all approaches must be replaced by customized learning plans (Ravitch, 2010; Mehta et al., 2012; Fullan 2011). It has also been noted that small schools have

advantages over large schools, mainly in the areas of individualization and social cohesion (Barker, Bruce, 1997; Clowes, 2003; Cushman, 1997). But it would be unfeasible to build a large-scale public education system consisting of school as small as PIE schools. The duplication of physical facilities and other resources would be too costly.

However, PIE schools can be aggregated in modular fashion to form larger schools within which the small PIE schools operate as self-contained units. When aggregated in this way, the benefits of PIE schools are preserved at an acceptable per-pupil cost. The Mechner Foundation has created a detailed implementation plan and financial analysis to show that an aggregation of 18 PIE schools, for a total of approximately 600 students, would preserve the benefits of the PIE technology at a per-pupil cost approximately 25% below that of present-day public schools, even with inclusion of many IEP students.⁴ The economies are due in large part to the elimination of a significant percentage of IEP and special education programs, of remediation programs, discipline incidents, and teacher stress. Other savings result from the efficiencies of the team approach and the decentralized decision making.

The PIE technology's low student-teacher ratio and team format inevitably puts Learning Managers in close touch with local community circumstances. This makes PIE schools readily adaptable to diverse socio-economic environments and cultures, rural as well as urban demographics, and diverse student populations.

The Socialization Issue

It may seem paradoxical that a small-school environment, like that of a PIE school, is more conducive to social learning than the large-school environment of more traditional schools. When there are

⁴ PIE schools can also be operated as tuition-based private schools, either singly or with several self-contained PIE schools in the same physical premises, but such schools would benefit only those able to afford them.

hundreds of children, with students normally gravitating into their social comfort zones, often with self-segregation by gender and socio-cultural factors, social learning is limited.

In the tight environment of a PIE school, on the other hand, close friendships often develop between children who might not otherwise be inclined to seek each other out. Not all relationships need to result in significant friendships, but all relationships, including difficult ones and those with the Learning Managers, provide opportunities to hone the social skills needed to make and keep friends and manage the normal challenges of dealing with others. Such skills are required in many real-world family and work situations, and in the maintenance of friendships. The intimate, safe, and nurturing social environment of the PIE school functions as a good incubator of these skills. The relationships that form in this environment lead to more social learning and emotional maturation than do the superficial and transient relationships that typically form in large schools, especially when Learning Managers are present to supply feedback and coaching.

LearningCloud--the PIE Database

LearningCloud, PIE's database of learning objectives and learning resources, described in Mechner, Jones, & Fiallo (2013), is a core element of the PIE technology. This database, which consists of a theoretically unlimited number of learning objectives, links existing learning resources (workbooks, electronic lectures, exercises, texts, etc.) to the learning objectives they may help achieve.

Rudimentary versions of LearningCloud have been in use at Queens Paideia School where it is being developed and used, and a software development team is working on a more advanced and expandable version of it. The PIE technology's assessment system is being upgraded in parallel, because Learning Cloud is needed for the assessment system's operation. LearningCloud also helps implement the Common Core Standards by providing a way to define them opera-

tionally and specify their learning outcomes by means of learning objectives.

LearningCloud will be made available to schools and educators throughout the world as an open source learning facility.

How LearningCloud is used

LearningCloud provides Learning Managers with fast and convenient access to the database of learning objectives from which they can draw the ones that fit every student's individual needs. It enables them to check, at any time, what each student recently did and achieved and on what learning objectives s/he is currently working, in every subject area. They can search LearningCloud for learning objectives and units they consider appropriate as next steps, basing their selection on their observation and knowledge of that student. For the learning objectives selected, LearningCloud suggests applicable learning resources. When Learning Managers provide a student with a learning resource that requires a certain activity (reading, listening, watching, etc.), they focus that activity on the learning objectives to be achieved.

For more mature learners (usually at the 6-12th grade levels), as well as in higher education, LearningCloud may also come to function effectively in self-instructional modes, as when students peruse it to find learning objectives they may want to pursue. LearningCloud is not only an essential tool of the PIE technology, but a tool that can be used in all schools to promote increased individualization of education (Mechner, Jones, & Fiallo (2013). And the advent of computers and the internet has made many new types of learning resources available for use in schools and beyond (e.g., de la Fuente et al. 2013).

The PIE assessment system

Purposes of the assessment system

The continuous stream of learning outcomes generated by the PIE

technology's use of learning objectives permits continuous and detailed assessment. Learning Managers can observe every student's progress in each content area.

Assessment data consisting of learning outcomes provide valid and useful information on student progress in the academic subject areas and on the students' personal development. Such data provide evidence of many of the technology's benefits, and feedback to the Learning Managers regarding their practices, selection of learning objectives, and techniques.

The assessment system undergoes continuous refinement and improvement as experience is gained.

The issue of validity

In the social sciences, performance indices are often chosen for the ease with which they lend themselves to measurement rather than for their validity in providing relevant information about the phenomena that are considered important. But when the goal is to achieve a practical result, as in education, the issue of validity assumes central importance. That is the reason for the PIE technology's focus on identifying and measuring the indices that ultimately matter—the ones public schools and educators should care about and that the PIE teams find relevant to improving the education they provide.

