CHAPTER 10

Future Possibilities for Education and Learning by the Year 2030

Introduction

2030 is 23 years from now (The study was conducted in 2007).

Looking back over the past 23 years can give a sense of the rapidity and magnitude of the changes we experience today and that are likely to accelerate in the future. Twenty-three years ago it was 1984. In 1984 how many would have believed that the Republic of Korea by 2007 would successfully compete with the United States in some areas of the transportation, information, and communications industries? Or that its economy would be larger than Russia's? Or that many of the world's brightest youth would be playing computer games created in Korea? The rate of change over the past 23 years seems very fast to many people today, yet the factors that made those changes are accelerating. As a result the changes over the next 23 years will be even greater.

In 1984 there was no European Union, World Trade Organization, International Criminal Court, Space Shuttles serving Russian and American astronauts in the International Space Station, millions of people searching billions of references in less than a second, or cloned sheep. 23 years ago what Ministry of Education had the objective of connecting their school children to the Internet? What Ministry of Education had the objective of preparing students to participate in the global knowledge economy?

Imagine two countries back in 1984. Both were about the same in all things except that one declared a national objective of cooperating with international computer networks[1] to connect their educational systems into an international knowledge system in order to improve education for all in their country. Now, 23 years later – today – which country would be in a better position for the emerging global knowledge economy? And which country would have produced more students ready for today's complexities and opportunities?

Today educational policymakers face the same kind of choices: to look far ahead seeking emerging educational opportunities or just make moderate innovations that appear creative. Fortunately, the Ministry of Education and Human Resources Development of the Republic of Korea has requested this international assessment of future possibilities for education and learning by the year 2030 to help inform them of their choices for setting better long-range educational policies.

What might surprise us today about 2030?

If we don't know that something is possible, then we will not try to make it happen. What are some of the educational and learning possibilities by the year 2030? What might we do today to take advantage of these emerging possibilities? Since the implementation of new ideas

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[1] In 1984 there were several such efforts: EARN (European Academic Research Network), BITNET (A network of universities in the USA), ARPANet (US Department of Defense with relays through Stanford University, UCLA, and MIT), CARNET by PfP International, CompuServe, Econet, TCN, and FIDO net. There were also satellite computer connections for educational applications by ATS-1 and ATS-3 of NASA.

can turn out differently than expected, it is also wise to ask what could make them turn negatively as well as positively.

To answer these questions, the Millennium Project reviewed futurist thought to design a Real Time Delphi which collected the judgments of 213 experts around the world, selected by the Nodes of the Millennium Project.[2]

This study assessed 19 possibilities:

1. National programs for improving collective intelligence

2. Just-in-time knowledge and learning

3. Individualized education

4. Use of simulations

5. Continuous evaluation of individual learning processes designed to prevent people from growing unstable and/or becoming mentally ill.

6. Improved individual nutrition

7. Genetically increased intelligence

8. Use of global on-line simulations as a primary social science research tool

9. Use of public communications to reinforce pursuit of knowledge

10. Portable artificial intelligence devices

11. Complete mapping of human synapses to discover how learning occurs and thereby develop strategies for improvement of learning

12. Means for keeping adult brains healthier for longer periods

13. Chemistry for brain enhancement

14. Web 17.0

15. Integrated life-long learning systems

16. Programs aimed at eliminating prejudice and hate

17. E-Teaching

18. Smarter than human computers

19. Artificial microbes enhancing intelligence

These possibilities present a broad array of policy choices and options which can inform the policy-making process. Each possibility was rated by an international panel in terms of its likelihood. These average ratings by the international panel gave 14 of the possibilities better than 50% chance that they will occur. Figure 1 presents the possibilities in rank order by average likelihood.

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[2] See Section III Analysis and Appendix for a full report on the process of the Real Time Delphi for Education and Leaning Possibilities by the Year 2030, and the list of participants.

Figure 1: Likelihood of Education Possibilities—year 2030
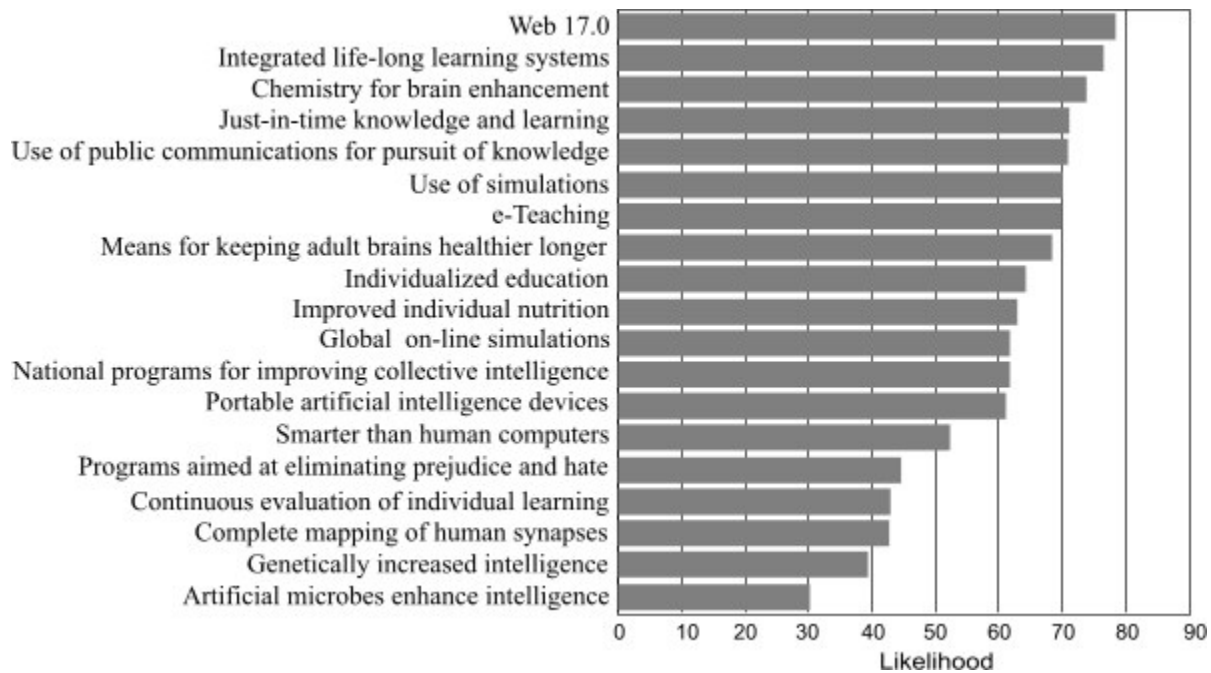
If educational policymakers believe these results, then what steps should policymakers consider today?

To answer this, the respondents were encouraged to provide judgments about factors that could help or hinder the possibilities, and assuming they occurred, to conjecture about consequences that might follow.

As Moore's Law continues to be valid over the new 23 years, portable intelligent devices could have the processing power of the human brain. Individuals would access the world's knowledge that has been integrated by Web 17.0 for "just-in-time knowledge and learning", using simulations with virtual reality interfaces adapted to individuals' unique needs throughout their lives. Continuous evaluation of individual learning processes designed to prevent people from growing unstable and/or becoming mentally ill, along with programs aimed at eliminating prejudice and hate could bring about a more beautiful, loving world.

In parallel, brain function should also be dramatically increased by improved personal nutrition and brain enhancement pharmaceuticals. Insights from partial mapping of the human brain and other methods could dramatically increase personal intelligence and longevity by 2030. More remotely in the future, brains may be genetically enhanced and designer bacteria could make the brain cells work more efficiently. With the use of public communications to reinforce the pursuit of knowledge and the use of these learning innovations and educational concepts, individual and collective intelligence of societies could be improved.

Advances throughout history have created gaps between early adapters who can afford the initially higher costs and those who are less able to afford the advances. Many participants in this study warned that serious efforts will have to be made to prevent dangerous

knowledge/intelligence gaps leading to unstable conditions. Policymakers should develop ways to encourage broad democratic usage of these new powers without letting their abuse by the few to disadvantage the many. Over the last several years, the digital gap has begun to narrow, giving hope that greater decentralization, access, transparency, and proliferation of feedback mechanisms can address these concerns. Although many comments from the international panel could be grouped into advances for individual learning or group learning, the overall picture of the future is so extraordinarily rich and complex that both approaches can be accommodated.

The following paragraphs list the possibilities in the order that they were presented in the questionnaire (together with the references provided to the participants in the questionnaire), the average of the panel's estimates of likelihood by 2030, and a distillation of the pattern of both positive and negative features of these possibilities. The full text of the responses is presented in the Appendix.

1. <u>Distilled Insights per Possibility</u>

1. National programs for improving collective intelligence

2. Just-in-time knowledge and learning

3. Individualized education

4. Use of simulations

5. Continuous evaluation of individual learning processes designed to prevent people from growing unstable and/or becoming mentally ill.

