



## **How to Plan, Design and Re-Engineer High-Performance, Technology-Supported Classrooms for the 21st Century**

- **Re-Engineering the Classroom is an Important Step Toward Re-Engineering the School for the 21st Century**
- **Shift from Classroom Full of Computers to Computerized Classrooms, Use Computer and Its Monitor as a Medium for Education and Training in a Cooperative Learning Environment**
- **A Modern Multimedia “One Room High-Tech Schoolhouse” which Makes Possible New Forms of Multi-Modal Distance Learning**
- **Simplify the Educational Technology to Empower Teachers with “Consumer-Like” Tool Rather than Just Adding Technology**

**James K. Chang  
President, COMWEB Technology Group  
Founder, Global Knowledge Exchange Program  
409 Minnisink Road  
Totowa, New Jersey 07512 USA**

**Tel: (973) 890-0010  
Fax: (973) 890-9077  
Videoconference: IP: 12.135.49.227  
Email: [jchang@COMWEB.com](mailto:jchang@COMWEB.com)  
<http://www.GKE.com>  
<http://www.COMWEB.com>**

## **I. THESIS**

“Business Week” in its February 28, 1994 issue offered an in depth analysis of the educational technology revolution of the past 10 years. This cover article revealed that, despite millions and millions of dollars spent on new learning technology, schools (for the most part) had not achieved real improvements in teacher productivity or student achievement. The article further explained that school spending for learning technology had taken a similar course to that of corporate spending on information technology during the late 1970s and early 1980s. Initially, Corporate America was puzzled why, despite huge investments in computers and related office technologies, the actual corporate performance - i.e. efficiency and profitability -had not shown immediate and dramatic improvement. But eventually, U.S. Corporations came to understand that while there was nothing inherently wrong with information technology itself, IT could not be the total solution. It was not enough to simply automate the old manual business processes using computers. Rather Corporations must fundamentally change the way they do business in order to take advantage of technology. Re-Engineering the corporation soon became mainstream practice in the United States.

Educational institutions are just now beginning to go through the same important learning curve. Experts in instructional technology are realizing that simply buying into the latest technology or installing high bandwidth networks (fiber, etc.) or connecting to the Internet is not the path to the 21st Century. These are only tools. As practitioners we must fundamentally change the way teaching and learning take place. And what better place to begin that in the classroom itself? Re-engineering the individual classroom into a multi-purpose, multimedia networked learning environment is the greatest step we can take toward re-engineering the school as a whole for the 21st Century.

## **II. LESSONS LEARNED**

What exactly has COMWEB Technology Group learned after being involved in over 1500 classroom infrastructure projects over the past 14 years? This includes work in K-12, Higher Education, Corporations, Government and Professional Training Centers around the world.

### **Lesson 1:**

Re-engineering the ”Mindset” of the teacher and the administration is more important than the technology itself because too often we use 21st Century tools and still follow 18th Century methods.

### **Lesson 2:**

The “integration” and “application” of technology is far more important than the technology itself. What the administrators want for their teachers is a complete “CAR” (Classroom), not mere auto parts!

### **Lesson 3:**

Rather than using the new educational tools to continue doing things the old way, we must fundamentally change the way we teach and learn in the classroom. What we are moving toward is a continually updated, just-in-time, and true lifelong learning environment.

### **Lesson 4:**

Educational Technology need not be “complicated” and “expensive.” Teachers and School Administrators must learn how to manage their technologists (and the technologies) rather than being managed by them.

### **Lesson 5:**

Teacher In Service Training and Professional Development in the area of Educational Technology is the single most critical element for Educational Reform. Do not build a “21st Century Car” (Classroom) without also providing a training program for the driver (Teacher) and traffic rules (License) to be obeyed.

### **Lesson 6:**

Do not re-invent the wheel (21st Century Classroom) or try to be the proprietary designer and engineer of the modern school building. Teachers and administrators should focus on defining the functional requirements for the classroom rather than specifying the details of the technology components.

