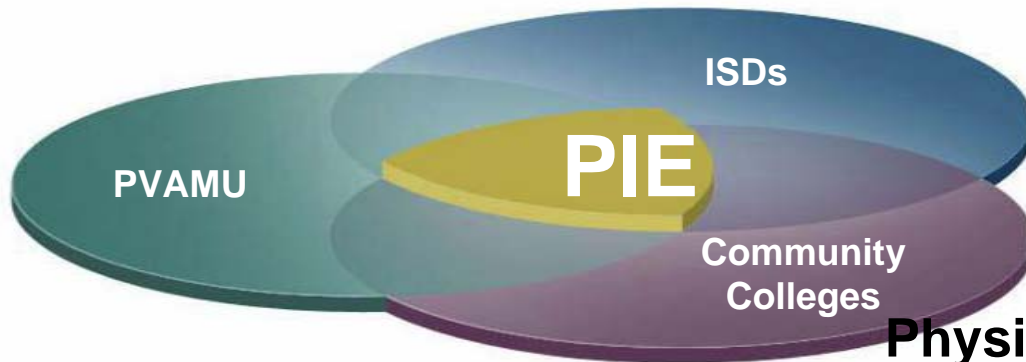


TEXAS SCHOOLS IN THE GLOBAL ARENA IS OUR COMPETITIVENESS COMPETITIVE ENOUGH?

PIE PROJECT (PARTNERSHIP FOR INNOVATION IN EDUCATION)

A SCHOOL-UNIVERSITY PARTNERSHIP FOR A
GLOBALLY COMPETITIVE
SCIENCE AND MATHEMATICS EDUCATION



A. Anil Kumar, Ph.D.
Departments of
Physics and Electrical Engineering
Prairie View A&M University
aakumar@pvamu.edu



PIE PROJECT PARTNERS

**A. Anil Kumar, PVAMU
Thomas Linton, TAMU-
Galveston
Vivian Garza, Tyler ISD
Denise McAfee, Houston ISD
Karen Nickel, Galveston ISD
Brenda Paloski, Pasadena ISD
Cindy Wilems, Pasadena ISD**



QUESTIONS

- How well prepared are our students for the world after high school?
- What does it mean to be prepared for college or the workforce?
- Are the state and national standards in science and mathematics adequate to meet these needs?
- Are these standards consistent with workforce and global expectations?
- Are these standards being properly implemented?
- Are there appropriate assessment processes and practices in place that ensure that the standards are being met?
- Is it realistic to expect ***all*** of our students to be prepared?
- What will it take to close the expectations gap?



PERHAPS THE SINGLE MOST IMPORTANT QUESTION IS

Are the science and mathematics preparations of a Texas high school graduate on par with those of his/her international classmates in the first freshman semester?



*The answer seems to be an
overwhelming
NO!!!*



SOURCES OF THIS ANSWER

- Conversations with teachers
- Conversations with university and college faculty
- Conversations with industry folk
- Various assessments and studies
- Global comparisons

“America’s high schools are obsolete. ... By obsolete, I mean that our high schools—even when they’re working exactly as designed—cannot teach our kids what they need to know. ...” - *Bill Gates, National Governors Assoc. Education Summit, February 26, 2005*



NEW CHALLENGES FACING U.S. EDUCATION

- ❑ Increased demand for higher education
- ❑ Internationalization of education and research
- ❑ Proliferation of places where knowledge is produced
- ❑ Increased number of scientific and engineering talent across the globe
- ❑ Reorganization of knowledge
- ❑ Emergence of new, global expectations



LOCAL PICTURE

Several Houston area schools possess a
low Teacher Quality Index

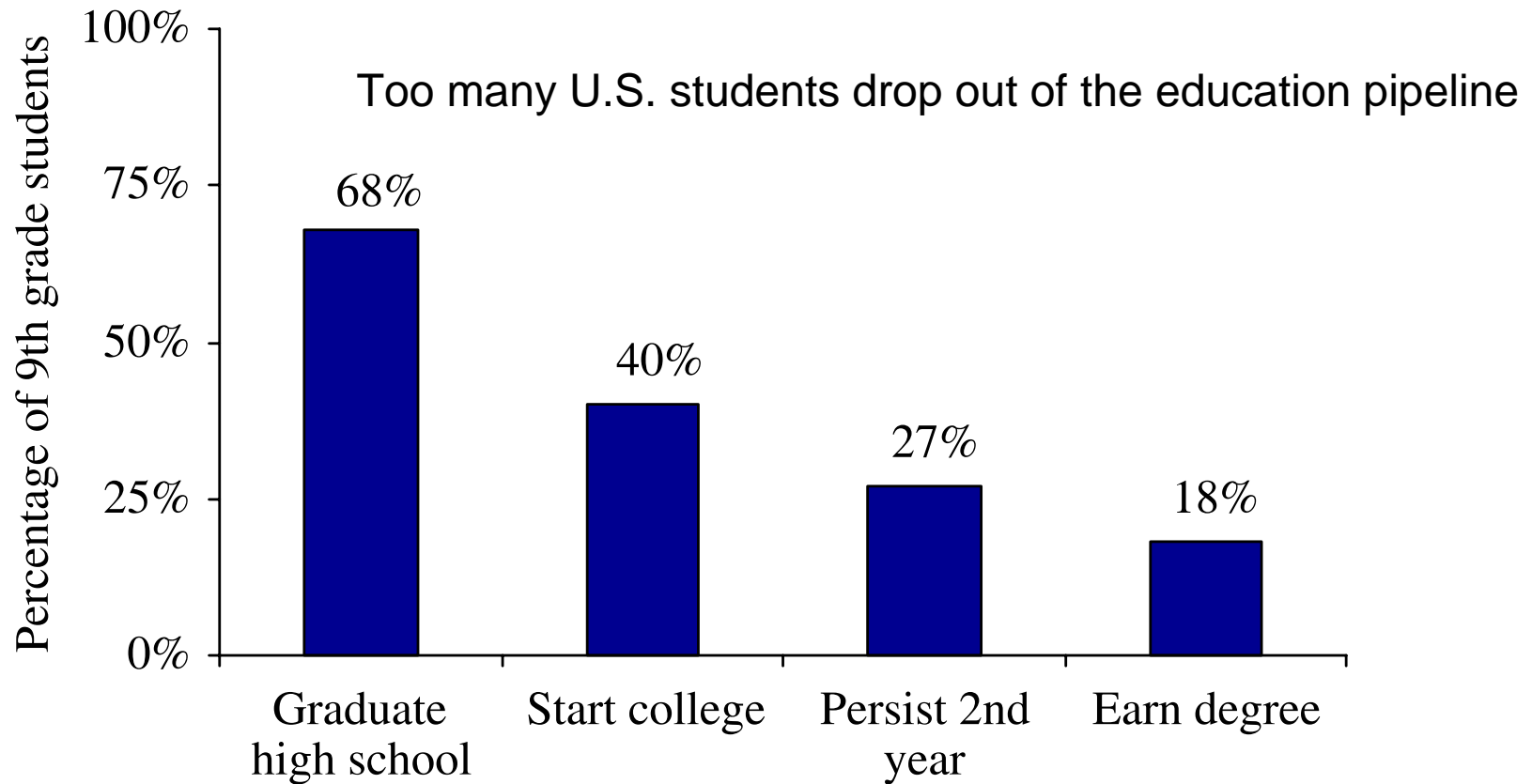
Ed Fuller

Houston Chronicle, July 17, 2005



NATIONAL PICTURE

(From American Diploma Project Network)