6. Improved individual nutrition

7. Genetically increased intelligence

8. Use of global on-line simulations as a primary social science research tool

9. Use of public communications to reinforce pursuit of knowledge

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12. Means for keeping adult brains healthier for longer periods

13. Chemistry for brain enhancement

14. Web 17.0

15. Integrated life-long learning systems

16. Programs aimed at eliminating prejudice and hate

17. E-Teaching

18. Smarter than human computers

19. Artificial microbes enhancing intelligence

1. National programs for improving collective intelligence[3]

Some richer as well as lower income countries have (by this year of 2030) made improving collective intelligence a national goal; this includes improving individual capabilities as well as intelligence for their nations as a whole. The average of 189 respondents' estimates of likelihood of this by 2030 was 62%.

1.1 What might make this happen?

The widespread realization that collective intelligence (CI) provides a political and economic advantage in an increasingly knowledge- and creativity-oriented globalized economy will lead to the adoption of this national objective. In addition it should also improve the general functioning of society and social well-being and reduce the fear of falling behind. Some respondents saw this as inevitable due to the continuing advances of ICT, the continuation of Moore's Law, and Internet's increasingly easy use by the general public. CI will become a new buzzword with major academic institutions using it as a strategic research focus and demonstrating that it is the next logical step in social-technological evolution. Downloadable open source prototypes for collective intelligence by MIT or similar institutions, and promoting successful experiences such as Wikipedia and Google will also help.

Countries with leadership that respects and encourages free thought and the rights of the individual might announce this goal first, especially Asian countries that want increased respect and economic power, but it might also take complex and urgent national and international problems and disasters to get CI accepted as a national goal. Increasing and intense international competition among countries might also tend to develop the concept of competitive human capital within national education programs. Another way to foster CI is the pursuit of nationally important projects like landing on the moon, especially if the process is equitable in mobilizing many people to ensure collective solidarity. Finally, the increasing volume and complexity of knowledge will continue to drive the world toward collective intelligence approaches.

1.2 What are some positive consequences?

More people will work together to solve problems. It should make large-scale intelligence-improving programs possible, which will improve national economies and reduce the rich-poor gap. It should stimulate more meaningful participation of civil society in national intelligence and reduce repetition, overlap, and confusion with information pollution and overload. Virtual learning and decision making communities could gradually supplant nation-states in effective decision making, increasing social stability. Human life would be more civilized and earth's resources might be more treasured, with better protection of the environment.

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[3] References given for this possibility in the RT Delphi were: 1) Collective intelligence examples: http://www.socialtext.net/mit-cci-hci/index.cgi?examples_of_collective_intelligence ; and 2) Are dramatic increases in collective human-machine intelligence plausible within 25 years? Yes – 70%, The Millennium Project Delphi, 2003 linhttp://www.acunu.org/Delphi/SciTechScenariosRnd2.html#humachk

A smarter society will reduce some of the costs of low-cognition individuals (in terms of crime, wasted education effort, failed social projects), increase the number of people able to handle more complex work, and might have the benefit of attracting more creative people. It might vigorously promote the reformation of the educational system and the development of education. Research is continuing to show that learning is fundamentally a social process. Open-source, knowledge creation communities, and mass collaborations have resulted in very widely used information, social sharing and learning resources such as Wikipedia, YouTube, MySpace, FaceBook, and SecondLife. Learning will be primarily accomplished on the Web, as continua of new structured knowledge are developed on the Web by Wikipedia-like collectives which will enable anyone to do a self assessment of prior knowledge, and then be placed into the particular knowledge continuum just where they need to be in order to progress in a guided learning experience at their own pace of learning.

1.3 What prevents this from happening?

Ideologies that make any intervention into cognition are politically controversial. These include issues involving group cognitive differences, gender differences, the heritability of cognitive abilities, the use of biomedicine for enhancement and the relationship between individual and state. The lack of a single decision point for a curriculum tends to increase the number of people involved in the decision who could defeat the idea, such as politicians fighting globalization, religious groups with conservative views, and others who do not want a change in the status quo.

Some other perceptions that might prevent this possibility are: escalating costs with benefits too far in the future to be seen as 'real'; romantic anti-science backlash focusing on feelings; the inability to make major changes in beliefs about how learning and value creation really happens; the lack of interest in long-term projects; and "Conspiracy theories" about methods of increasing intelligence. War, famine, pandemics, economic depression, social convulsion, disease, poverty, ignorance, religious prejudices, and other disruptions could hamper efforts to improve collective intelligence, potentially resulting in a vicious cycle, and self-destruction.

1.4 What are some negative consequences?

Those countries that do not pursue increasing intelligence as a national goal are likely to have less economic growth, leading to "intelligence divides," increasing gaps between the rich and poor, and massive inferiority complexes and depression about "falling behind." If techniques were manipulated, it could lead to vicious competition, ignoring basic education, controlling choices, invading privacy, and regimenting thoughts. Psychological effects of diminishing individuality and authorship could cause a student revolt against being part of a "collective." If improved cognition reduced acceptance of traditional values it might be politically disruptive, while other forms of cognition enhancement might be supplied with subtle or not-so-subtle attempts at manipulation towards ideological ends.

2. Just-in-time knowledge and learning[4]

Rote learning has diminished in importance by 2030. With ubiquitous computing and education for life-long learning, 'just-in-time knowledge' has become the norm. The average of 181 respondents' estimates of the likelihood of this by 2030 was 71%.

2.1 What might make this happen?

Possibilities are failure of rote learning to achieve educational objectives; desire for personalized learning; continued advances in artificial intelligence; and the realization that this it the only way to keep up with rapidly changing knowledge in all fields. Life is too complex to know what one needs to know and when one needs to know it, so this will occur by necessity. Infrastructures will be built for teachers and students to use 24 hours a day and 7 days a week worldwide.

The confluence of advances in nanotechnology, neuroscience, artificial intelligence, and avatar-based synthetic online worlds will make education more experiential and engaging by 2030. Rote learning will continue because it "trains" the brain, but "Just-in-time knowledge" works, because it gets us what we want. The need to be constantly updated on new knowledge and developments will require transferring the teaching from specific subjects to those needed for specific purposes with fast, practical learning procedures and new methods of teaching. We will need to learn more about how to learn and how to use information and spend less time on learning specific information or subjects.

2.2 What are some positive consequences?

Anyone anywhere will have access to the education they want where this is implemented. People will become more self-confident, more empowered, businesses will be more efficient, countries will improve their economic development, and societies will be more practical, efficient, and harmonious. Education and training costs will lower. It will be easier to change jobs, taking greater advantage of human resources. Rote learning will continue to diminish leaving room for reflective thinking, which is indeed the cornerstone of significant learning.

Just-in-time knowledge and learning might greatly improve human competence and intelligence; enhance democracy by creating a more educated public; increase the number of more responsible global citizens; accelerate the creation of advanced knowledge and learning networks; reduce the 'power' of academic arrogance; and initiate another Renaissance. Much of traditional education will be replaced by Web-based, managed learning provided by open source collaboratives or vendors who compete in delivering measurable knowledge acquisition and retention, with speed and effectiveness as the basis of their payment. Teachers and students must be part of a team where the teacher is a coordinator of information collection.

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[4] References given for this possibility in the RT Delphi were: 1) Computerworld: Just-in-Time Learning, 2000 http://www.computerworld.com/news/2000/story/0,11280,44312,00.html ; 2) Just-in-time Learning; the acquisition of knowledge or skills as they are needed. http://www.wordspy.com/words/just-in-timelearning.asp

2.3 What prevents this from happening?

The technological collapse of the Internet; too much computer hacking, information manipulation and other forms of information warfare would make people uncertain of what to trust. The costs might be prohibitive. Ignorant, backward, stubborn prejudices within traditional education systems where the teacher is the only active subject and the student a passive element, along with conservative religious leaders could discourage this possibility. Worries about bias and shallowness, as well as problems in teaching robust information gathering skills, might also slow its adaptation.

In a world where everybody can look like a specialist there will be more risk of decisions being made on shaky grounds and less respect for true expertise, and there would be fewer good ways of validating actual competence. Slow and old educational validation systems may slow the adaptation of this possibility.

2.4 What are some negative consequences?

Just-in-time knowledge and learning could produce a very practical, but a very superficial world of knowledge. Innovation could suffer. This could create poor learning habits; self-centered lazy-thinking; a less engaged public in the political process, leading to more government control; the inability to see the "big picture" for the good of the planet, and a reduction in problem-solving reasoning, much like many people's current inability to concentrate or focus on a topic in-depth without intermission or a commercial break. Some rote learning will be necessary to reduce these negative consequences.

While this development could certainly lead to advancements in science and technology, other fields like history and civics might suffer. It would increase the rich-poor gaps, since it might be impossible for lower income countries to implement. Those with the advanced technologies for "Just-in-time Learning" will evolve differently from those in the least-advanced societies caught in the divide and left behind.

3. Individualized education[5]

Through tests of various sorts, including simulations, the needs of individual students are being assessed and curricula and instructional methods are tailored to individual students. It is recognized by 2030 that all students have special needs and those needs are being largely met in many places in the world. The average of 179 respondents' estimates of the likelihood of this by 2030 was 64%.