### III. 21st Century Classroom Functional Requirements

Based on the over 1,500 technology-based classroom and corporate training facility projects in which we have participated, we conclude that 80% or more of the functionality for which educators are looking is fundamentally similar by nature. Rather than focus on the technology components, the teacher should be focused on the functional requirements. We conclude that the following are among perhaps the most important capabilities:

- Multi-Purpose
- Multi-Functional/Multicultural
- Software- & Curriculum- Independent
- Accommodates Various Teaching Methods
- Highly Interactive Cooperative Environment
- Distance Learning Capable
- Open Architecture
- Knowledge Automation- Capturing the “Process Knowledge”
- Communication within Classrooms
- Multi-Channel Communications
- Faculty Development Program
- Global Knowledge Exchange Program



## Global Knowledge Exchange (G.K.E.)



The Essential Infrastructure for Re-engineering a Classroom or Training Facility to Become a High-performance, Computer-Supported, Multimedia-Based, and Distance Learning Capable Environment

#### FEATURES/BENEFITS:

##### MULTIPURPOSE

Can be used to teach or learn any subject from ESL to CAD for both computer literate as well as to novices.

##### MULTIFUNCTIONAL

A classroom can be used as a:

- Computer Lab.
- CBT Training Room.
- Video Conference Room.
- Multimedia-based Classroom.
- Lecture and Presentation Room.
- Distance Learning Room.
- Internet Training Room.
- Meeting Room.

##### SOFTWARE AND CURRICULUM INDEPENDENT

Can be used with any software and can adapt to any curriculum or computer platform.

##### ACCOMMODATES VARIOUS TEACHING METHODS

- Lecturing
- Coaching
- Cooperative Learning
- Distance Learning
- Team Teaching
- Internet-based Learning

##### HIGHLY INTERACTIVE COOPERATIVE LEARNING ENVIRONMENT

3-Way interaction:

- Teacher to Student
- Student to Student
- Student to Teacher

For both local and remote sites.

##### DISTANCE LEARNING INSTRUCTION CAPABLE

Can be used to support site-to-site and site-to-remote Distance Learning Applications including Software Training.

#### FEATURES/BENEFITS:

##### OPEN ARCHITECTURE

The system can support any computer platform PC, MAC, SUN, etc. and works even without CPU's, just monitors. It can integrate with any data or video conferencing system or any multimedia peripherals.

##### KNOWLEDGE AUTOMATIC CAPTURE OF THE PROCESS KNOWLEDGE

The system can record both teacher's lecture as well as student's presentation which can be re-used or in developing case studies or student portfolios.

##### COMMUNICATION WITHIN CLASSROOMS

Instant or Multimedia-based communication. Instantly share text, graphics, data, software or video from anyone to anyone or in sub-groups.

##### MULTI-MODAL COMMUNICATION

Communication between sites can be implemented using various media from traditional telephone lines, ISDN, Fiber, ATM, Satellite wireless connections, etc.

##### TEACHER/FACULTY TRAINING PROGRAM INCLUDED

The GKE Professional Development Program includes:

- Educational Technology Seminar Series
- Computer in Education Certificate
- Multimedia in Education Certificate
- Distance Learning Certification
- Instructional Technology Design Program

##### GLOBAL KNOWLEDGE EXCHANGE PROGRAM

Option to join the large group of Global-based educational associations for the Educational Exchange Program.



**COMWEB - Technology Architect Group**  
 155 Route 46, Wayne Interchange Plaza II, Wayne, NJ 07470 USA  
 Tel: 201-890-0010 Fax: 201-890-9077 ISDN: 201-890-9664  
<http://www.comweb.com> E-mail: [info@comweb.com](mailto:info@comweb.com)

**\* Multi Purpose:**

In order to maximize the return on investment, the classroom should be designed to support the teaching of any subject ranging from ESL, Math, Science, Law, Engineering, Management, and Medicine to CAD. The classroom should also be designed to be accessible to both highly computer -literate users as well as relative beginners.

**\* Multi Functional**

There should be no such thing as a “computer classroom” but rather “a classroom with computers.” Rather than design a classroom for a single function, the infrastructure should be designed to support a variety of needs such as:

- General Use Classroom
- Computer Lab
- CBT Training Center
- Video Conferencing Room
- Multimedia-based Classroom
- Lecture and Presentation Room
- Distance Learning Room
- Internet Web-based Learning Center
- Curriculum & Student Portfolio Production Room
- Administrative Meeting Room

**\* Software- and Curriculum-Independent**

In the life-long learning environment of the 21st Century, educational needs will be constantly changing. Therefore, the classroom should be designed to accent any computer hardware, computer operating system or application software and it should be easily adapted to any curriculum program.