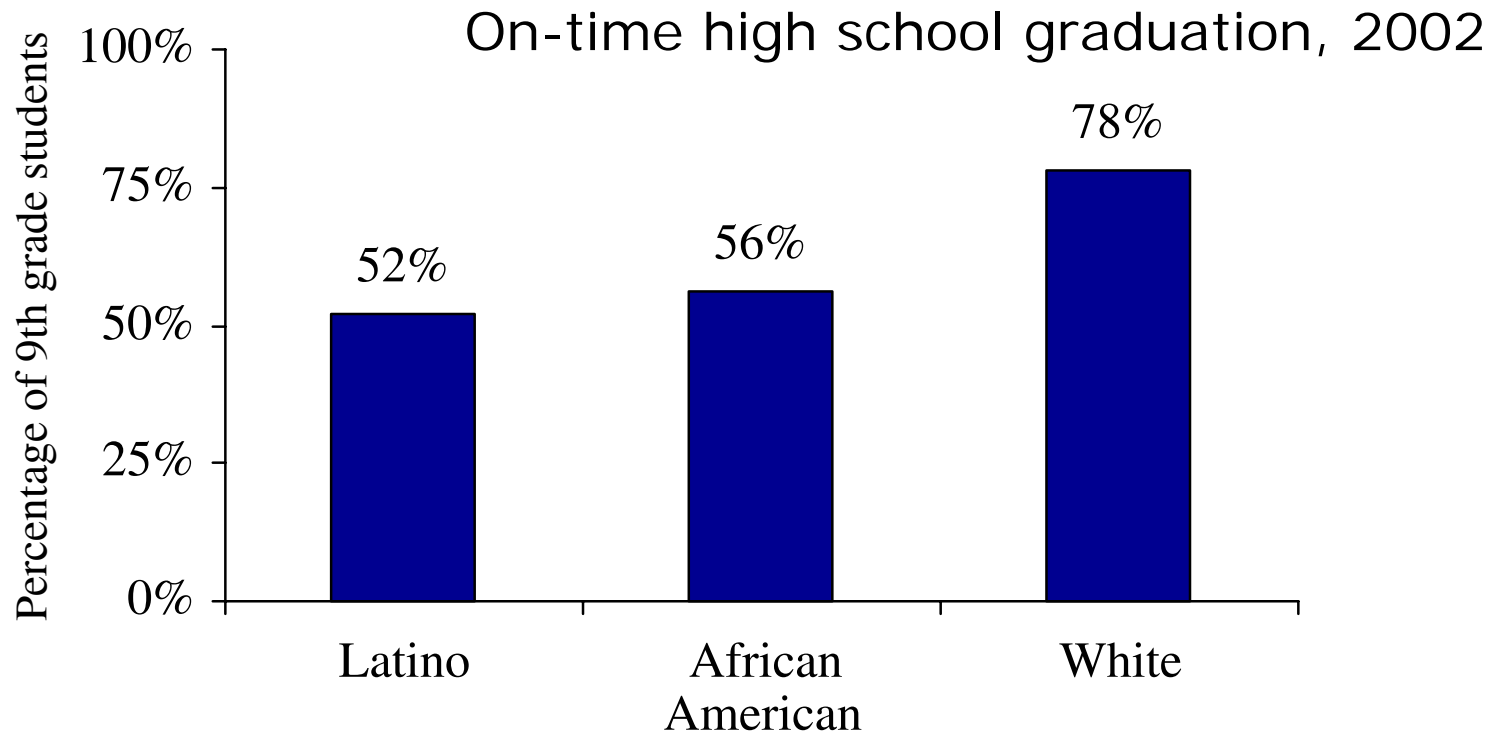
Source: National Center for Public Policy & Higher Education, *Policy Alert*, April 2004. Data are estimates of pipeline progress rather than actual cohort.



(From American Diploma Project Network)

NATIONAL PICTURE

ONLY ABOUT HALF OF AFRICAN AMERICAN AND LATINO STUDENTS GRADUATE FROM HIGH SCHOOL IN FOUR YEARS

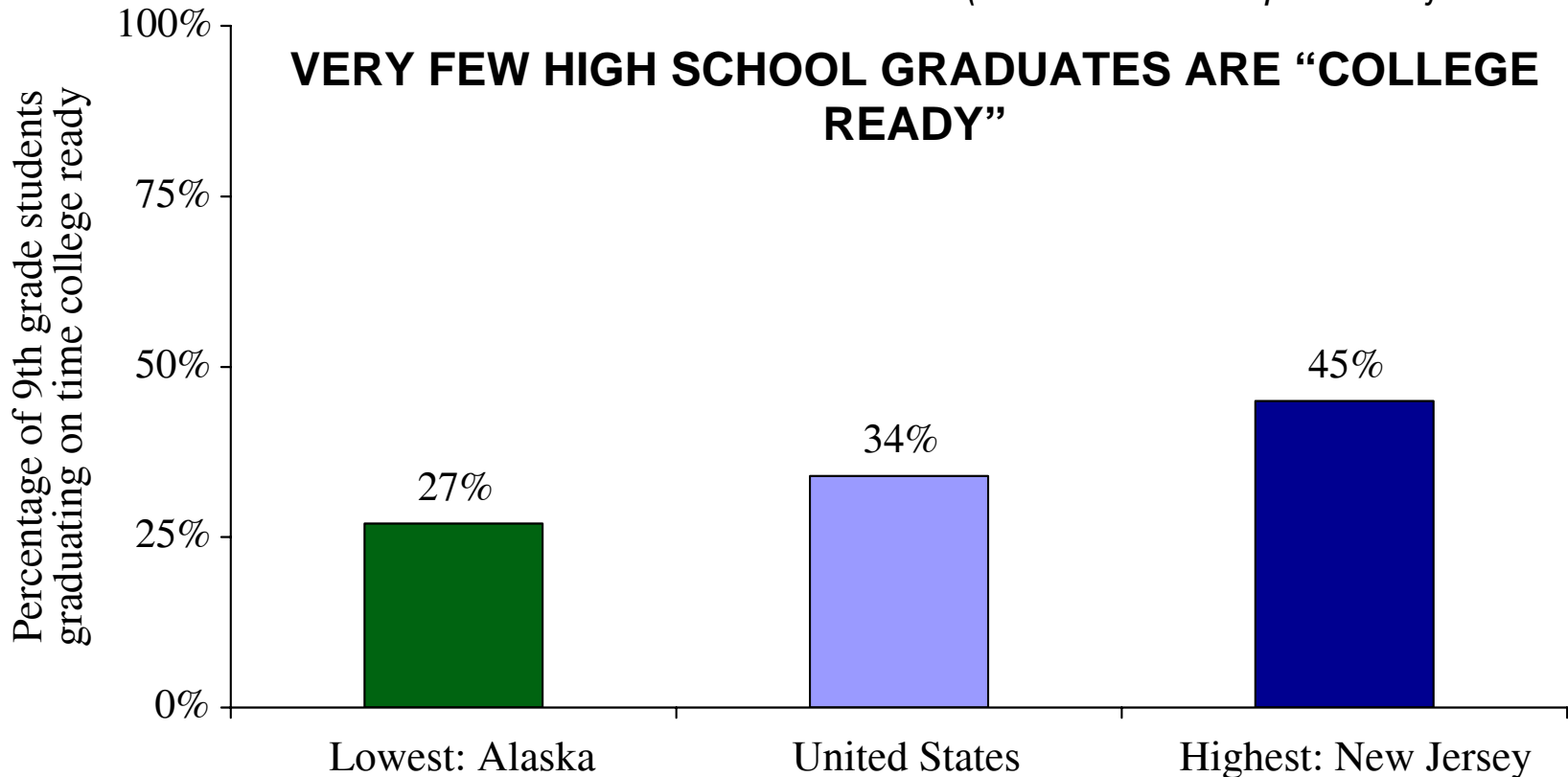


Source: Manhattan Institute, *Public High School Graduation and College-Readiness Rates: 1991–2002*, February 2005, http://www.manhattan-institute.org/html/ewp_08.htm.