3.1 What might make this happen?

The convergence of advances in the Internet, cognitive sciences, medicine, artificial intelligence,

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5 References given for this possibility in the RT Delphi were: 1) Special Education Resources on the Internet, 2001 http://www.wordspy.com/words/just-in-timelearning.asp

continuation of Moore's Law, just-in-time learning, plus the success of the $100 laptop will make this more available. Young people who want to function more intelligently and teachers with advanced technology skills are already driving this process

If facilitated by mentors, it could be the core of the new educational paradigm. The proper use of IT and "coaching on-line" to address individual learning not only in elementary, secondary, and tertiary education, but also of adults for "life long learning" should be included. This can also be made more likely by the assumption that everyone is potentially a genius, and that each genius is different from the others; and by teachers who awaken the curiosity and creativity in each student; improved low cost individualized educational software; proliferation of reusable learning modules at all levels of society; and standards and single-sourcing for learning modules at all levels, so that there is no confusion or overlap in what has been learned.

3.2 What are some positive consequences?

This should lead to more satisfied students, greater respect for individual uniqueness and innovative achievements, changes in ideas about equal schooling rights, better use of genetic information to customize learning, and more special "geniuses" nurtured to their potential. The academic arrogance about who should be taught could also be reduced.

Increasing numbers of people will be leaders in different aspects of life. Leaders will need leaders among them to be coaches and referees so that teams work effectively and help competition to be fair, and to help different teams to be able to live together.

3.3 What prevents this from happening?

New ideological or religious movements that sweep the world into mono-thematic curricula; lower student-teacher ratios that could raise costs too high for poorer educational systems to afford; teacher shortages; standardized examinations; teacher unions that abhor the prospect of rewarding their superior colleagues; difficulties in reliable diagnoses and evaluation of results; and the desire to preserve standard courses based on a lower than average student capability, giving priority to teaching material rather than learning, can prevent this from happening. Until teachers have tools to read students' minds there will never be fully "individualized" education. Since learning is a social activity, there will continue to be needs for common goals for learning.

3.4 What are some negative consequences?

Widespread use of very individualized learning could reduce social cohesion; individualized learning could lead to more individualized vs. team or group acting within society. Such individuals could create new ways of learning that might divide society over how best to conduct education. The results of individualized education depend upon the intellect, objectivity, empathy and intent of the people involved and the artificial intelligence systems used. This could be a great way to "brainwash" people into adopting a particular ideology or way of acting.

4. Use of simulations[6]

In 2030, virtual reality simulations with programmed learning are available and used internationally, accounting for nearly a third of the tele-educational experience in elementary and secondary schools. These simulations allow people to progress at their own pace, alone or in groups. They are designed on the basis of insights derived from cognitive science. They diagnose and adapt to the individual's and/or group's learning style and need for hints and other forms of prompts. This is a means of providing artificial experience and social experimentation in a safe environment. The average of 168 respondents' estimates of the likelihood of this by 2030 was 70%.

4.1 What might make this happen?

The interplay of the VR game industry and educational systems; leadership willing to commit the funds over enough time to demonstrate the benefits; the continued advance of Moore's Law, nano processes, increased bandwidth, popularization of high-tech VR; the spread of video games and easy-to-use software creation tools (will X Bot become a teaching tool?); growing acceptance and participation in simulated societies like Second Life; using wiki-like approaches to creating simulations for specific learning environments; applying new insights from cognitive science; and the needs of the knowledge economy, could make this possible. Simulations of all kinds are a widespread and vital part of military training today.

As scientific collaboratories force standardization of data and simulation formats, educational simulations can be a lowered-cost byproduct. Costs could also be lowered by global cooperation and subsidized wiki-like development of simulations with common modules used worldwide. Future generations of 'Second Life'-type simulations could also lower educational subsidies as these applications become commercialized. Open source standards should be considered for educational simulation software to become more accessible. Computer-smart students will be best reached through the uses of social networks such as Facebook and MySpace which will morph into avatar-based VR worlds. VR design and implementation costs are going to improve, and once the interface becomes more natural, the numbers of people using many new applications will accelerate around the world.

4.2 What are some positive consequences?

This immersive experiential learning will have a continually growing impact, making larger numbers of truly educated people, opening eyes to new experiences, stimulating creativity, improving tacit knowledge of the behavior of complex systems, providing space for individual personality development, and furthering the evolution of humanity. It will challenge people to believe that if a problem can be solved in virtual reality, then in can be solved in the "real world".

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[6] References given for this possibility in the RT Delphi were: 1) Jong-Heon Kim, et al., Virtual Reality Simulations in Physics Education http://imej.wfu.edu/articles/2001/2/02/index.asp , 2) Virtual Reality: History; Expo/Theater/Virtual Environments, 1995 http://archive.ncsa.uiuc.edu/Cyberia/VETopLevels/VR.History.html, 3) Wikipedia, Virtual Reality, 2006 http://en.wikipedia.org/wiki/Virtual_reality.

Simulations can satisfy both individual needs and collective learning experiences. Continuous real-time science, governance, and learning simulations will connect real-time public intelligence and information to government budgets, making simulations a basis for dialog and decision. Simulations will become a more normal mode of interaction,lowering costs of high performance hardware. This will evolve into new forms of individualized educational platforms.

See Holopticism http://www.thetransitioner.org/wiki/tiki-index.php?page=Holopticism

4.3 What prevents this from happening?

Concerns about video game violence, limited home access and/or understanding by parents, lack of leadership, high costs, difficulties of implementation, and disagreements about what values and content to include could inhibit its acceptance. Serious VR educational applications are more difficult to create than that experience today in Second Life.

4.4 What are some negative consequences?

This could lead to cyber "addiction," loss of touch with reality and face-to-face human contact, and disconnections between learning in simulations and actual activities in reality. Cults of brilliant but socially backward individuals with little sense of team spirit and sharing could grow. It could also limit thinking about possibilities in the "real world" to those options offered in the "virtual reality" systems. It might encourage selfish and unrealistic perceptions as people achieve status in cyberspace that they cannot achieve in reality. It could limit the face-to-fact communications needed especially by younger people; even though simulations will be come very vivid. To make educational simulations universally acceptable, they could become shallow, conveying little sensibility and moral character, and be poorly used by teachers who do not add the complexity and interactivity of real experiments that can be lacking in "edutainment."

The gap between those nations, regions, and cultures that use simulations and those who don't will widen through time. There could be a backlash to this trend. Some groups will assert the value of 'real' interaction and deny the benefits of virtual simulations. Whether this backlash becomes violent will partly depend on the proportion of population with access to this technology. Cyber crimes and purposeful design of immersive VR technologies to negatively influence human behaviors are also possible. See Edward Castronova's excellent book "Synthetic Worlds."

5. Continuous evaluation of individual learning processes designed to prevent people from growing unstable and/or becoming mentally ill.[7]

The objective of these programs which have appeared in several countries is to identify persons who seem likely in later life to exhibit antisocial behavior including terrorist activities and

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[7] Reference given for this possibility in the RT Delphi was: Jean-Pierre Voyer, The Pre-conditions for a Constructive Social Inclusion Research Agenda, 2003 http://www.ccsd.ca/events/inclusion/papers/voyer.pdf.

violent criminality. Special nurturing programs are provided to people identified in this way to help keep them from becoming unstable or mentally ill in later life.

The average of 170 respondents' estimates of the likelihood of this by 2030 was 43%.

5.1 What might make this happen?

The increasing awareness that single individuals can become massively destructive (SIMAD) could bring this about, but great care should be taken to ensure that these activities are in the public interest and that they do not drift into totalitarian applications. Perfecting the theory and methods of psychological evaluation and the use of Maslow's hierarchy of needs should be used to guide the development of such programs. The evaluation systems used would have to be validated by many individuals and the samples would have to be significant. The programs will have to be self-evidently beneficial, and very creative and engaging to encourage widespread adoption.

If developed in a humane environment, this activity could identify young people at risk. Alice Walker's work showed that those who led troubled lives but still did well had one thing in common: they all had found someone who loved them. A program like this could identify and match these youth with appropriate mentors.

5.2 What are some positive consequences?

It could help make for more harmonious and stable societies; reduce social problems like suicide, drug abuse, and terrorism; provide deeper knowledge of human nature; and increase investments into preventive mental health and medicines. It could also be a relatively inexpensive way to deal with certain mental health issues - especially as people live longer.

5.3 What prevents this from happening?

Perceptions that it could be a one-time classification system used by governments to control or eliminate deviant behavior or that it could be implemented by more dictatorial paranoid societies to reduce creativity and innovation would prevent this from happening. All geniuses are always a little crazy! Although proposed with good intentions, it is full of too many negatives such as "profiling" to find universal acceptance. Antisocial behavior including terrorist activities and violent criminality is not just a problem of individual nurture, it has also has social causations. No one knows how to do this, especially to make it work in very large populations. The increasing evidence that most mental illness has a genetic or physiological cause indicates that these programs might have limited effectiveness compared to genomic analysis.

5.4 What are some negative consequences?

This program might result in group speak, less privacy, reduced freedom of speech and thought, and strengthening of intelligence-gathering/police organizations in those nation-states with the worst histories of human rights violations. This could lead to neo-socialist realism, preventing more new forms of art.

Some of the world's brightest thinkers would have been classified in a negative fashion by such programs - what would have happened to them and their breakthroughs? In the future, if we begin to "cure" or isolate individuals with deviant personalities, are we going to destroy something that could have been of benefit to the world? Who decides what is "deviant"?