One prominent and contentious instance of the validity issue in recent times is the use of standardized test scores to assess academic achievement and teacher performance. A criticism of this emphasis is that standardized test scores, though they meet the criteria of being quantitative and obtainable, often don't provide valid measures of far more important aspects of the education students receive or of teacher performance, and tends to deflect attention from them. The potential unintended effects of holding teachers and schools accountable for test scores (e.g., teaching to the test and fraud in grading) are well recognized.

Data collected and tracked

The PIE assessment system seeks to identify, measure, and quantify the most important and valid indices of the quality of the education being delivered, including indices that are difficult to measure—social, communication, and self-management skills.

Some elements of academic performance correspond to standard curriculum components, and some equally important ones, like communication skills, thinking skills, self-management skills, do not. Those that do can often be measured and quantified in terms of grade-equivalent level by means of tests, and those that don't cannot, and must therefore be assessed by means of ratings or qualitative descriptions of performance.

These are some of the types of information that a PIE school assessment system collects and tracks:

- Grade-equivalent performance and progress in the main academic subjects—math, science, social studies and language.
- Continuous assessment of academic performance in terms of learning objectives achieved and work products produced.
- Tracking of every student's personal development progress as a function of time in the school, on 20 indices of non-academic behavior, by means of rating scales.
- Assessment and tracking of every student's performance in every academic subject as a percentile ranking against national norms, through use of standardized tests.

Accommodating Diverse Curriculum Philosophies

The PIE technology is applicable to a wide range of educational goals and curriculum philosophies. Different cultures teach their children different belief systems, ways of behaving toward others, and ways of leading their lives. The PIE technology can accommodate any particular set of these by selecting applicable subsets of

learning objectives from LearningCloud in the creation of learning plans. When LearningCloud does not contain some learning objectives that would be needed for a particular educational goal, these can be generated and added to LearningCloud.

Simulating Real World Situations

The overarching goal of the PIE technology is to prepare students to function as competent and productive adults in a world that is expected to be more complex than that of their parents. A basic way it seeks accomplish this is to simulate some of the important features of that world, and thereby provide an environment in which the vital social-interpersonal skills, learning skills, and self-management skills will be learned.

One of these features is the mixed age grouping. It promotes social learning by generating richer and more varied interactions than those that typically occur when all students are of the same age. Other features simulate the types of situations and interactions that occur in the world of work—the collaborative activities and group meetings in which people present their work and ideas to each other and discuss them. The PIE technology’s low student-staff ratio enables Learning Managers to provide students with continuous coaching and feedback in these situations.

Motivating academic achievement

Traditional education systems assume that grades and test scores are needed to maintain academic achievement. But when these extrinsic motivators are the main ones, retention tends to be compromised—it will often fade quickly after a test.

The motivational approaches used in the PIE technology lean toward intrinsic motivators—those that will be forthcoming outside the learning situation. Examples of such motivators are practical applications of the acquired skills or knowledge, achieving desired re-

sults, connecting new material and subject matter to things already known, becoming able to do something that was previously out of reach, or satisfaction of curiosity. The premise is that such intrinsic rewards produce higher levels of achievement and better retention than extrinsic ones like test scores, competition, tokens, money, or other rewards that would not be forthcoming outside the learning situations. Learning becomes inherently enjoyable when it produces intrinsic rewards.

The Learning Managers know that for any praise, acknowledgment, or recognition to be intrinsically rewarding, it must make contact with the substance of the achievement rather than just the fact of it having occurred.

Alternative configurations of PIE schools

PIE schools can be implemented in any configuration that preserves the PIE technology's key features:

- Mixed age grouping of 20-40 students being educated by a team of 4 learning managers.
- Each of the 4 core academic subject areas has one Learning Manager who is strong in that area.
- The education that the students receive must be individualized, with emphasis on social-emotional learning and self-management skills as well as on the academic curriculum.
- Each student has a customized learning plan that consists of clearly defined learning objectives.
- All students should have permanent personal work stations, which they normally leave only for instruction in foreign language, music, art, physical education, group activities, or breaks.

Configurations can differ with respect to the range of grade-equivalent levels and ages. If the range is too narrow, the benefits

of the mixed-age feature are diminished. One possible set of ranges is K-6 and 6-12.⁵ Within a PIE school, the students can be grouped in different ways for different purposes. Here is one effective grouping approach:

- Mixed-age groups for the standard independent work sessions (in the core subject areas) with every student working on his or her personal learning plan, with occasional one-on-one assistance from Learning Managers or interns.
- Periodic re-grouping by similar ability level for discussion sessions, presentations, collaborative projects, and feedback from peers relating to the work that was done independently.
- Similar-ability groupings for physical education, dance, music, art, and language instruction.

Roughly twice as much time is devoted to independent work as to group work.