NATIONAL PICTURE

(From American Diploma Project Network)

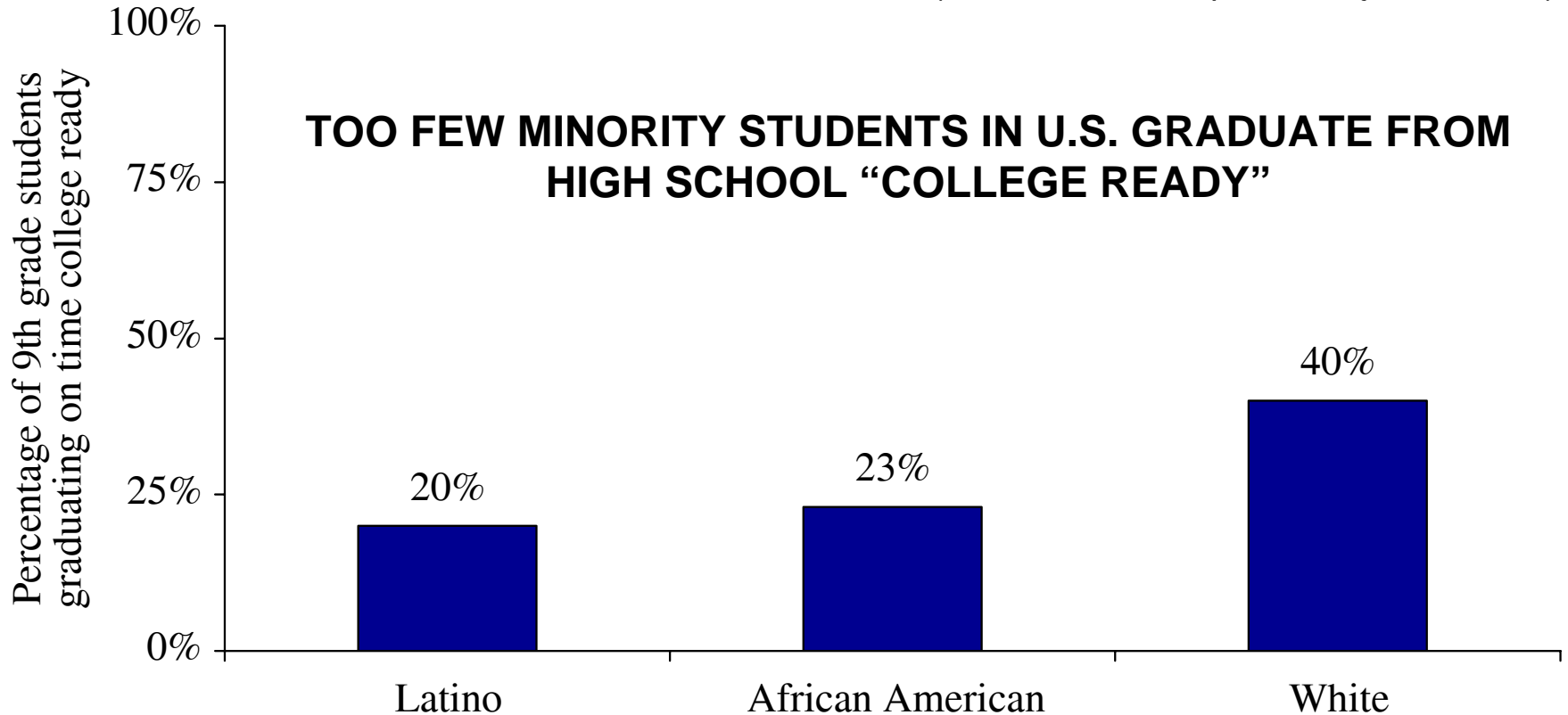


Source: Manhattan Institute, *Public High School Graduation and College-Readiness Rates: 1991–2002*, February 2005, http://www.manhattan-institute.org/html/ewp_08.htm.



NATIONAL PICTURE

(From American Diploma Project Network)

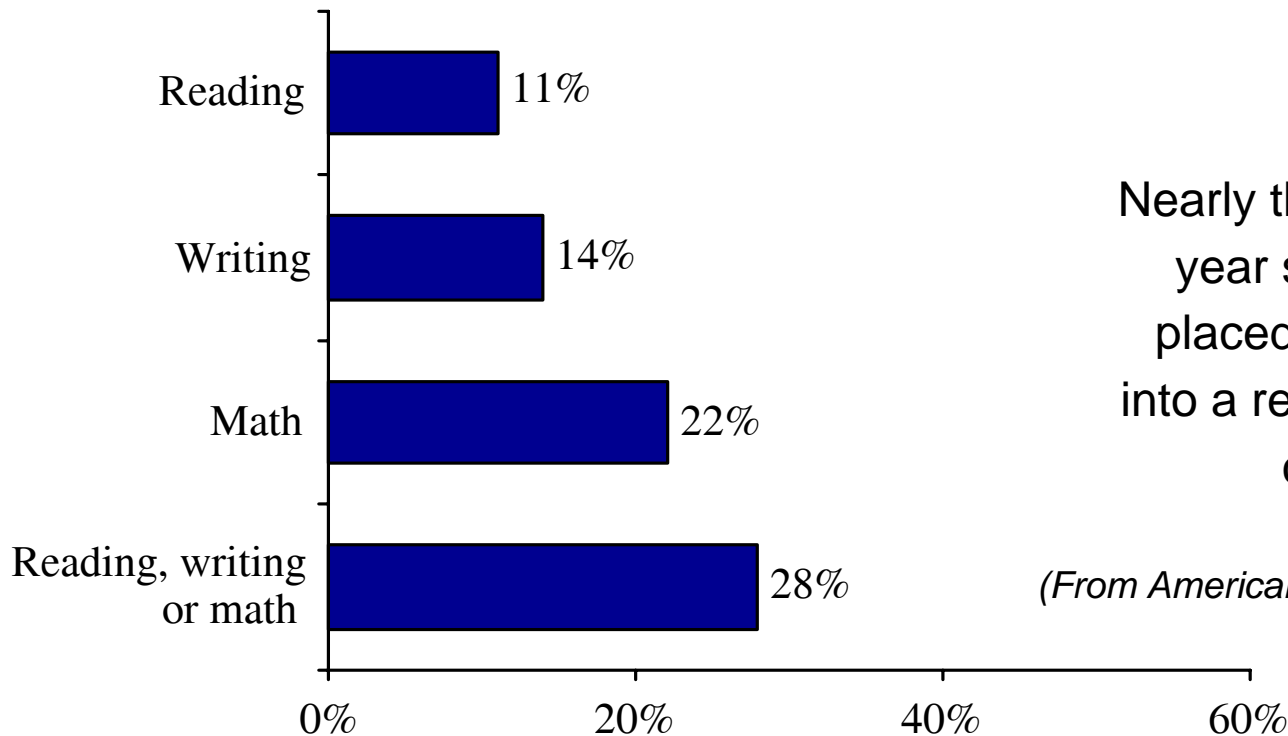


Source: Manhattan Institute, *Public High School Graduation and College-Readiness Rates: 1991–2002*, February 2005, http://www.manhattan-institute.org/html/ewp_08.htm.



COLLEGE BOUND DOES NOT NECESSARILY MEAN COLLEGE READY

Percentage of U.S. first-year students in two-year and four-year institutions requiring remediation



Nearly three in 10 first-year students are placed immediately into a remedial college course.