6. Improved individual nutrition[8]

Self-administered diagnostic tests identify individualized nutrition requirements for improved cognitive development. These tests are used in the more affluent areas and are beginning to be used in lower income areas with government and insurance company support. The average of 162 respondents' estimates of the likelihood of this by 2030 was 63%.

6.1 What might make this happen?

Alliances among health insurance companies, education programs, and businesses could promote self-administered tests and help educate the consumer about new nutritional foods. Insurance companies could lower premiums to those who use the tests and new foods. Scientific breakthroughs in nutrition, DNA testing, improved understanding of the "nature and nurture" factors in health, individualized medicine, and "nutrigenomics" would also increase the chances of this possibility. NGOs and UN agencies would be necessary to help in poor countries.

6.2 What are some positive consequences?

It could greatly improve a nation's health and cognitive development; reduce the cost of health care, and increase longevity and physical strength and performance.

6.3 What prevents this from happening?

Poverty, cultures with bad nutrition habits, lack of political will, costs of converting food production to more individualized and nutritious foods, and fear that the diagnostics could be faulty. Yet the overall beneficial effects of full and diverse nutrition may overshadow the high cost-benefit of individual effects. It may not be financially possible for poorer areas. The sensual pleasure of inherited eating habits could override such prescriptions. If DNA tests were required, then some people will oppose it.

6.4 What are some negative consequences?

This could further the separation between the rich smart people who can afford special diets and the poor less smart people who can't.

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8 References given for this possibility in the RT Delphi were: 1) Foods that Build and Foods that Drain the Brain, 2000 http://www.askdrsears.com/html/4/T040400.asp#T040405; 2) Foods and Vitamins that Help Brain Development and Repair Damage http://www.yourfamilyclinic.com/nutrition/brainboost.html; 3) UN FAO, Fish is food for the brain as well as good protein, http://www.fao.org/FOCUS/E/fisheries/nutr.htm

7. Genetically increased intelligence[9]

Genes that contribute to increasing intelligence and learning have been identified and used by many parents in the upper and middle classes of the world to change the potential intelligence of their future children. Treatments have been subsidized for many people in the poorer regions. The average of 159 respondents' estimates of the likelihood of this by 2030 was 39%.

7.1 What might make this happen?

Future synergies among neurosciences and genetics, parents who want a better life for their children, and initial successes of cognitive enhancements through pharmaceuticals, could make this happen. The main form of near future genetic intelligence enhancement would be Preimplantation Genetic Diagnosis (PGD), selecting away genes involved in pathologically lower intelligence. This would lead to a reduced number of the lowest performing, in turn increasing the average. But PGD would have to become more common, which requires improvements in technology, automation of the process to bring down the price, creation of standards that make different treatments comparable, and, most importantly, attitudinal shifts that make genetic selection more acceptable.

Genetic enhancement of intelligence should be combined into a single procedure that would also reduce affect genes associated with criminal behavior. Just as we "correct" our eyesight with glasses, we should also correct our low intelligence. Once a safe procedure is available for increasing intelligence, parents will take their child to the country that first offers it. Genetically increased intelligence should be accompanied with or preceded by the development of social ethics, acceptance of differences, and respect for others.

7.2 What are some positive consequences?

Cure mentally retarded children. As with most advances richer people would have this for their children, but eventually the price will come down to make future generations more intelligent.

7.3 What prevents this from happening?

Insufficient progress in genetics, high costs, fear of genetic mutations caused by incorrect use of genetic technology, and the belief that life is an unalterable gift from God will discourage this possibility.

7.4 What are some negative consequences?

Naive selection criteria may lead to favoring a few detectable "intelligence genes" although they do not represent the full range of human capacity (on the other hand, even assuming broad

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9 References given for this possibility in the RT Delphi were: 1) Wesley Smith, Biohazards Advances in biological science raise troubling questions about what it means to be human, 2005 http://www.discovery.org/scripts/viewDB/index.php?command=view&id=3005; and 2) Everett Mendelsohn, The Eugenic Temptation, Harvard Magazine, 2006 http://www.harvardmagazine.com/on-line/0300126.html

approval and use of the technology, this limitation is unlikely to affect a very large number of people by 2030).

It could increase the rich-poor gap, possibly leading to a divided society of intelligent managers and less intelligent consumers, or used by future dictatorships wishing to manipulate people or develop a "super race," or providing it just for "world leaders." Children might no longer have 'time' to be children.

8. Use of global on-line simulations as a primary social science research tool[10]

Virtual realities like Second Life (which in 2006 had more than a million and a half inhabitants) are used by leading cognitive scientists, curriculum experts, and behavioral scientists to evolve the equivalent of natural laws for social behavior and new tele-virtual educational simulations. In these e-universes, people act as societies, form laws, build new cultures and provide a means to experiment with the glue of society without the concerns that might accompany human experimentation. The average of 161 respondents' estimates of the likelihood of this by 2030 was 62%.

8.1 What might make this happen?

Initial use may be for business market research and political forecasting, and then when the cost comes down it could be used in teaching social science. This will evolve naturally from phenomena such as Second Life.

8.2 What are some positive consequences?

It could reduce research costs; provide superb 'strawmen' for comparative analysis; and stimulate the imagination to promote development of creative cultures. Anyone anywhere will have access advanced social science research education.

8.3 What prevents this from happening?

It is almost impossible to reproduce real social situations in cyberspace. People may not provide enough accurate information for the simulations, hence reducing their value. Acceptable controls using such tools may be a bit of challenge. Abuse of people in cyberspace is possible, the same way experimenters have abused humans in research in the past. If results show that political directions are headed in the "wrong" directions, then future applications could be suppressed.

8.4 What are some negative consequences?

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10 References given for this possibility in the RT Delphi were: 1) Second Life Home Page, 2006 http://secondlife.com/; 2) Popular Science, Your Second Life is Ready, 2006 http://www.popsci.com/popsci/technology/7ba1af8f3812d010vgnvcm1000004eecbccdrcrd.html; and 3) Roger Segelken, Artificial worlds used to unlock secrets of real human interaction, 2003 lihttp://www.news.cornell.edu/releases/Feb03/AAAS.Macy.hrs.html nk

Virtual realities could result in a kind of split personality— one focused in the cyber world and the other in the conventional world — that could work against the evolution of human society. "Second Life" could have conflicts with real life in culture, ethics, morality and other aspects.

9. Use of public communications to reinforce pursuit of knowledge[11]

In 2030, social marketing of learning concepts or memes is widespread. Some of the themes have been: Intelligence is Sexy; Knowledge is Cool; Knowledge Matters; and Ignorance Equals Poverty. Public media leaders often meet with educational leaders, cognitive scientists, and entertainers to discuss promoting the message that learning is a central pursuit of life. The average of 161 respondents' estimates of the likelihood of this by 2030 was 71%.

9.1 What might make this happen?

With the coming knowledge-based economies, the importance of knowledge and intelligence would be highlighted, and the media and entertainment industries could be enlisted to play a role in the pursuit of knowledge, such as Project Red for AIDS with celebrity Bono. Informal meetings like this already happen in the USA with the Ad Council, so it seems likely that in 25 years public communications will be even more widespread.

9.2 What are some positive consequences?

It should promote the development of people's imagination, creativity, and innovation; produce a better educated population, and improve the knowledge economy; enhance democratic governments and promote the general well being of societies; and be an essential part of reducing poverty, increasing social justice, and accelerating progress.

9.3 What prevents this from happening?

Too many diverging viewpoints within the media, public conformism, and lack of a professional ethic within the public media could prevent this. Societies would have to become more pro-education first. With the success of individualized learning there might not be as much need for public media, and it could be seen as a new form of social engineering by less enlightened governments and therefore would be opposed by free societies.

9.4 What are some negative consequences?

The messages might become dull and overused, negatively reinforcing education.

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[11] References given for this possibility in the RT Delphi were: 1) The Social Marketing Institute, http://www.social-marketing.org/sm.html ; 2) Wikipedia: Social Marketing, 2006 http://en.wikipedia.org/wiki/Social_marketing ; 3) Center for Disease Control, Social Marketing, 2003 http://www.cdc.gov/communication/practice/socialmarketing.htm

10. Portable artificial intelligence devices[12]

Most people carry tiny computers that contain extensive personal memories, and interact with their owners in human fashion. Meet a person on the street and the ear buds whisper on the basis of facial pattern recognition," That's Billy Johnson whom you met at a party three years ago. He is a pilot and his wife's name is Angie"' More seriously, the machine also participates in personal decision making and on the spot need for information. Some individuals have been technologically augmented with nanobots, brain chips and nanotech transceivers in clothing. The average of 158 respondents' estimates of the likelihood of this by 2030 was 61%.

10.1 What might make this happen?

Maturity of recognition technology (voice, face and retina, etc.), nanobots, brain chips, and other forms of nanotech transceivers used by early adopters among very rich individuals will make this happen.

10.2 What are some positive consequences?

These devices will improve memory, analysis, and decision-making, and make human competence advance rapidly. Naturally, the richer nations will get this first, but just like the hand calculator, as the price comes down, their use will spread worldwide.

People's lives and experiences will be recorded allowing them to better manage their lives, learn from their experiences, and re-live their happier experiences as they grow older. Personal AI should also reduce crime significantly. Imagine a very advanced Google in your pocket to which you ask it to identify someone walking down the street, or point out others in the area with similar interests. The AI devices may also tell with whom to interact and help you to interact with them.