The 6th to 12th grade range in the PIE technology

The important differences between K-6 and 6-12 PIE schools reside in the features designed to promote independent learning—the degree to which students take charge of their own education. Given the overarching goal of preparing students for life beyond school, the education they receive must generate the required skills and personal qualities.

In the 6-12 schools, the learning objectives place increasing emphasis on self-directed learning and on development of the associated self-management skills. The learning plans include learning objectives that target the skills of working, communicating, and collabo-

⁵ The grade-equivalents implied by these ranges are not based on age only. In the PIE technology, every student is at a different level of achievement in every subject, making the traditional rigid grade concept inapplicable. The “grade-equivalent” concept takes into account not only age but also academic achievement, as well as such non-academic factors as social maturity and self-management skills.

rating with others. In the academic areas, students can move ahead when they are able and motivated to do so, even into college level material and beyond, with mentoring, guidance, and support from Learning Managers who help them locate the needed learning resources, not necessarily limited to those available within the school.

Learning Managers make sure that the students' learning plans don't contain curriculum gaps. They see to it that the students fulfill their commitments, maintain their schedules, and remain properly motivated. They regularly arrange for students to present their work to peers for discussion and feedback

Non-academic Learning

The Learning Managers also continue to work on every student's non-academic education. The PIE technology requires students to commit to goals, take charge of their own progress, and work productively with others. In group and team activities, they develop the skills of persuading, negotiating, attentive listening, note-taking, inquiry, cooperation, and collaboration. In self-management they learn time management, organization of their physical environment, goal-setting, impulse control, self-observation, and reflection. In their social interactions, they learn to act toward others with courtesy, respect, consideration, and kindness, and develop a reputation for reliability, dependability, and honesty. These types of learning occur as a result of mentorship and coaching from the Learning Managers, and being in a school culture in which those personal characteristics are the norm.

Traditional secondary schools, with their higher student-teacher ratios, cannot address these aspects of education. The PIE technology, by addressing them, prepares students not only for success in college but also for productive and satisfying lives.

Special features of the 6th-12th grade education

At the 6-12 level, commitment to the achievement of learning objec-

tives and projects is more formal than in the lower grades. Learning plans cover more advanced academic content, including and exceeding the goals stated in the Common Core Standards. Students are encouraged to zoom ahead when motivated and able to do so. Students periodically take tests and discuss the results with their Learning Managers.

Independent learning is balanced with presentations to peers, discussion sessions, collaborative projects, and field work. Students meet in small groups to discuss what they have read, researched, written, and learned. Questions and responses from peers and Learning Managers help develop critical and creative thinking. Students are regularly challenged to defend their assertions, clarify their points of view, and consider alternative viewpoints. They are encouraged to delve deeply into subjects that interest them, independently and in collaboration with fellow students.

Learning objectives aimed at independent learning

- Self-originated learning objectives (“SOLOs”) that reflect the student’s particular interests. Students pursue SOLOs only when Learning Managers are satisfied that the objectives are achievable and educationally useful.
- “Large” learning objectives or projects of increasing challenge that students choose from menus that Learning Managers offer them. Such projects may take weeks or months to complete: performing a science experiment, writing a short history of the Pythagorean Theorem, publishing a newsletter, or collaborating with another student to write a conjecture of how history might have been different if... Over the years of secondary school, these projects become more challenging and complex, and students work on more than one at a same time.
- Learning objectives that require expository writing (persuasive, descriptive, analytical, and so forth), with progressively more demanding standards.

- Learning objectives designed to improve a student's ability to learn by listening to a speaker, e.g., the skills of note-taking and reviewing those notes. The increasing prevalence of on-line learning (MOOCs)—lectures and videos that can be reviewed multiple times, offer important new learning resources.
- Learning objectives that improve students' test taking and studying techniques: formulating anticipatory test items on both factual and conceptual material; allocating time wisely; and using good guessing strategies when needed.
- Learning objectives related to field work. On a regular basis, Learning Managers make arrangements for students to work outside the school, as aides in laboratories, educational institutions, or business offices. The goal is to expose students to diverse work environments, types of work performed, and people who perform them.

Long-term effects of this type of education

As students begin to function as independent, self-motivated learners, they do an increasing amount of their academic learning on their own, often delving deeply into topics that interest them, independently or in collaboration with others. As their self-confidence grows, they take ever greater charge of their education and make ever better choices as to where to invest their efforts. Many begin to function somewhat like graduate students motivated by the acquisition of knowledge or proficiency. Their work products become increasingly sophisticated and their communication and collaboration skills continue to improve.

Much of this progress is due to the PIE training in self-management skills. The learning objectives that relate to these skills are similar to ones that are included in many types of business management and executive training programs.

Along with enhanced self-management and learning skills, the PIE

technology prepares students for college work and online learning, as well as for graduate work in which students take ownership of their education. But the main end product of the PIE education is preparation for all aspects of a productive, successful, and satisfying life.

Summary and Conclusions

The PIE technology for configuring and operating K-12 schools offers a way to deliver individualized educations to diverse student populations, with significant benefits to students, teachers, families, and communities. It may also provide a way to reconfigure schools, classrooms, and the roles of teachers for comprehensive, economically viable school reform.

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