(From American Diploma Project Network)

Source: National Center for Education Statistics, *Remedial Education at Degree-Granting Postsecondary Institutions in Fall 2000, 2003.*

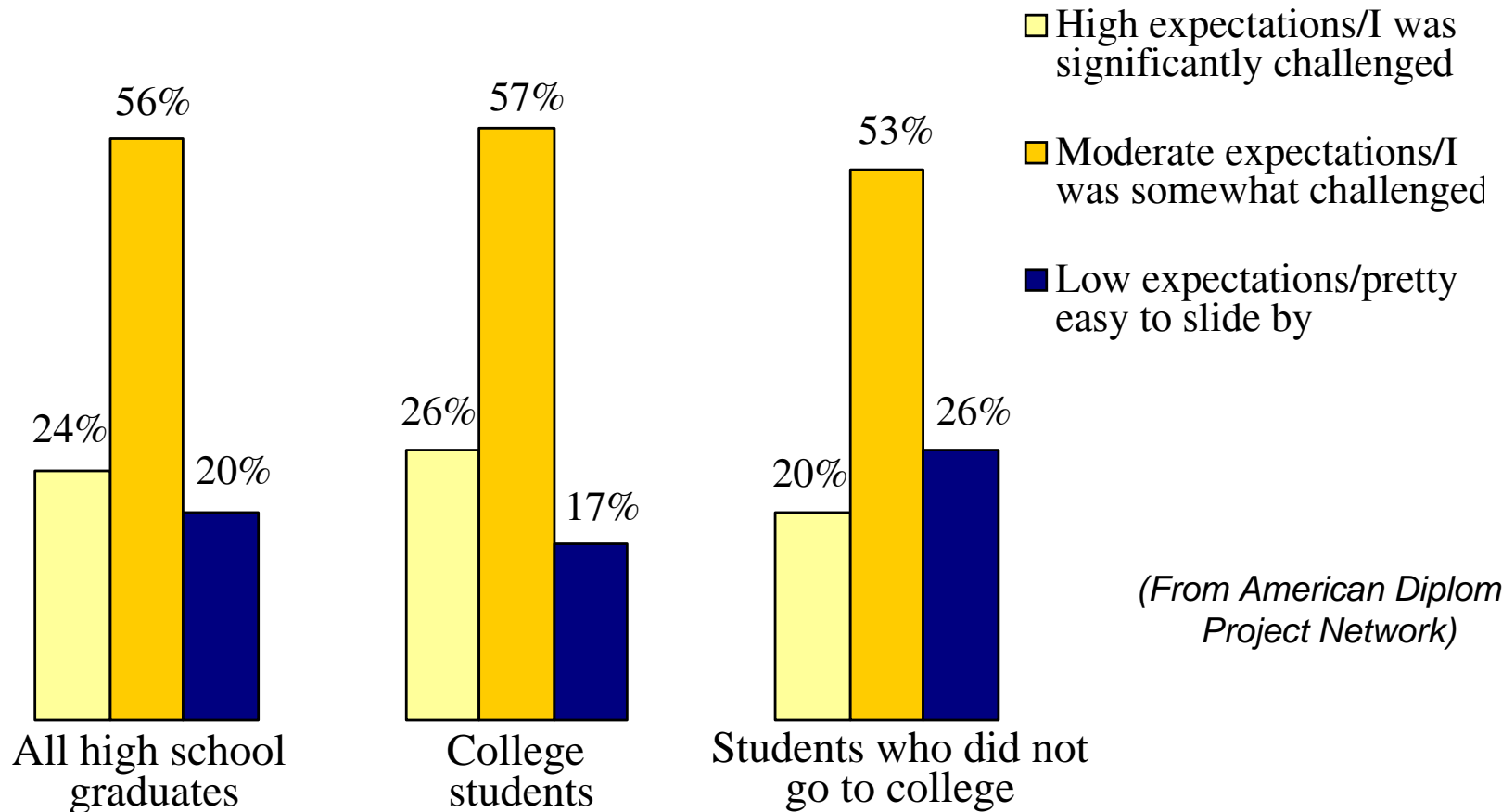


GAPS BETWEEN STANDARDS AND REAL-WORLD NEEDS

- “Large Gaps” between what discipline-based experts feel about what should be important for students to learn and what is relevant to meet the needs of college or the workforce.
- High school standards in a few states seem to reflect that they do not meet the expectations of postsecondary faculty and employers.



MOST HIGH SCHOOL GRADUATES WERE MODERATELY CHALLENGED



(From American Diploma Project Network)

Source: Peter D. Hart Research Associates/Public Opinion Strategies, *Rising to the Challenge: Are High School Graduates*

Prepared for College and Work? prepared for Achieve, Inc., 2005.



MAJORITY OF GRADUATES WOULD HAVE TAKEN HARDER COURSES

(From American Diploma Project Network)

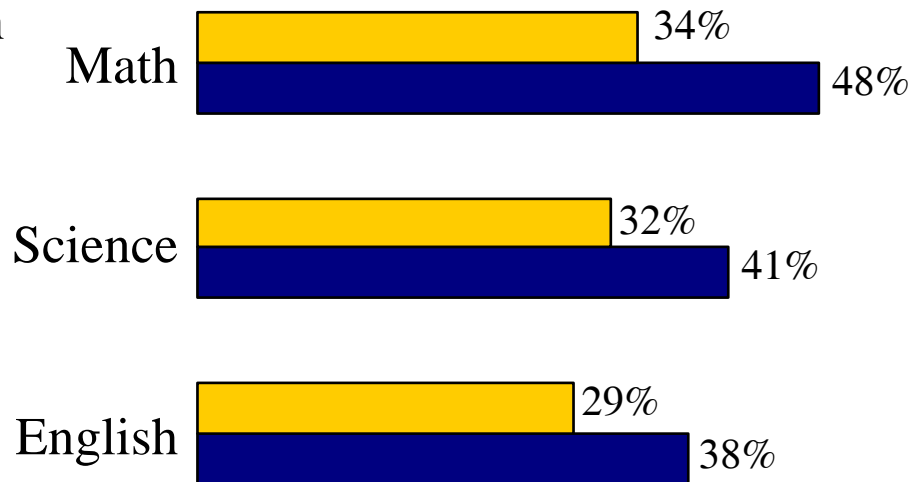
Knowing what you know today about the expectations of college/work ...

Would have taken more challenging courses in at least one area

■ College students
■ Students who did not go to college



Would have taken more challenging courses in:



Source: Peter D. Hart Research Associates/Public Opinion Strategies, *Rising to the Challenge: Are High School Graduates Prepared for College and Work?* prepared for Achieve, Inc., 2005.



CONNECTICUT'S CORE SCIENCE CURRICULUM

PreK-2:

–Development of *wonder* about the natural world and the ability to apply basic process skills

Grades 3-5:

–Development of basic *descriptions* of natural phenomena and the ability to perform simple explorations

Grades 6-8:

–Development of basic *explanations* for natural phenomena, and the ability to apply experimental procedures to acquire new knowledge

Grades 9-10:

–Development of *interest* in global issues and the ability to collect, *analyze* and use data to explore and explain related science concepts

Grade 11-12:

–Development of *deep understanding* of science concepts and principles; preparation for future studies/careers



NATIONAL PICTURE GENERAL PERCEPTIONS

National Science Foundation (US) survey, 2001

- 25% thought that scientists were apt to be odd and peculiar people
- 29% thought that scientists have few other interests but their work
- 53% of those surveyed agreed with the statement "scientific work is dangerous"
- Physics is..... old-fashioned, outdated, irrelevant to modern society



THE PARALLEL TRAINING UNIVERSE

- New players in higher education offering “just-in-time” education and training in more advanced technologies.
- I.T. companies/I.T. training providers – operate outside certified higher education credentials and accreditation.
- In Yr 2000, global I.T. companies ‘certified’ 1.6 million students worldwide with 2.4 million certificates in Information Technologies.
- Cisco alone offers certificated training in 19 languages.
- Corporate Universities – > 2000 in Yr 2001 in the US.