10.3 What prevents this from happening?

Complexity of facial pattern recognition, and privacy issues involved in face recognition and other information requirements for decision making could restrict this. Certain uses of the devices might be restricted because of defense and military intelligence considerations.

10.4 What are some negative consequences?

Potential loss of privacy, continually arising ethical issues, widening of the rich and poor gap, potential uses by criminals, a race to build portable 'anti-artificial intelligence devices' to protect privacy, and reduced intellectual and emotional capabilities of people who have become dependent on these devices are some potential negative consequences.

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[12] References given for this possibility in the RT Delphi were: 1) Stanford Research Center, Artificial Intelligence Center, 2006 http://www.ai.sri.com/; 2) MIT, Computer Science and Artificial Intelligence Laboratory, 2006 http://www.csail.mit.edu/index.php ; 3) Journal of Artificial Intelligence Research, 2006 http://www.jair.org/

11. Complete mapping of human synapses to discover how learning occurs and thereby develop strategies for improvement of learning[13]

Just as the gene was decoded so was the connection pattern of the synapses in the human brain. From this complex map came information about cognitive development, intelligence, emotion, how to design artificially intelligent machines, and ultimately how to improve the speed and depth of learning. The average of 152 respondents' estimates of the likelihood of this by 2030 was 43%.

11.1 What might make this happen?

The realization that increased intelligence is the key competitive advantage in the knowledge economy will stimulate massive brain research by several countries that fund the research over sufficient time to make breakthroughs. The Allen Brain Atlas project is an example of what is quickly happening in neuroscience [an interactive, genome-wide image database of gene expression in the mouse brain]. Complete understanding of mental functioning requires improvements in dynamic scanning methods (like extending the scope and resolution of such techniques beyond what we now have in functional MRI) database management, image processing, computational neuroscience, and automated research that may not be enough to finish the job by 2030; nevertheless, even partial results are likely to produce important neuroscience insights about learning. Advances in complexity theory, acceptance that it will take incremental advances to achieve this, and the need to make great advances would also help to bring this about.

11.2 What are some positive consequences?

A more complete understanding of neuroscience could result in extraordinary progress in robotics and empower most fields of cognition, from AI to learning enhancement drugs. It would be a great advance in life sciences, provide a qualitative leap in learning theory and human and machine intelligence, and establish a significant benchmark in human history.

11.3 What prevents this from happening?

This is a very complex task, which could be blocked by the belief that it is far too complex and expensive to complete in 25 years. Other inhibiting factors include the belief that intelligence and emotions go far beyond patterns of synapses or that insights from this research might not be very helpful in understanding how learning occurs on a personal level for an individual. The dominant educational establishment and ethical issues over human testing could also prevent this.

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[13] References given for this possibility in the RT Delphi were: 1) Mapping miniature synaptic currents to single synapses using calcium imaging reveals heterogeneity in postsynaptic output, 2006 http://www.ionchannels.org/showabstract.php?pmid=7619520 ; 2) Society for Neuroscience, Scientists Map Maturation Of The Human Brain; Make Advances In Understanding The Lasting Effects Of Stress, Nicotine And Alcohol, 2006 http://www.sfn.org/index.cfm?pagename=news_11082003a ; and 3) Allen Institute for Brain Research, 2005 http://www.alleninstitute.org/content/about_the_institute.htm

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11.4 What are some negative consequences?

If this were to occur, it could result in the abuse of power and prestige by the scientists and doctors at its forefront and a series of problems with human and animal testing. It might also trivialize human emotion and being—is love only a set of chemical reactions?

12. Means for keeping adult brains healthier for longer periods[14]

In our time (2030) we have techniques for keeping adult brains healthier during the aging process. For example, adult neural stem cells have been cloned and injected into adult brains to keep them far healthier for longer times then formerly believed possible, making old age learning and an older knowledge-based work force possible. The average of 158 respondents' estimates of the likelihood of this by 2030 was 69%.

12.1 What might make this happen?

Rising standards of living, aging populations with increasing political power, and falling fertility rates will speed medical science to make this possible. People used to think that adults could not grow new nerve cells. Research has now shown that new brain cells are created every day. Many of the new cells born each day die off, but exercise and a more stimulating environment reduce the death rate of brain cells. Some research indicates that continued adult learning may be associated with the growth of new brain cells. Research in neurogenesis (adult growth of new brain cells) should keep brains healthy longer, certainly by 2030, and this is only one line of research. Some background is available in these resources:
http://www.wellesley.edu/Biology/Concepts/Html/neurogenesiswhat.html;
http://www.medterms.com/script/main/art.asp?articlekey=18200;
http://en.wikipedia.org/wiki/Neurogenesis
Adult brains will stay healthier longer, as a result of training, biofeedback, behavior modifications, medications, and other stimulants. These processes may make people "better than well."

12.2 What are some positive consequences?

This has the potential for elimination of brain diseases, including reducing mental illness, Alzheimer's and Parkinson's diseases, and hence avoiding large numbers of elderly with dementia, while adding the elderly to the work force, reducing the economic effects of falling fertility rates.

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[14] References given for this possibility in the RT Delphi were: 1) Monika Guttman, The Aging Brain; Scientists are amassing a greater understanding of the long-term risk factors that adversely affect the brain, with the goal of halting cognitive deterioration, 2001. http://www.usc.edu/hsc/info/pr/hmm/01spring/brain.html ; 2) The Brain Aging Journal, 2006 http://www.brainaging.ro/Pub-BAJ.htm ; 3) Medical News Today, With Few Factors, Adult Cells Take on Characteristics of Embryonic Stem Cells, December 9, 2006 http://www.medicalnewstoday.com/medicalnews.php?newsid=49405

12.3 What prevents this from happening?

People believing it is not possible and hence not investing in the necessary research, ethical issues, ageist assumptions that decline is inevitable, and the fear of tampering with "order of nature" and the brain – the most complex structure in the known universe – could delay some developments in cognitive sciences. The potential costs could limit the widespread use of the relevant techniques to extend brain functioning. Techniques like functional magnetic resonance imaging (fMRI) may take longer to produce results than expected.

12.4 What are some negative consequences?

This development could leave a group of non-treatable elderly behind, while vital elderly might feel locked out of a youth-directed society, possibly becoming discontented or forming isolated subcultures or enduring other imbalances in the quality of life.

13. Chemistry for brain enhancement[15]

Brain chemistry research has led to safe drugs that enhance intelligence, improve memory, increase attention span, and improve visual acuity and hand/eye coordination. The average of 154 respondents' estimates of the likelihood of this by 2030 was 74%.

13.1 What might make this happen?

Changes in the perception of enhancement are needed for enabling this, and development of an "enhancement culture" among people will be needed to set the social norms of when they are proper or not proper to use. Positive evaluation of the ethical consequences, current research by DARPA, spreading to civilian uses, and increased awareness of sources such as: http://books.google.com/books?hl=en&lr=&id=9ykQOkpFFuEC&oi=fnd&pg=RA1-PR9&sig=qKHKN5wzw88tl2IzgZN0eYM8vtk&dq=%22Pardridge%22+%22Brain+Drug+Targeting:+The+Future+of+Brain+Drug+Development%22+#PPP1,M1 and http://www.smart-kit.com/s59/brain-enhancement-with-flax-seed-oil-and-vitamin-c// will increase the likelihood of this possibility. Ritilin, Valium, and Prozac are examples of new psychoactive drugs that do not "enhance" human intelligence, but allow one to function normally, despite mental problems. Adrenalin has been used to erase traumatic memories.

13.2 What are some positive consequences?

This could result in enhanced human intelligence and physical functioning, plus those positive consequences from the previous possibility.

13.3 What prevents this from happening?

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[15] References given for this possibility in the RT Delphi were: 1) Wikipedia: Psychoactive Drug, 2006 http://en.wikipedia.org/wiki/Psychoactive_drug ; 2) World Health Organization: Psychotropic Drugs, 2006 http://www.who.int/topics/psychotropic_drugs/en/ ; 3) Psychotropic Drugs and Children; Use, Trends, and Implications for Schools, 2004 http://www.healthinschools.org/sh/psychotropic.pdf

Medical regulations on testing and marketing, ethics of usage, suspicion of drugs, high value placed on "the natural," medical monopolies, and the fear of the unknown effects of "wonder drugs" would discourage the possibility.

13.4 What are some negative consequences?

Thinking that "miracle drugs" will solve all human problems will yield dangerous consequences such as luring people into a competitive drug race, overdosing, and ignoring the complexity of the human psyche.

14. Web 17.0[16]

By 2030 the trend toward data integration on the Web that started around the turn of the century (Google Earth, Wikipedia, the MIT course material) has progressed to the point that a large part of the world's knowledge - data, analyses, discussions - has been integrated into Semantic Web 17.0. That structure is organized according to a logical framework of concepts (both precise and fuzzy ones), has a natural language interface, is dynamically maintained, and contains an intelligent subsystem that 'understands' the logical rules that govern the interactions of entities. The interface makes heavy use of virtual reality type graphic techniques for presenting knowledge and processes. The average of 151 respondents' estimates of the likelihood of this by 2030 was 78%.