**\* Highly Interactive Cooperative Learning Environment**

The classroom design must provide real time 3-way interaction:

- Teacher to Student(s)
- Student(s) to Teacher
- Student to Student(s)
- At both local and remote sites

In addition, the design should provide for synchronous interaction as well as asynchronous interactions.

**\* Multi-Modal Distance Learning Instruction Capable**

There should be no such thing as a “Distance Learning Classroom,” but rather a “Classroom which can Support Distance Learning.” It should be used for both site-to-site and site-to-multisite Distance Learning Programs. Applications include software training as just one option. There are MANY good reasons to use a computer-supported, multimedia-based distance learning classroom. Under one scenario teaching and learning still begin and end in a real classroom with a group of real students and teachers, not the “virtual classroom” of the hype. The classroom should be designed to support every type of “multi-media communication”-- both “short-distance learning” (in which teacher and student are in the same room) and “ Long-distance learning” (in which teacher and student can be separated by hundreds or thousands of miles). Two or more classrooms anywhere in the world can be easily and inexpensively linked and function as a single high performance and highly interactive learning environment. An instructor in either room or a team of teachers can communicate face-to-face and screen-to-screen with students at the remote site in an approach to education, which we call “classroom-to-classroom communications.” The synchronous (real-time) links are supplemented by asynchronous links (Email, WWW, etc.). What we are witnessing here is the birth of an inexpensive hybrid digital-analog, synchronous-asynchronous medium, which goes everywhere to connect groups large and small.