GLOBAL PICTURE

HIGH SCHOOL GRADUATION RATE: UNITED STATES TRAILS MOST COUNTRIES

	OECD Reporting Country	Graduation Rate (%)			
1	Denmark	100	9	Hungary	82
2	Norway	97	9	Italy	82
3	Germany	93	12	Czech Republic	81
4	Japan	92	13	Belgium	79
5	Poland	90	13	Iceland	79
5	Switzerland	90	15	Ireland	77
7	Finland	85	16	United States	73
7	Greece	85	17	Sweden	72
9	France	82	18	Luxembourg	68
			18	Spain	68
			20	Slovak Republic	61

Source: Organisation for Economic Co-operation and Development, *Education at a Glance 2004*, 2004.



GLOBAL PICTURE

The European Knowledge Area

Main goal of EU: Becoming "the most competitive dynamic knowledge-based economy in the world" by 2010 (Lisbon 2000)

The Bologna declaration, made by the higher-education ministers from 40 European nations, commits their governments to reforming their university systems to create a European Higher Education Area by 2010.

European Higher Education Area

Goals:

- A common frame of qualifications
- Empowering Europeans to use new learning opportunities in Europe

European Research Area

Goals:

- networking of national research programs / excellent research centers
- targeted major projects



The Developing Process of a New European Higher Education Area

Bologna Summit, June 1999

- adopt a system of easily readable and comparable degrees
- adopt a system with two main cycles (undergraduate /graduate)
- establish a system of credits (such as ECTS)
- promote mobility by overcoming obstacles
- promote European cooperation in quality assurance
- promote European dimensions in higher education

Prague Summit, May 2001

- lifelong learning
- involvement of students
- enhancing the attractiveness and competitiveness of the European Higher Education Area to other parts of the world (including the aspect of transnational education)

Berlin Summit September 2003

Intermediate priorities for the next two years:

- promote effective quality assurance systems
- step up effective use of the system based on the two cycles
- improve the recognition system of degrees and periods of studies

And additionally:

- include the doctoral level as the third cycle in the Bologna Process

(From Global Perspectives in Undergraduate Programs, by Diaz, Buerke, Burke)



INDIA

- With over 250 universities, 10,750 colleges, 8m students – India has one of the world's largest higher education systems
- HEI enrollments suffer through slow progress in primary & secondary schooling
- Affiliating universities – centrally controlled curricula. Can affiliated colleges respond to changing demand for 'certified' training?
- Some mismatch – lack of qualified manpower to advance traditional occupations, where 80% of workforce is
- Advancing SME sector – critical to growth of Indian economy



THE IMPACT?

America now ranks sixth in the world in the percentage of its wealth it spends on R&D.

It is largely a reflection of rising educational standards around the world, so it's a comparative decline.

In real terms, no single country can even come close to matching the US in the total scientific investment by government, corporations and foundations.

So what is there to worry about? Well, there are some facts Americans find hard to swallow after decades of striding the frontiers of science. Fewer of the Nobel prizes go to American scientists, down to about half from a peak in the 90s. Papers from Americans occupied 61% of published research in 1983, now the total is just under 29%.

http://news.bbc.co.uk/2/hi/uk_news/magazine/4172504.stm



It may not get better soon since a higher proportion of young Americans is opting for better paid law and medicine over science and engineering and visa restrictions on bright foreign students further dilute the talent pool.

"The rest of the world is catching up."

John E. Jankowski, a senior analyst at the National Science Foundation.



A NEW STUDY

A new study asks why, despite decades of reform, massive infusions of funds, aggressive efforts by policymakers, and the strong commitment of educators, there is no significant improvement in academic proficiency of high school graduates, closure of the achievement gap, and increase in high school graduation rates.

*From the study, *Paying For Education*, Texas Public Policy Foundation co-published with the Milton and Rose D. Friedman Foundation. <http://www.texaspolicy.com/>, May 5, 2004*



INFERENCE

- ❑ Our approaches seem to be at best incremental.
- ❑ What we need is nothing short of reinvention and innovation.
- ❑ Need for a major rethink at pedagogic and curricular levels.
- ❑ Need imaginative synergy with other knowledge streams.
- ❑ Rekindle interest in experiments and sensory observations.
- ❑ People learn science best by doing aspects of science with modern tools.
- ❑ Restore the inspirational role of teacher-motivator & mentor.
- ❑ Integration with concepts of sustainable development.
- ❑ Learning science as an enlivening experience.



PVAMU'S RESPONSE TO THE EDUCATIONAL NEEDS OF THE NEW MILLENNIUM - THE PIE PROJECT

PIE PROJECT PARTNERS

**A. Anil Kumar, PVAMU
Thomas Linton, TAMU-
Galveston
Vivian Garza, Tyler ISD
Denise McAfee, Houston ISD
Karen Nickel, Galveston ISD
Brenda Paloski, Pasadena ISD
Cindy Wilems, Pasadena ISD**

POTENTIAL PARTNERS

**Jackie Nowlin, Aldine ISD
Gerardo Novelo, Hempstead
ISD
Robert Faber, Waller ISD
Dana Richardson, Royal ISD
Willie Pickens, Aldine ISD
Debra Harper, North Harris
College-Carver Center
Cy-Fair College**



OUR APPROACH

- Provide training for in-service teachers in science and mathematics in interactive learning environments based on hands-on projects - projects relevant to real world integrating science, mathematics, technology and business (Science Education Center in the Physics Department- <http://www.i2i.pvamu.edu/physics>).
- School and university faculty collaborate on **every** element of student preparation - curriculum alignments, lesson plan preparations, feedback and assessment mechanisms, test preparations, learning assessment, career counseling, among others.
- Design a spiral curriculum that provides a sequential build-up of course material with vertical and horizontal integrations.



OUR APPROACH

- Emphasize the “real world needs” (college or workforce) at each stage in school and correlate them with the curriculum content.
- Establish an interaction between pre-service teachers, in-service teachers and the university faculty.
- Involve parents, school administrators and community leaders in student development.
- Establish year-round mentoring, periodic interaction with industry personnel, and communities of learning and communities of practice.