14.1 What might make this happen?

The progression from teaching children to teaching adults, and then to self-directed learning, together with progress in semantic analysis, and the realization that knowledge must be worked on cooperatively will make Web 17.0 the place where people will go to learn when and how they choose to do so.

14.2 What are some positive consequences?

It should make the networks intelligent, make query and analysis more exact, break down barriers to knowledge cooperation, stimulate co-creation for massive co-development, and reduce complexity, confusion, chaos, and error. It could change the economic paradigm of payment for access to intellectual property to the paradigm of income from the 'act of knowledge working' with some shared property. Douglas Englebart's Open Hypertextdocument System (OHS) and Pierre Levy's Information Economy Meta Language (IEML) could combine with XML Geo, and other open innovations to make it possible for any individual to immerse themselves in the diversity of information, inclusive of historical information, multi-cultural and

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16 References given for this possibility in the RT Delphi were: 1) The Futurist: The Intelligent Internet http://www.gcn.com/online/vol1_no1/26338-1.html; 2) Bill Gates, Now for an Intelligent Internet, 2000 http://www.microsoft.com/presspass/ofnote/11-00intelligenti.mspx; 3) Artificial Intelligence Foundation, 2006 http://alice.pandorabots.com/

alternative perspectives, real-time serious games/games for change, and practical rigorous dialog and consensus building. Human collective consciousness will greatly advance as networked intelligence is always on and instantly accessible and ways of knowing are no longer a struggle.

14.3 What prevents this from happening?

The current illegal and unethical uses of the net are likely to increase if more ethical means are not implemented. Some bottlenecks would be the ability for improved semantic analysis, "individualistic vs. group solutions," and industries that fight open source software initiatives.

14.4 What are some negative consequences?

New kinds of viruses and methods of manipulating information delivery could be used to distort knowledge on the Semantic Web by those who don't like the new knowledge. In the past, cigarette companies distorted cancer research, today an oil company is distorting global warming research, and, in the future, some groups might want to distort research that counters their ideologies. As ideological wars were fought by industrial means in Korea and Vietnam, future ideological wars could be fought by information warfare means yet to be invented, making the Semantic Web a battle zone and hence less trusted. Major geopolitical problems, terrorism, ideological conflicts, and even open source arguments could become foci for, or versions of, information warfare.

15. Integrated life-long learning systems[17]

Today (2030) education ranges across all age groups from pre-natal programs to programs for the elderly that provide knowledge, work, and leisure enjoyment. The average of 158 respondents' estimates of the likelihood of this by 2030 was 77%.

15.1 What might make this happen?

Life Long Learning is already a trend reinforced by longevity as well as the further development of knowledge and learning society; Elderhostel is a contemporary example. To some degree the Internet is providing life-long learning now, although few see it that way yet. More people are devoted to education (teaching and learning) and for more years than ever before in history. Improved classification of competences required by different occupations for all ages groups; better understanding of HOW we learn from elementary school on up; and increased attention to the spiritual needs of people via more humanistic educational approaches would promote the emergence of such a possibility.

15.2 What are some positive consequences?

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[17] References given for this possibility in the RT Delphi were: 1) Elderhostel; Adventures in Lifelong Learning http://www.elderhostel.org/ ; 2) Life in the USA- Retirement and Aging New Careers, 2005 http://www.lifeintheusa.com/aging/careers.htm

Reformation of education, increased curiosity, self-improvement and learning become more a part of life, helping the evolution of society. Greater attention will be paid to prenatal care as a necessary condition for better overall physical and mental performance.

15.3 What prevents this from happening?

Economic and cultural retrogression, growing generation gaps, and the widening divides between rich and poor could increase conflicts that would interrupt the evolution of education.

15.4 What are some negative consequences?

Too much dependence on computers and learning systems that might suffocate people if they are too conservative and the educational managers are too complacent. It could also create a gap between those who use the systems and those who opt out.

16. Programs aimed at eliminating prejudice and hate[18]

Our psychologists in 2030 believe that many wars and extremist activities are fueled by overt or subtle teachings of parents, peers, and teachers. Significant efforts have been made to reduce these influences in the education of young people. The average of 154 respondents' estimates of the likelihood of this by 2030 was 45%.

16.1 What might make this happen?

Universal curricula created by some internationally accepted body like UNESCO or Wikipedia 8.0 is more likely to be universally accepted and used by parties to an educational treaty. It has to be developed with the sense that it will be taught in Chicago as well as Jeddah. Curricula should include emotional as well as intellectual development, and acknowledgement of individual potential to contribute to society, as well as a respect for cultural diversity, the value of 'soft' knowledge, and more accurate history. In addition, better integration of insights from psychology would contribute to understanding the need for unlearning, re-cognition, and commitments to new beliefs and emotional change. Special attention should be given to the learning that occurs during adolescence when students form their personal philosophies and world views. Reduction of violence in media and entertainment would help the curricula be more effective.

16.2 What are some positive consequences?

Society becomes more auspicious, respectful, democratic, free, equitable, harmonious, and stable. Such programs are essential for the survival of humanity, as increasingly destructive capabilities become more available to small groups and individuals.

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[18] References given for this possibility in the RT Delphi were: 1) US Department of Justice, Preventing Youth Hate Crimes, http://www.usdoj.gov/crs/pubs/prevyouhatecrim.htm ; 2) Kathleen Cotton, Fostering Intercultural Harmony in Schools: Research Finding http://www.nwrel.org/scpd/sirs/8/topsyn7.html ; 3) Canada's Fourth Report under the International Covenant on Civil and Political Rights, 2006 http://www.canadianheritage.gc.ca/progs/pdp-hrp/docs/iccpr/notes_e.cfm

16.3 What prevents this from happening?

If it is created within an atmosphere of "I will tell you how to teach your children," it will fail. As long as there are significant gaps between rich and poor, and limited resources, prejudice and hate will continue to be inflamed by extremists. Some governments will want to intervene and control people's behavior. It may take at least a generation beyond the Westphalian "state-above-all"; thereafter, there may be 'space' to begin significant efforts to design and offer educational means with less emphasis on extremes in society.

16.4 What are some negative consequences?

If it is possible to reduce or eliminate hatred and prejudice, then it means that others can control human minds for ill as well. For example, cult leaders, totalitarian states, or new forms of ideological political correctness might use these methods or technologies to control the public. Education alone would not be enough to eliminate prejudice and hate; programs must include specific means to achieve social justice.

17. E-Teaching[19]

Most of the poorer areas, as well as the more affluent ones use global outsourcing for e-teachers on-demand. These e-teachers are increasingly artificial constructs using artificial intelligence, rather than live humans. The average of 159 respondents' estimates of the likelihood of this by 2030 was 70%.

17.1 What might make this happen?

E-teaching can be encouraged by the increasing realization that e-teaching is good for both affluent and poorer regions of the world, that it can make the best teachers available to many people regardless of location, and can be cost-effective. It can address both the diversity in knowledge levels and the unevenness of access to knowledge in education systems. Outsourcing to the best e-teachers will increase their income to the point that they can hire computer programmers, cognitive scientists, and others to make really brilliant programs to reach even more people around the world. Continued improvements and cost reductions in virtual reality, bots, and tele-education collaboration among educational institutions, governments, business, and NGOs will also help. Today, Homework Help from India charges US$18 an hour for tutoring on any subject. Knowledge can be shared and built upon at no cost. It is inevitable that the cost of communications will go to near zero and the cost of e-teaching will be within the reach of all, especially if the government subsidizes e-learning. Special interests will have to be defeated by firm and wise government policies.

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[19] References given for this possibility in the RT Delphi were: 1) John Harris, Why We Need Better E-Teaching, Not More E-Learning, 2005 http://meld.medbiq.org/divergent_views/better_eteaching_harris.htm ; 2) Wikipedia, e-learning, 2006 http://en.wikipedia.org/wiki/E-Learning ; 3) Wikipedia, Advanced Distributed Learning, 2006 http://en.wikipedia.org/wiki/Advanced_Distributed_Learning

17.2 What are some positive consequences?

E-teaching will help education to become more democratic, increase access to more people around the world, reduce financial and environmental costs per student, and thus help reduce poverty, popularize science and culture, increase the joy of learning, facilitate the exchange of information among educational institutions, and open new methods of education. It will also lead to customized one-on-one instruction, and make knowledge acquisition easier, faster, more individualized, virtual, and more globalized. With continuing development of advanced interfaces, it is likely that educational opportunities in virtual or synthetic worlds will be perfected as tools for teaching. Avatars or 3D holographic recordings will allow top teachers to send their lessons to all including the underprivileged. Appropriate levels of funding and an R&D emphasis on education (and not just "gaming") could advance this. It's possible that by 2030 accelerating technologies could lead to a point at which the elite will be educated in part through direct brain downloads or novel nanotechnology applications and the people in poorer areas will have to "settle" for 3D VR teachers and learn the "old-fashioned" way, by listening and trying to remember. The live teacher is one of the least efficient, and perhaps least effective ways of teaching; artificial constructs will become more and more the norm.

17.3 What prevents this from happening?

E-teaching could be delayed by entrenched monopolies, educational system inertia, lack of access to computers with high speed Internet, governments and other institutions that do not value education enough, and the lack of cooperation in exchanging information.