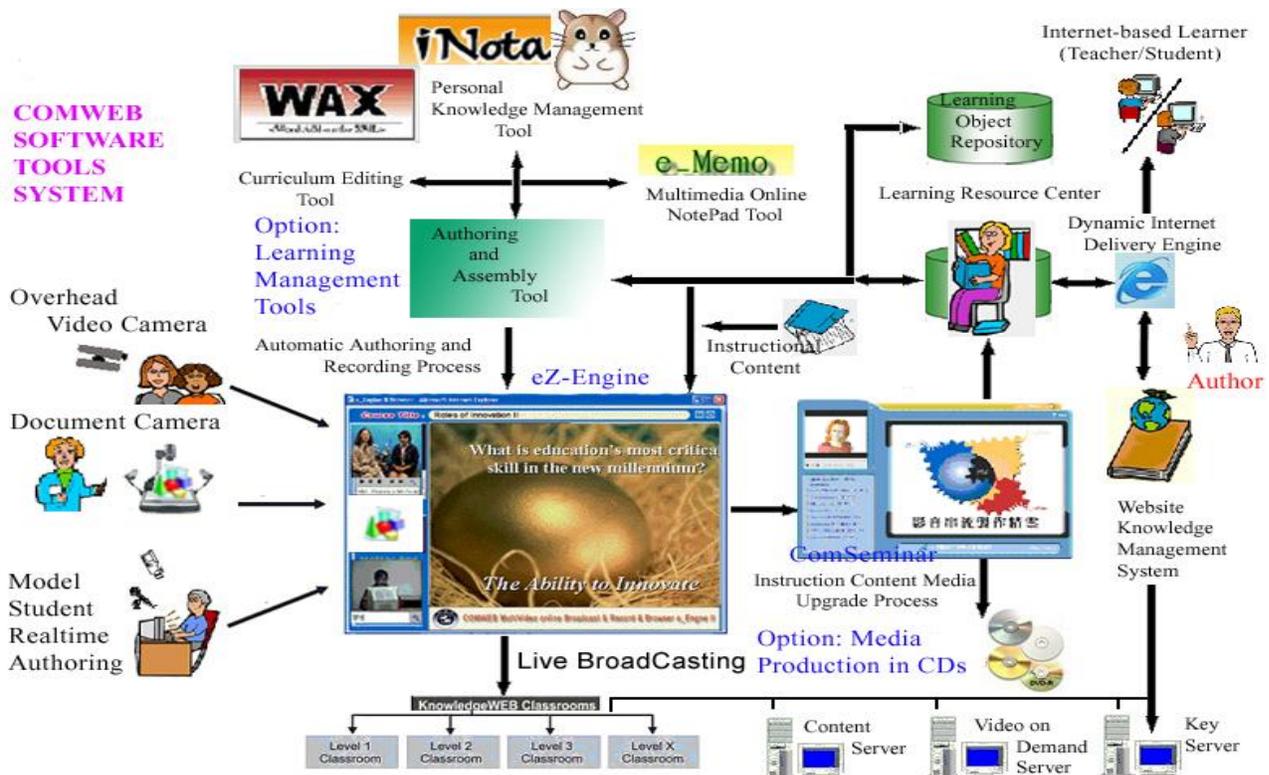
**\* Open Architecture**

The classroom must support any computer platform: PC, Mac, Sun, etc. and work even without CPUs, just monitors only. It can integrate with any data or videoconferencing systems or any multimedia peripheral. The design should provide a migration path for integrating old equipment with any emerging or future technologies.

In a unique multi-layer configuration designed for maximum flexibility, a modular, plug-together hardware backbone interconnects all the various digital and analog devices. This hybrid digital-analog instruction delivery system is the central “structure” which integrates ALL the other technology at the point of instruction. Think of it as a “network-of-networks.” Additional digital or analog devices, like simple building blocks, can be introduced on the fly as the lessons dictate.

**\* Knowledge Automation - Capturing the Process Knowledge**

19th Century education was among the most labor-intensive industries. The 21st Century classroom, similar to the automated office, should facilitate knowledge automation and should record both teacher presentations as well as student work which can later be re-used when developing case studies, curricula or student portfolios. The classroom will be the source of new knowledge creation. We should systematically look at how knowledge is created, assembled, presented, published, preserved, synthesized and distributed. The “economics” of “Knowledge” and its productivity will be of great importance in the 21st Century learning environment.



**Next Generation Knowledge Automation WEB System**

-Content Creation Process Automation & Personalized Knowledge Management System-

**\* Communication within Classrooms**

While many schools are pursuing distance learning applications which connect individual classrooms to other locations, we should be aware that most current classroom designs always put teachers and students at a distance, even though only 10-20 feet may separate teacher and students or student and student. Too often people concentrate on connecting from one classroom to other classrooms. We must also fundamentally change the way we communicate within the classroom.

**\* Multi-Modal Communication**

Just as the most up-to-date transportation networks today are multimodal in nature, exploiting a combination of airplanes, ships, trains and trucks, the 21st Century classroom represents a multimodal approach to educational communications. A hardware backbone within the classroom acts as the localized information delivery system, a feeder and distribution-switching device for whatever other communication links happen to be in use. The connections between classrooms can be digital or analog, wired or wireless (e.g. Internet, Fiber, ATM, etc.) including even ordinary telephone lines. The choice of medium depends simply on where you are connecting and what you are teaching today. You can have more than one connection running at the same time or change the connections during the course of a class. The “best in practice” of current distance learning programs often require creative packaging of different communication media.