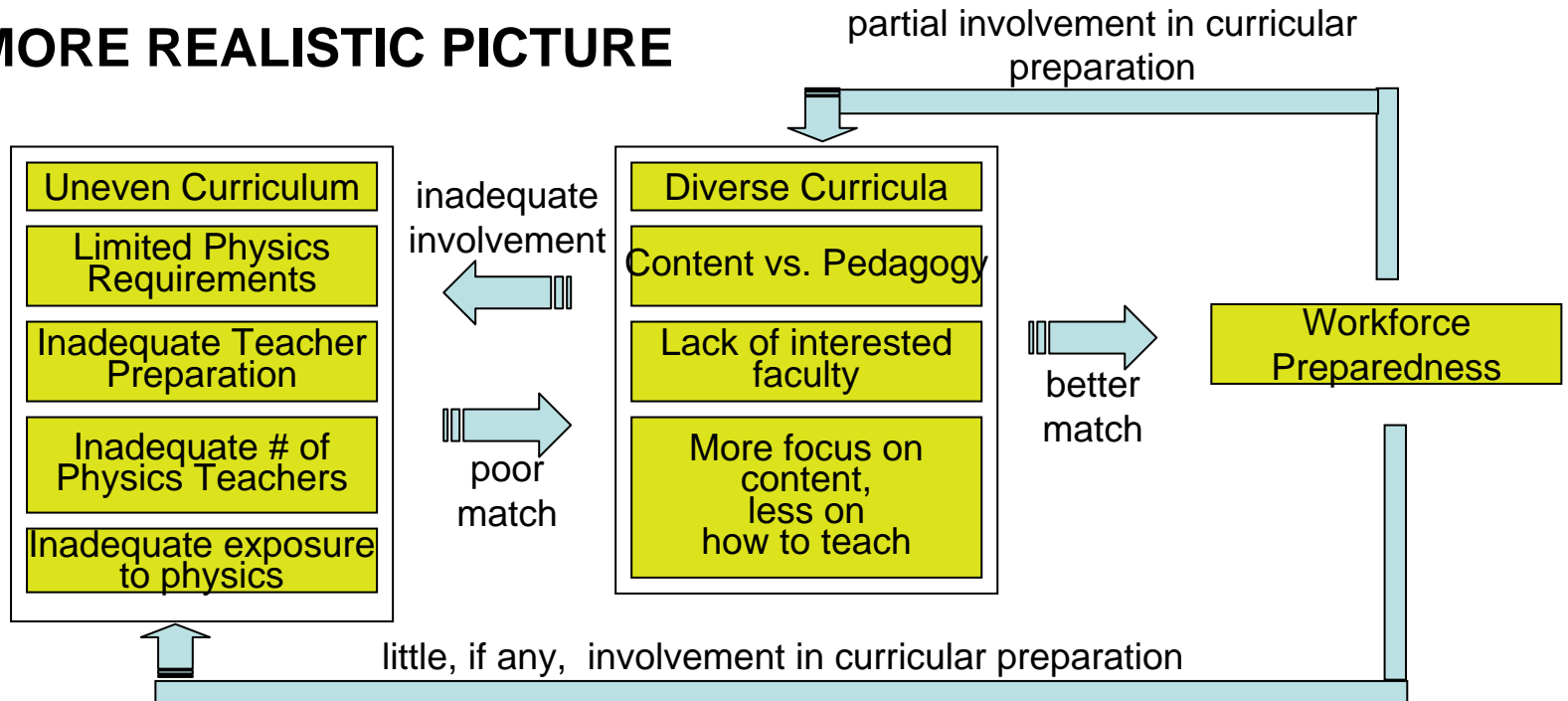


CURRICULAR ALIGNMENTS!

Alignment is A Good Starting Point But More is Needed!



A MORE REALISTIC PICTURE



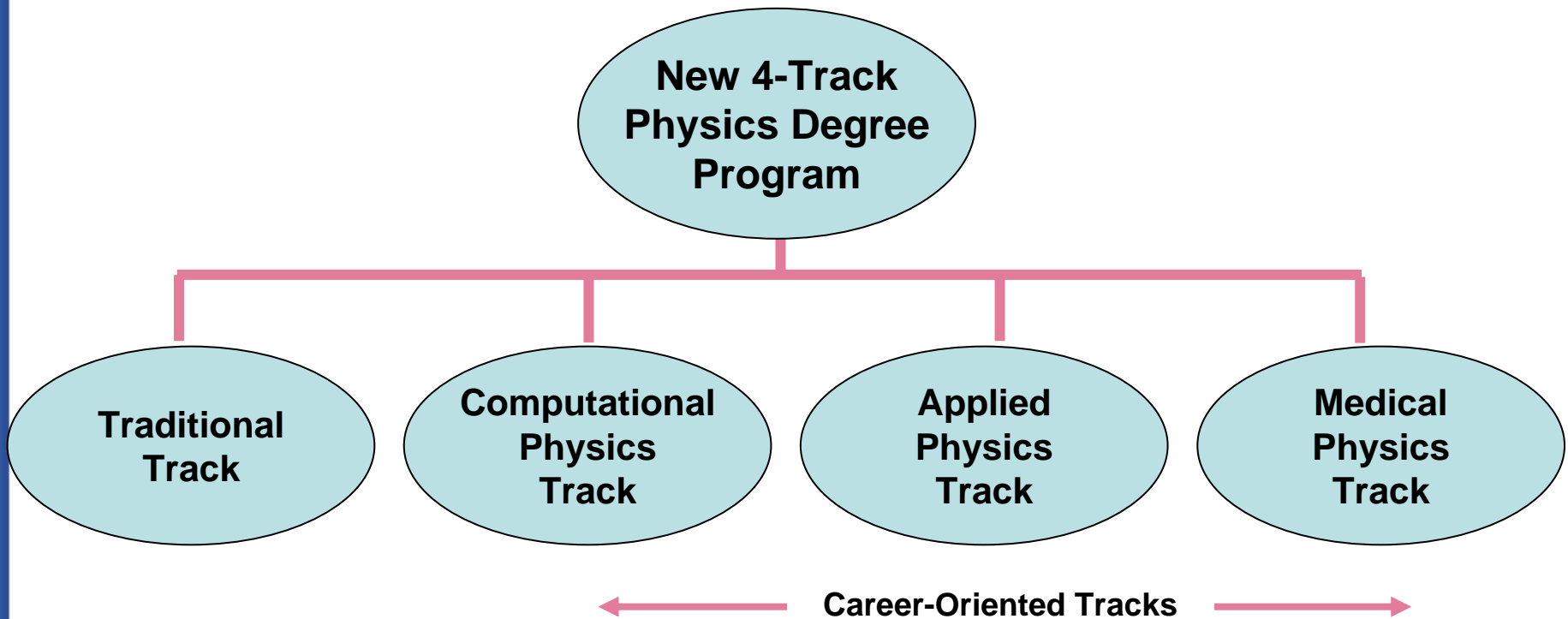
EXPECTED RESULTS

- Teachers with enhanced competence and confidence to design and implement the curriculum, and assess student performance and learning.
- A well-designed, spiral curriculum in science and mathematics that is on par with that in competing nations.
- A more comprehensive understanding of science and mathematics, and their relation to a diversity of careers.
- Seamless transition from high school senior to freshman at any college/ university.
- High school graduates ready to compete in the global arena.
- Uniformity of curriculum across Texas schools should reduce (even eliminate) any necessity for remediation.
- A "critical mass" of people and capabilities that has the potential for sustainability of the proposed programs.
- It has explicit inter-institution mechanisms that would allow for physical exchanges/loans of personnel and employ technology.
- Incorporate diversity into all aspects - projects, teams and interactions.
- An ongoing, integrated programmatic structure as opposed to discrete, short term programs.



NEW 4-TRACK PHYSICS DEGREE PROGRAM

The new four-track degree program is an innovative approach with potential to attract more students to physics.



CHANGES IN THE PHYSICAL SCIENCE CURRICULUM

- ❑ Introduced three new courses in Physical Science - Physical Science II, Physics of Atmospheric Science, and an Online Weather Course - to provide a more extensive and in-depth content for science teachers teaching Integrated Physics and Chemistry (IPC) courses.
- ❑ Introduced a capstone course - PHYS 4473: Senior Research Project - that should provide potential science teachers with teamwork and classroom management skills.
- ❑ A new Physics Education Track is being discussed with the College of Education for possible implementation towards producing physics teachers.
- ❑ Substantially upgraded the laboratories for Physical Science sequence.



TECHNOLOGY INTEGRATION INTO PHYSICS

- ❑ Physical Science course sequence - PHSC 1123 and PHSC 2123 - is using Hewitt's Conceptual Physical Science which also has a fully integrated web-based course management.
- ❑ Engineering Physics course sequence - PHYS 2513 and PHYS 2523 - is using Serway and Jewett which also has a fully integrated web-based course management.
- ❑ Three laboratories are equipped with Smart Boards.
- ❑ Physics Learning Center is fully networked to Internet II. The computing environment coupled with the audio-video equipment should provide a enhanced high technology-aided learning environment.
- ❑ New Science Building is ready for wireless operation.
- ❑ "Electronic communities of Practice And Learning (E-PALs)" among Academy Members, partnering high school students and other schools is being planned.



SCIENCE EDUCATION CENTER (SEC)

An innovative learning environment

- ❑ An innovative learning environment for high school teachers and students.
- ❑ The main thrust is to make science interesting and fun for the learner as well as encourage scientific and critical thinking practices.
- ❑ SEC will provide multi-media equipment, hands-on gadgets of learning to stimulate interest in the physics and physical sciences via a number of digital experiments, novel demonstrations and computer simulations.
- ❑ One example of a "digital experiment" is the Virtual Environmental Science Lab, in which the student plays environmental scientist and explores some of the problems facing the environment in a specific eco-system.