17.4 What are some negative consequences?

Although it is a useful tool for distant publics, it may not be a substitute for face-to-face education that provides the human dimension. The personality of teachers and experience of interpersonal communication is an important part of the educational process; e-teaching might not be able to take personal differences into account. Education is more than exchange of information. The poorest areas might not be able to afford e-teachers, perpetuating the knowledge gap.

18. Smarter than human computers[20]

Machines exist today (2030) which are clearly smarter than humans in any way that 'smartness' can be measured. With this threshold having been passed, the roles and methods of education and learning are being reassessed everywhere. The average of 155 respondents' estimates of the likelihood of this by 2030 was 52%.

18.1 What might make this happen?

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[20] References given for this possibility in the RT Delphi were: 1) The Singularity Institute for Artificial Intelligence http://www.singinst.org/overview/whatisthesingularity/ ; 2) Nick Bostrom, Futurist Magazine, When Machines Outsmart Humans, 2000 http://www.nickbostrom.com/2050/outsmart.html ; 3) Raymond Kurzweil, Will My PC Be Smarter Than I Am?, 2000 http://www.kurzweilai.net/meme/frame.html?main=/articles/art0354.html?

Moore's Law seems like a good indicator that artificial intelligence will overtake human intelligence by 2029, as forecasted by Ray Kurzweil. In effect, the Internet is already a 'smarter' than human computer; this depends of course on how one defines 'smartness.' If 'smarter' means memory or specific functions, then the Net has already surpassed the individual human brain. Advances in the fields of artificial life and nanotechnology will continue and it is likely that machines will pass the Turing test and extend into ways of machine 'understanding' beyond simple information processing. The fulfillment of this and other scenarios in this vision of 2030 could eliminate the need for conventional schools and human teachers. If superhuman AI emerges, these entities are also going to require some form of education, which most likely would be extremely different from human learning in terms of learning facts, social interactions, relations with the physical world, and growing up from childhood to maturity.

18.2 What are some positive consequences?

This development could dramatically increase human development and be regarded as the best tool or co-agent ever created by humanity. The integration of artificial intelligence and the human intellect in micro-devices would dramatically enhance the efficiency of learning, the nature of work, and fundamentally change the methods of education and learning. This processing power may yield very different kinds of "thinking" from that of humans and provide an interesting cross-reference to understanding reality.

18.3 What prevents this from happening?

Computers may surpass "intelligence" as we define it today, but they will never be able to compete with the other learning areas of individuals such as emotional and social where the interests of individuals reside. There could be a backlash from people who feel threatened by robots and computers that might grow beyond our ability to control, or who believe that such computers would be used by powerful evil forces. Frustration at not being able to achieve this goal could lose support for further development, as some believe that it is impossible to make machines which are clearly smarter than humans in any way. The knowledge and intelligence of the physical, psychological, social, emotional domains could be mimicked but not the thinking intelligence, and if it could be, who would trust it?

18.4 What are some negative consequences?

It might increase unemployment, and lead to the division of humanity between the "technologically enhanced" and the "naturals," a constant worry in the development of artificial intelligence and its direct application to human beings. As the future will continue to be "unevenly distributed" - a select few will benefit before everyone else; and the outcome will depend upon the benevolence of the people in control of the technology. We might not recognize superhuman intelligence for what it is, especially since it may be distributed and not a single perceptible being per se, which could lead eventually to the science fiction image of intelligent machines controlling humanity before humans realize it.

19. Artificial microbes enhance intelligence[21]

Genetic codes have been written for new microbes which improve neural performance when co-habiting the brain. The average of 148 respondents' estimates of the likelihood of this by 2030 was 30%.

19.1 What might make this happen?

Craig Venter's work on writing genetic code to create unique lifeforms might develop some lifeforms by 2010, then it might take another ten years for creating the microbes able to live in and assist the brain, then add another ten years to test on other mammals. Hence, by 2030 it could be possible to have safe microbes assisting the brain in keeping neurons healthy. It would be wise to dedicate some of the research money to public education, as was done for the Genome Project, so that public understanding evolves with research developments. Gates-type foundations funded by the nouveau-super-riche in countries like India, Russia, and China could accelerate the research.

Symbiotic organisms have many advantages over gene therapy, but they require ways of circumventing the immune system. Symbiotic gut bacteria producing drugs seem very plausible, and could probably be used for enhancement. Anti-cavity mouth bacteria have already been demonstrated. Psychopharmacology, nanobots, and computer brain interfaces may also increase human intelligence.

19.2 What are some positive consequences?

This development would revolutionize life sciences. Healthy brains will last much longer, reducing medical costs, and could make for a wiser civilization.

19.3 What prevents this from happening?

There is a normal "human" fear about the unknown; many people will be afraid of artificial microbes, new bacteria, and nanobots. Those behind the anti GMO-regulations might also oppose this, as would those who consider altering human biology unethical. A global human review board might be created to help prevent this.

19.4 What are some negative consequences?

Microbes might mutate and cause mental disease or other unknown side effects; therefore, a series of research trials over years would have to be conducted.

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[21] References given for this possibility in the RT Delphi were: 1) Antonio Regalado, The Wall Street Journal, Biologist Venter aims to create life from scratch, 2005 http://www.post-gazette.com/pg/05180/530330.stm ; 2) David A. Relman, The human body as microbial observatory http://www.nature.com/ng/journal/v30/n2/full/ng0202-131.html; 3) Michael Purdy, Gut microbes' partnership helps body extract energy from food, store it as fat, 2006 http://mednews.wustl.edu/news/page/normal/7328.html

2. Analysis

2.1 Summary

The study questionnaire presented the participants with a list of 19 future education and learning possibilities and asked for:

- Estimates of the likelihood that the possibilities would be realized by 2030.
- Factors that might encourage or discourage the possibilities
- Consequences, both favorable and unfavorable, that might follow the achievement of the possibilities
- Other possibilities that might be added to the list.

The developments found to be most likely ($> 70\%$) were:

- Web 17.0
- Integrated life-long learning systems
- Chemistry for brain enhancement
- Just-in-time knowledge and learning
- Use of public communications to reinforce pursuit of knowledge
- Use of simulations

And the least likely were judged to be ($< 40\%$):

- Genetically increased intelligence
- Artificial microbes enhance intelligence

Several suggestions were received for other developments that might be added to the list. (See Appendix) These generally fell into the following four categories:

- Curriculum (e.g. teach morals, rational scientific thinking)
- Methods and Tools (e.g. universal translators, contests involving student projects)
- Administration and Institutions (e.g. tapping the capacity of groups, tele-commuting)
- The Students (e.g. early childhood development, flattening of the demographic pyramid)

The respondents made many contributions when commenting on the factors that might encourage or inhibit the possibilities and their possible consequences. (See Appendix) In general, these comments raised questions about:

- The costs and distribution of advantageous possibilities.
- How the developments might conflict with culture and thus affect their acceptability.
- The threat of unexpected consequences (particularly for biologic possibilities)
- The use of the developments to promote evil intent
- The reactionary impediments by existing institutions

There were some 274 people who signed in, and of these 213 provided at least one answer to the questionnaire (77.7%). Almost half (48%) of the people who answered at least one question visited the site more than once. Some of the people who visited the site more than once did so many times, the record (excluding the organizers) being a dozen.

Each participant, on the average, answered about 11 questions. The maximum number of answers to any question was about 181 and the minimum, about 100. (See Section 8 for details on the sample).

While every possibility in the study had its supporters and detractors, the levels of agreement about likelihood were generally high. It was found that agreement was highest at the highest and lowest likelihood extremes and lowest in the middle range of likelihood.

Among the key conclusions are:

> It is possible that the advances discussed in this study will not be available to all students, thus creating gaps in knowledge and capacities that are not present today. The lack of universal availability may be due to cost, political pressures (including the politics of academia), or reactions from existing institutions.

> Since some political regimes will view new educational capacities as a threat to their power, one can expect that some of these techniques will be outlawed or distorted to perpetuate the existing regimes, ideologies, and belief structures in various places in the world.

> The advent of learning enhancing drugs may result in a drug competition race and raise questions about the distribution and the ethics of charging for so important a commodity.

> It is possible that an international competition in intelligence may develop.

> The shift to a collective intelligence appears to be already underway, as evidenced by (paraphrasing one respondent) mass on-line collaboration, open source software, knowledge creation communities, and social sharing of learning resource (e.g., Wikipedia, YouTube, MySpace, FaceBook, and SecondLife) often without overt individual financial compensation or incentives

> The drive toward collective intelligence may give rise to its counterforce and effort by outstanding individuals to opt out of the "collective" (anti-borg)

> Developments lead to their counter developments and safeguards, even in education. For example the advent of portable artificial intelligence devices may lead to a 'race' to build portable 'anti-artificial intelligence devices' to protect oneself as an individual.

> Improvements in intelligence will make even the bad guys smarter.

> A "trickle down" strategy might be exploited to obtain new educational technologies; one respondent said, for example: "Standard data and simulation formats … allow cut-down versions of scientific simulations to be used in education." Perhaps the military and industry could be "mined" for similar applications.

> When teaching goes on line, computer hacking into the curriculum and information will be an issue.

> Just-in-time information can make everyone who has access look like an expert and true expertise will become hard to find and take on new meaning.

> Since nutrition is "natural" compared to (say) cognition enhancement drugs, it is likely to be easier to accept for many.