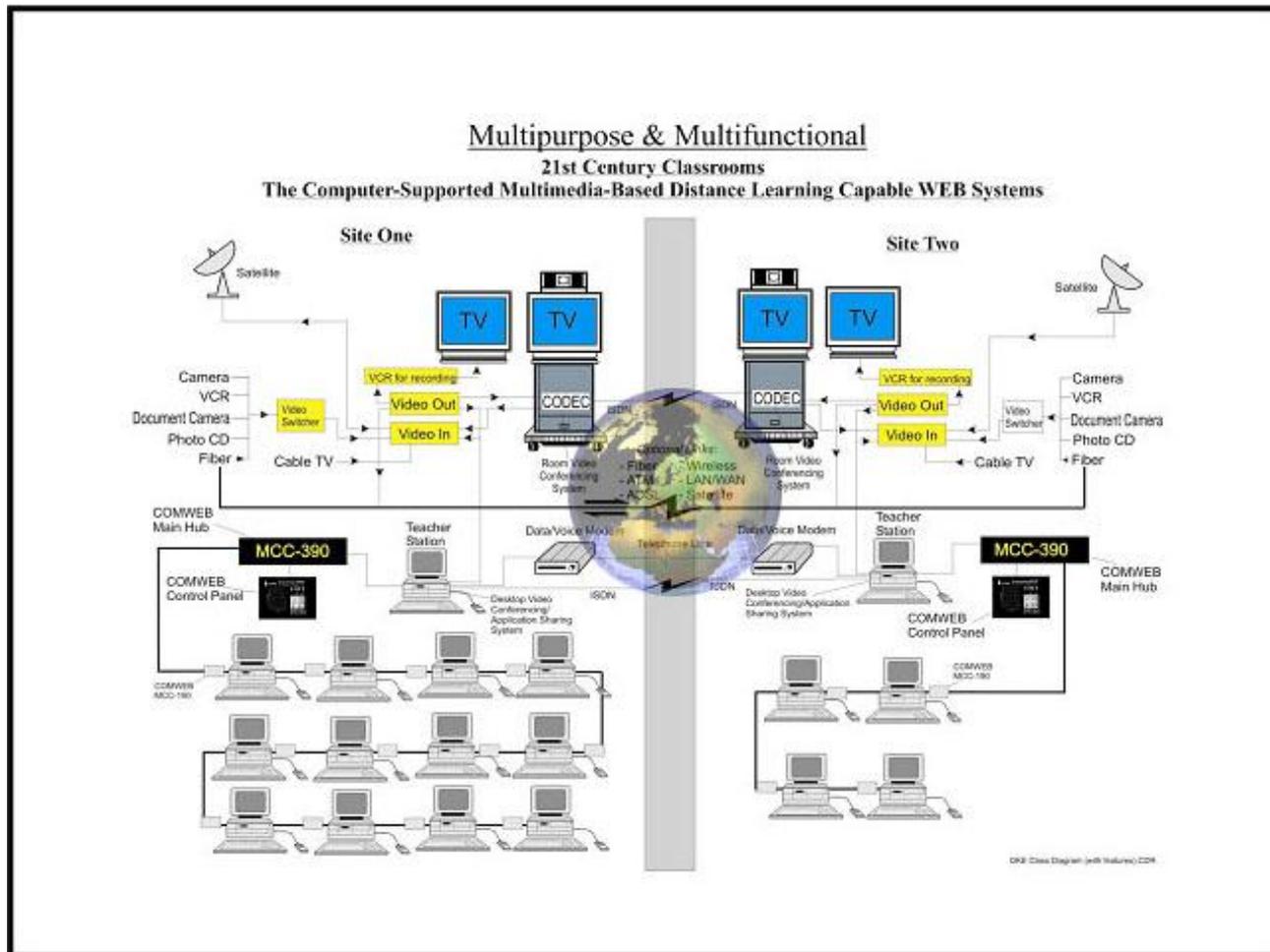
**\* Faculty Development Program MUST be Included**

Before driving a car, every driver must go through practical training and an exam in order to get a driver’s license. Each teacher and/or trainer must likewise go through a professional development program. Some specific technology training programs are as follows:

- Educational Technology Seminar Series
- Computer-in-Education Certificate
- Multimedia-in-Education Certificate
- Distance Learning Certificate
- Instructional Technology Degree Program