CONTINUING INNOVATIONS

- A "Scenario Laboratory" - simulations of potential careers and tutorials on "roadmaps" to professional careers www.mycareer.pvamu.edu
- Courses in history of science and technology with "what if" scenarios - recreate the subject in student's mind
- Art/drama interpretations of history of science/ technology
- Multi-disciplinary projects at schools
- Interactive e-mentoring
- Summer internships in industry
- Writing projects



AVAILABLE RESOURCES FOR TEACHERS

- Lesson Plans
- Online Projects
- Student Tutorials
- Teacher Sites
- Reference Materials
- Links to Current News and Events Information and Websites
- Professional Development Opportunities
- www.mycareer.pvamu.edu



NEXT STEPS

- ❑ Design and develop a new Physics/Science Education Track for implementation towards producing physics teachers.
- ❑ Design an integrated science and mathematics curriculum that is taught at all levels in school, comparable to global standards.
- ❑ Design and recommend new assessment techniques that are based on cognitive learning based on global comparisons.
- ❑ Organize a regional/national workshop/conference - *Systemic Approaches to Science Teacher Development* - for comparing science teacher preparation efforts.
- ❑ Enhance the partnerships to collaborative research initiatives on new dimensions and practices of teaching.
- ❑ Prepare and publish papers on specific efforts by the Science Curriculum Partners.



HOW IS THE PIE PROJECT DIFFERENT?

- The program is a year-round outreach program that has the highest probability of success, since it addresses all aspects of the student's educational needs, instead of being a short-term program.
- It is a progressive, multi-year, throughput model that will provide the maximum opportunities for interaction for the students in a realistic development and workforce environment.
- It is multi-disciplinary, thus providing the maximum exposure to most relevant disciplines for the students from elementary to high school levels. This aspect will also address individual developmental needs of students.
- It is a "pro-active" response as opposed to a "reactive" response to the college preparation issue, since the university faculty and corporate partners as the "latter receivers" of these students are integral factors in the early development of the student.
- Being a local collaborative interactive model, it will allow for family and community involvement, for continuous assessment and quality improvement, and hence can be easily replicated across the country or the world.
- Though local, the alliance will have a global impact.
- It encompasses the missions and objectives of the real corporate world, hence ensuring its ultimate relevance.



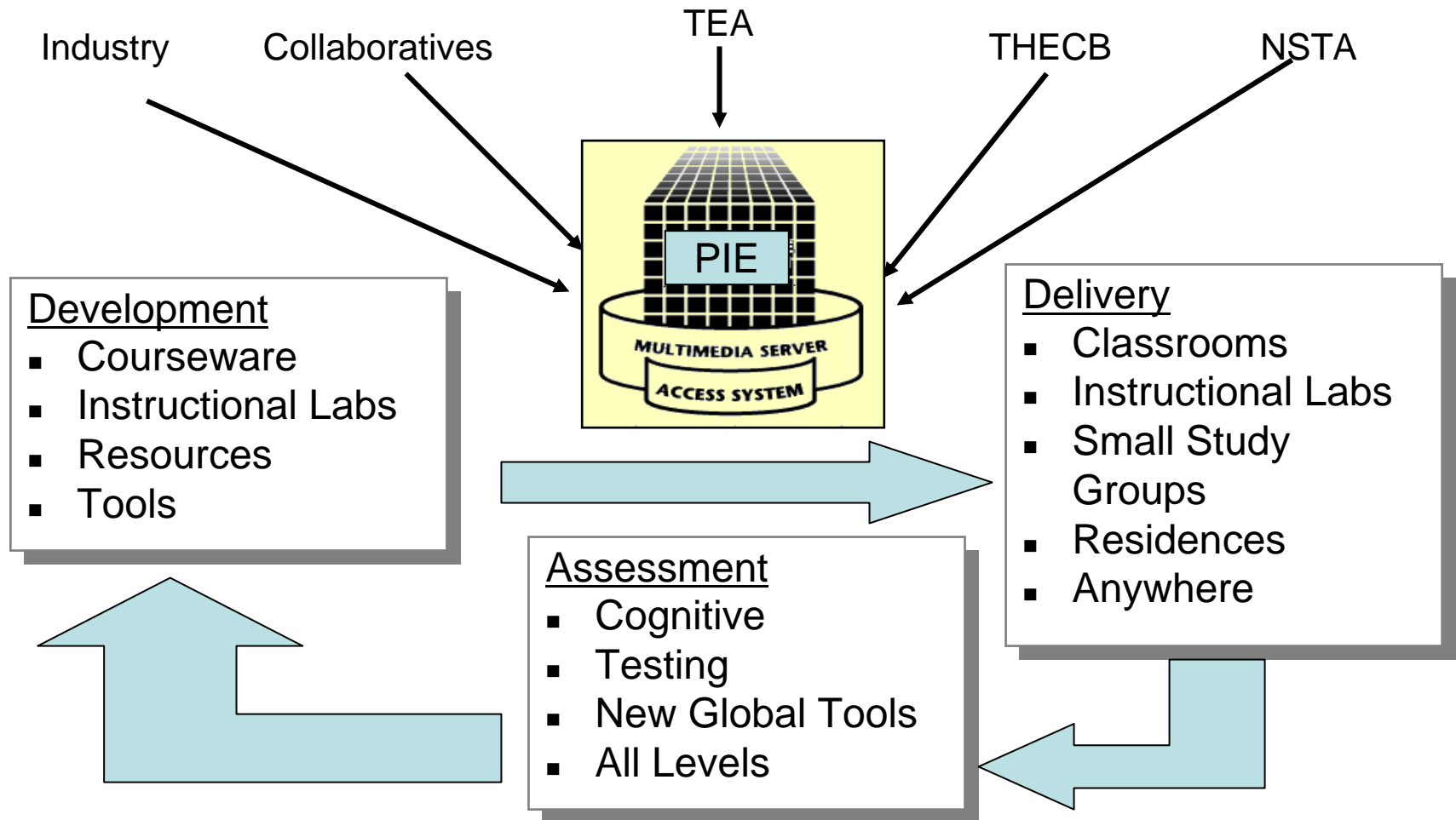
SCIENCE EDUCATION CENTER - A VIGNETTE

These pictures have been removed to reduce the size of the presentation. For various training sessions and images (photos and videos) please visit

<http://www.i2i.pvamu/physics>



PIE PROJECT CONTINUAL QUALITY IMPROVEMENT



OVERALL

Good News

- Certain infrastructure is in place.
- Many efforts are ongoing and several of them are successful in limited domains.
- Texas is still ahead of many states in standards, assessment, etc.

Bad News

- Standards are only addressing minimal expectations.
- Efforts are too fragmented to make a statewide let alone a national or global impact.
- Such impact is not possible unless a common goal is addressed and efforts are networked.
- True impact is only possible when each school has a critical mass of teachers properly trained and properly empowered.

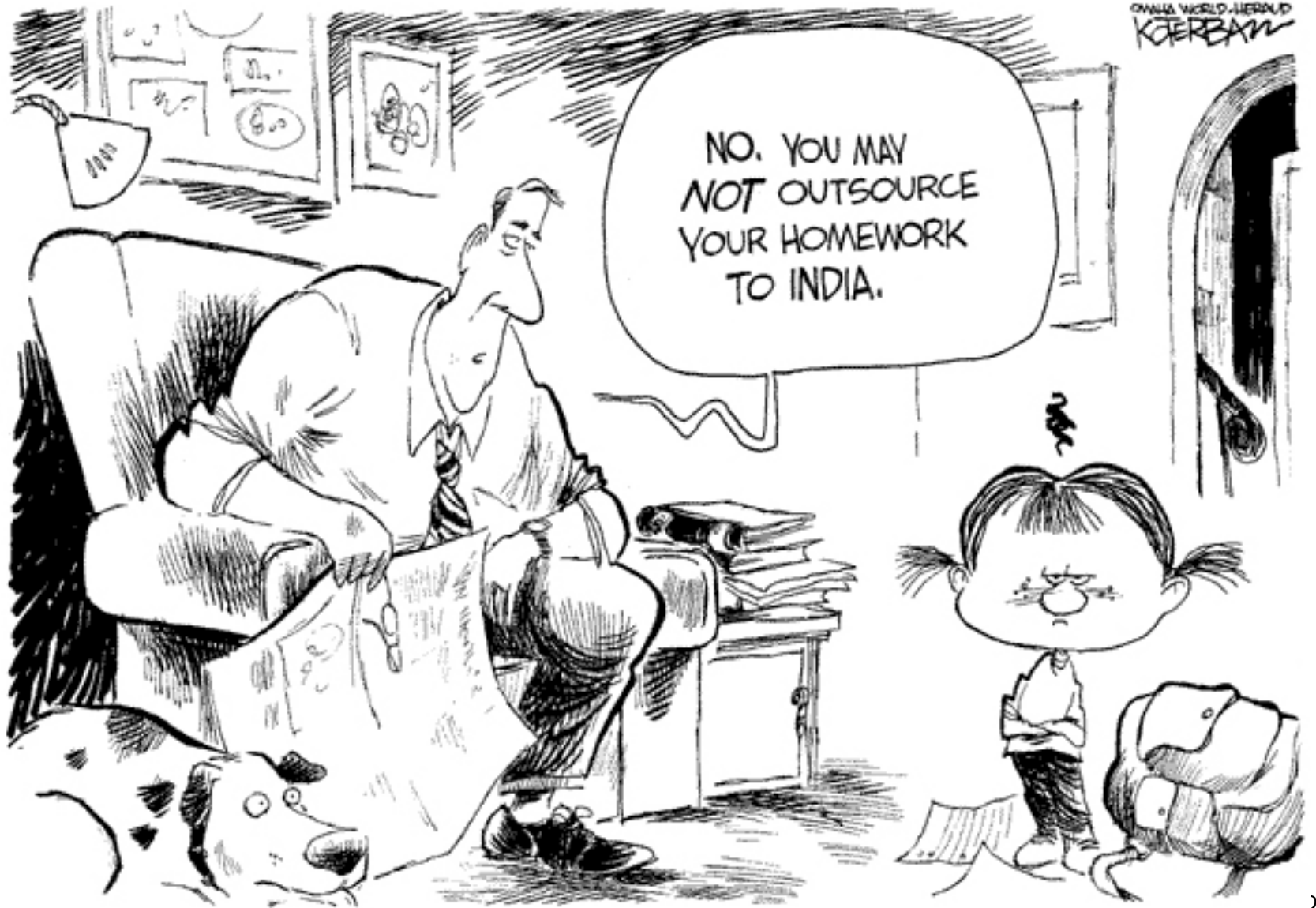


WHAT I AM LOOKING FOR

- Funding to continue existing activities and to expand the activities to more schools.
- Opportunity to collaborate with existing efforts so as to influence and learn from them.
- Support letters and endorsements for our proposals to funding agencies.
- Participation on relevant statewide and national level committees to contribute to systemic issues, in particular develop curricula, tools and practices that are comparable globally, and to develop new assessment tools.
- Participation in policy changes to empower teachers.



PIE PROJECT - "Bottom Up Preparation Meeting Top Down Needs"



PARTING THOUGHTS

Most teachers have little control over school policy or curriculum or choice of texts or special placement of students, but most have a great deal of autonomy inside the classroom. To a degree shared by only a few other occupations, such as police work, public education rests precariously on the skill and virtue of the people at the bottom of the institutional pyramid.

- Tracy Kidder

Teaching is the only major occupation of man for which we have not yet developed tools that make an average person capable of competence and performance. In teaching we rely on the "naturals," the ones who somehow know how to teach.

- Peter Drucker

When a subject becomes totally obsolete we make it a required course.

- Peter Drucker



"I skate to where the puck is going to be,
not where it has been."

- *Wayne Gretzky*



ACKNOWLEDGMENTS

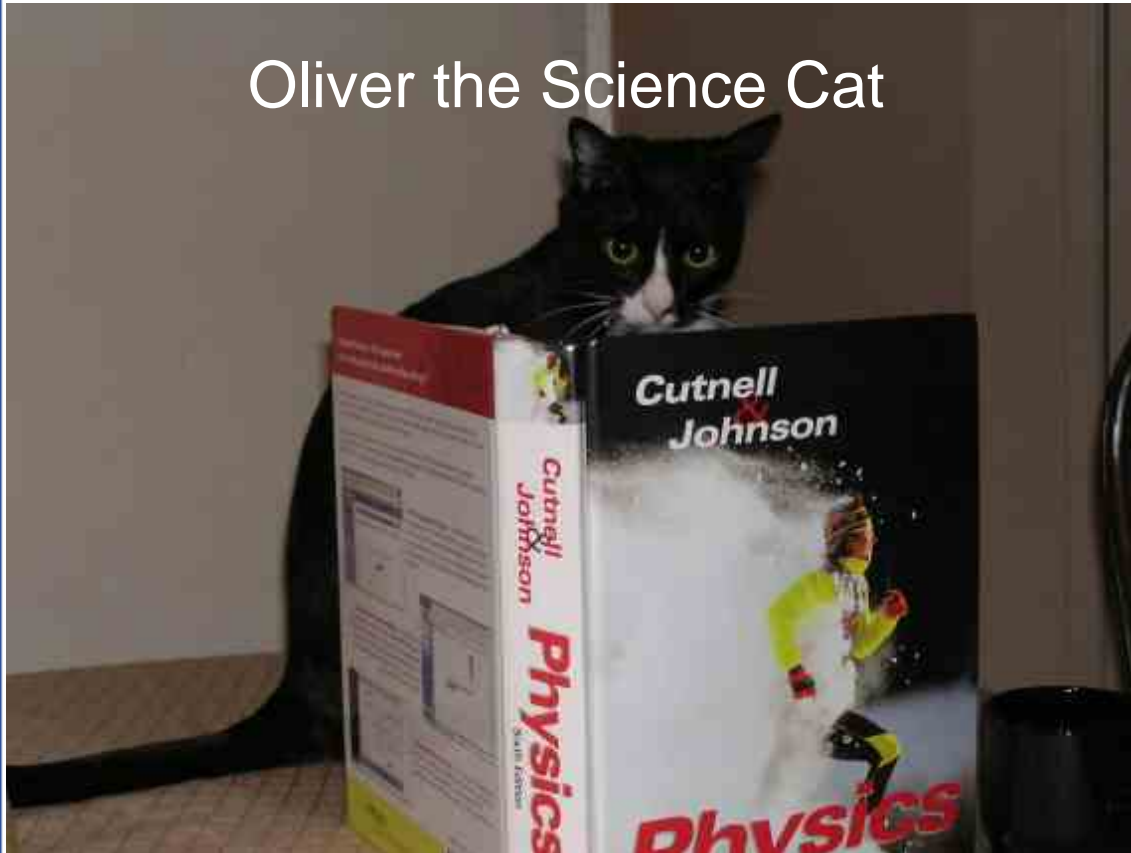
Thanks to Chris Comer and Irene Pickhardt for this opportunity.

Thanks to PIE PROJECT Partners for their passion, commitment and zeal to address perhaps the most important issue of our time.

Thanks to Sean Harris, Mohammed Mahboob and Jessica Williams for excellent research work on global comparison of science and mathematics education.



Oliver the Science Cat



THANK YOU.
ANY QUESTIONS?

www.i2i.pvamu.edu/physics

aakumar@pvamu.edu