**\* The 21st Century Classroom - KnowledgeWEB Classroom**

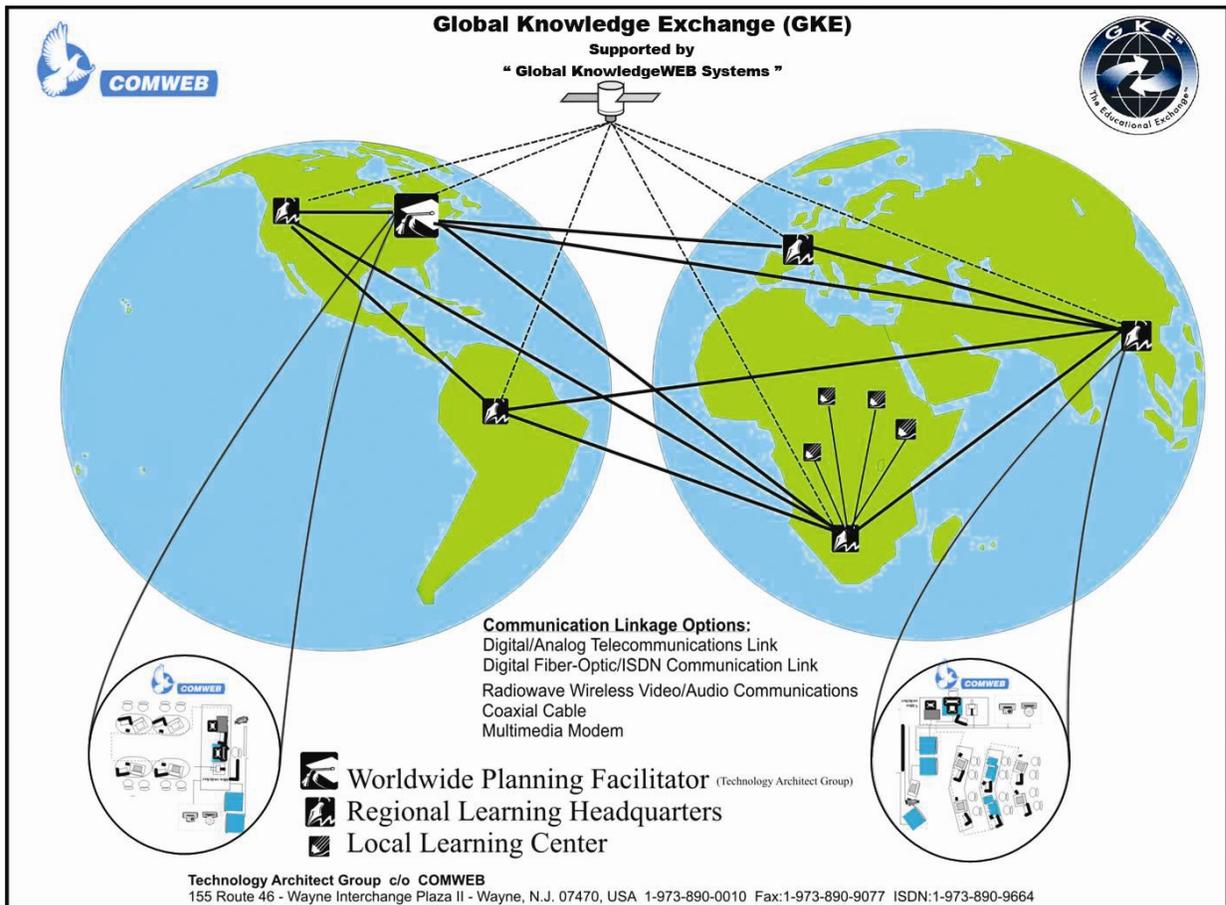
Based on these functional requirements, the following diagram illustrates how to design the best possible classroom. Please note that the standardization of the functions is what we are after, not the arrangement of the furniture or the aesthetics of the classroom.



- We need to simplify the Education Technology tool to “empower” the teacher with “consumer-like” tool rather than just adding technology. In other words, what the teacher needs is a fully functional car (classroom) rather than just a room full of auto parts. Computers, Internet, Network, TV, and furniture, are just auto parts. Teachers are the drivers; they do not need to know how to build the car. They just need to learn how to drive it. Today, almost everyone knows how to use a VCR’s, cameras, calculators, without having to learn the technology. We should focus on the classroom as a product (system) and its functionality rather than focus on each auto part.
- We need to shift the design concept of a classroom full of computers, to computerized classrooms. Use the computer and its monitor as a medium for Education and Training in a cooperative Learning Environment.

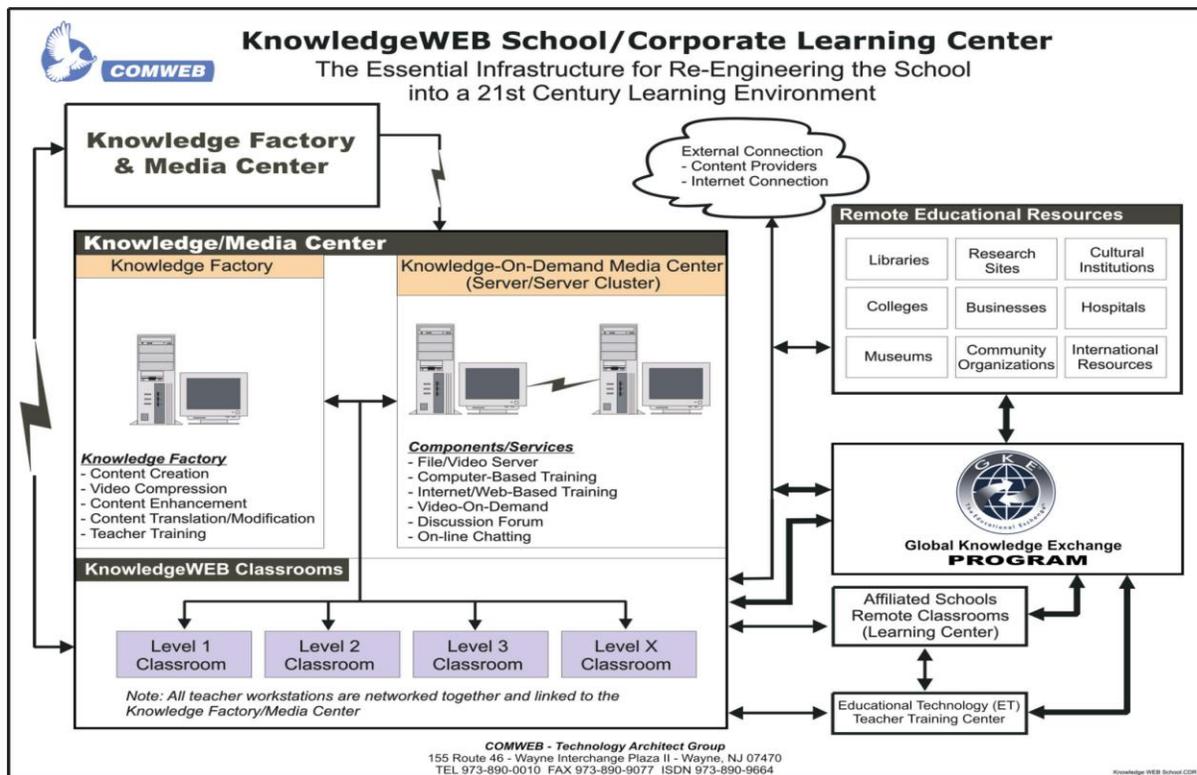
**\* Global Knowledge Exchange (GKE)™ Program**

Perhaps the best way to think about the 21st Century Classroom is not simply as an intersection of outside networks with local resources, but rather as the intersection of people and institutions and ideas. The 21st Century Classroom is a place to tap into the global brain. And it's all so simple. In the hands of a creative instructor, this room almost appears to operate in 3 and 4 dimensions. A student at one end of the room can view the screen of a student sitting at the opposite end of the room. An interesting and dynamic mix of group with individual hands-on activities becomes possible. The 21st Century Classroom will become the focus for innovative thinking about how best to apply technology to enhance student achievement and at the same time facilitate the Knowledge Exchange Program.



#### IV. Re-Engineering the Classroom is an Important Step Toward Re-Engineering the School

As we are about to enter the 21st Century, the substantive issues will begin to surface. What is the "Accountable School" in the 21st Century? The real challenge ahead will not be the technology itself. It's what we use it for. To date, no country has created the educational system which the knowledge society demands. We need to work together to develop new specifications for the school. The technology will still be significant, but primarily because it should oblige us to do new things rather than because it will enable us to do old things better. The diagram below illustrates a conceptual infrastructure for a KnowledgeWEB school.



#### V. SUMMARY

- **Defining functional requirements is the first step toward re-engineering the classroom**
- **Re-engineering the classroom is an important step toward re-engineering the school**
- **We must promulgate a global vision for resource sharing and Global Knowledge Exchange.**
- **Education institutions around the world must move away from competition to co-opetition.**
- **We must shift the focus from building islands of National Learning Infrastructure (NLI) to a true Global Learning Infrastructure (GLI).**