Cultural differences may lead one nation to adopt technologies and practices that lead to increased intelligence while other countries reject them based on cultural taboos or beliefs.

Rather than being used to enhance the intelligence of many people, genetic techniques might be used to remove or modify genes that result in lower intelligence

Any intervention may have unexpected medical and social consequences

Attempts to change curricula will inevitably bring questions about the ideologies that drive the changes

Respondents raised interesting and important questions about some of these possibilities:

Can simulations be so real and captivating that real life looses its significance?

Will intelligent machines think and reason in ways that are different than human thinking?

Will people migrate to countries that offer a means of increasing intelligence?

Does everybody become smarter, or does the gap grow?

Are the less intelligent made smarter, thereby raising the average or is everybody boosted?

2.2 Newly Suggested Developments

The RT Delphi form offered the participants the opportunity to suggest other possibilities that might be included in a list of potential 2030 changes. Some significant suggestions offered by the respondents (edited) appear below. A complete list is in Appendix.

Curriculum

- Teaching of morals, routine measurement of characteristics other than intelligence (e.g. emotional intelligence) will be commonplace.

- Emphasis on the need to learn how to learn. Not merely the acquisition of new facts and inputs, but the capacity to discard the unnecessary and to transform the useful information into effective and productive realities.

- I think that much more emphasis has to be given to ethical considerations. Some of the new technologies might produce a significant "yuck" factor and will make some people talk about the dangers of "playing God."
  By 2030 cross-cultural and cross-religious teachings should be available, if only to enable young minds to build their own opinions and make their personal decisions in these crucially "formative" areas.

- Training in rational scientific thinking will be part of basic education
  With a quickly globalizing world, more consideration should be giving to tolerance and understanding of different cultures. Religions themselves will be under increasing threats, and most other basic beliefs will have to be reconsidered among countries.

- Truth will not come anymore from religion but from science.

- Future studies are necessary since human action is future-oriented, to the extent that it is goal-oriented.

- It strikes me that the words "culture" and "religion" are totally absent at this point. By 2030 (hopefully), cross-cultural and cross-religious teachings should be available, if only to enable young minds to build their own opinions and make their personal decisions in these crucially "formative" areas.

- We will take issues like the teaching of wisdom much more seriously.

- A particular area of immediate improvement could be to give each infant the opportunity to develop at least 2 languages in their first 2 years of life (see Pinker for details). Natural multi-lingualism (as opposed to the much more difficult and less effective (but prevalent) path of learning other languages after the "infant window" has closed) has many other benefits for the development of individuals, including social benefits related to the early recognition of different cultures, etc...

Methods and Tools

- Virtual Reality simulations will extend to learning history in simulated, historically-accurate settings.

- Learning and education can be integrated in movies, games, and music in order to integrate learning and leisure. In this way a huge number of students can be reached, who in the "normal" education system is lost

- The use of brain imaging to fine-tune education by actually testing what modes of teaching work best.

- Universal translators available will make education international and global.

- Contests on specific projects to be performed by school students

- Live television brainstorming sessions with open participation from the audience

- Social simulations will guide political decisions

- Increased use of gaming including on-line games for learning
  Global access to internet becomes one of the global development goals

- Artificial intelligence-based software and devices would recreate, interpret, and analyze extinct languages. These would enhance enormously issues, facts, etc. not yet understood by pre-2030 times. Studies in History, Archeology, Egyptology, etc would be extremely buoyed by this technology.

- The developments in research of mental techniques [hypnosis, suggestion, and extrasensory perception] bring revolutionary improvements of human learning capacities.

- The right to equal access to information becomes one of the globally recognized human rights. By 2030 knowledge might be unified in one universal knowledge base, in the form of modular units with a management tool so that every student could download what they need. The management tool will bring together only the contents of all necessary units in one document to create a new book that consumer will order.

- Sub-100 dollar student computing devices which will provide the building blocks/foundation for individualized instruction

- Artificial microbes totally un-harmful to humans would add specific and temporary comprehension capabilities to an individual: i.e. pre-programmed artificial microbes labeled "PT" would permit an individual to temporarily understand and speak fluently the Portuguese language.

Administration and Institutions

- The State must guarantee inclusion of all of society first and specially in the educational system-, to each member of the country. Then an equal standard of education can be guaranteed to everybody. Personally we are quite far away from many e-tools, technology and nanotechnology instruments that are very useful and can perfectly incorporate in the educational item.

- Develop new models for collective knowledge and intelligence developments, a step ahead from cyberculture and towards a global brain and new stages of human consciousness

- Organized individual learning is considered less important than tapping the capacity of groups and communities (and whole societies) to take in, evaluate, effectively use, and creatively transcend the existing knowledge relevant to a given situation, creating new, potentially more powerful knowledge in the process. The results of such group and community "collective intelligence" will be broadly available to all individuals and groups, which makes individual "education" (as we commonly think of it re broad learning the lessons of the past) obsolete. Knowledge per se will be less important than today as society will be less prone to promote new knowledge

- The future that is being shaped by genetic engineering, weapons of mass destruction and unsustainable practices for the environment asks for a new spirituality for a transformation in human consciousness to cope with the global chaos and complexity. So, there may be a new relationship in the realm of education between teachers and students, or guru-disciple relationship that fosters a trustworthy effort to help accelerate change and prepare new citizens for a new future. New outcomes of teacher/student relationship could create new educational systems based on a new kind of learning cooperation.

- Due to urban congestion and global warming, government and employers will make it very attractive for more parents to tele-commute, which will increase the number of children being home schooled with the aid of tele-education and virtual schools.

- There may be a new relationship between teachers and students, a guru-disciple relationship; new teacher/student relationships could create new educational systems based on a new kind of learning cooperation.

- The abolition of schools, home education becoming the norm.

- There is a mismatch between the rigid structure of schools and the new technologies of learning.

- Education will become more privatized.

- Education methods will be more equalized worldwide (e.g. globalizing of education)

- Due to urban congestion and global warming, government and employers will make it very attractive for more parents to tele-commute, which will increase the number of children being home schooled with the aid of tele-education and virtual schools.

- Countries will recognize with status and pay human teachers in all areas who act as mentors and source of inspiration for life and learning

The Students

- Flattening of the demographic pyramid (more and more people are becoming older, living much longer, and having fewer children) will significantly change the population dynamics around the world. The education of the future has to seriously consider the relative shrinking of fresh, young, new people.

- Much more should (and may by 2030) be done to recognize the crucial first 5 years of the development of the human brain/mind. It evolved to experience and understand all aspects of the real world, especially social behavior, dominated by the infant-mother bond. Yet we "protect" so many of our infants from that reality, restricting their experience to "safe havens" like prams, cots, nurseries, etc... Changing this approach will not only have a dramatic effect on individuals reaching closer to their potential level of intelligence, but will also significantly improve their physical and mental balance/health.

2.3 Judgments of Likelihood by 2030

The participants provided judgments about the likelihood of occurrence of the possibilities prior to 2030. The table below displays the judgments of the group and the ranges of agreement and disagreement. The columns labeled "quintile" show (at the top of each cell) the number of people who responded in each quintile range (shown at the bottom of each cell). Thus, in the case of the first possibility, National Programs for Improving Collective Intelligence, 14 people answered in the range of 0 to 20%, 11 people in the range of 20 to 40%, and so on. The total number of people responding is shown in the column labeled "Total." In addition, the maximum, minimum, average, median answers, as well as standard deviation, are shown.

No.	Likelihood by 2030	Max	Med	Min	Avg	1st Quintile	2nd Quintile	3rd Quintile	4th Quintile	5th Quintile	Total	Standard Deviation
1	National programs for improving collective intelligence	100.0	69.0	-0.0	61.68	14 -0.0 to 20.0	11 20.0 to 40.0	67 40.0 to 60.0	72 60.0 to 80.0	31 80.0 to 100.0	195	24.2
2	Just-in-time knowledge and learning	100.0	75.0	-0.0	71.15	5 -0.0 to 20.0	11 20.0 to 40.0	28 40.0 to 60.0	88 60.0 to 80.0	52 80.0 to 100.0	185	21.2
3	Individualized education	100.0	70.0	-0.0	64.30	5 -0.0 to 20.0	23 20.0 to 40.0	41 40.0 to 60.0	76 60.0 to 80.0	35 80.0 to 100.0	181	23.1
4	Use of simulations	100.0	75.0	-0.0	70.09	3 -0.0 to 20.0	10 20.0 to 40.0	33 40.0 to 60.0	85 60.0 to 80.0	40 80.0 to 100.0	171	20.1
5	Continuous evaluation of individual learning processes designed to prevent people from growing unstable and/or becoming mentally ill.	100.0	40.0	-0.0	43.05	12 -0.0 to 20.0	65 20.0 to 40.0	63 40.0 to 60.0	26 60.0 to 80.0	6 80.0 to 100.0	172	21.5
6	Improved individual nutrition	100.0	66.0	-0.0	62.98	3 -0.0 to 20.0	15 20.0 to 40.0	54 40.0 to 60.0	72 60.0 to 80.0	19 80.0 to 100.0	163	20.5
7	Genetically increased intelligence	100	40.0	-0.0	39.43	20 -0.0 to 20	59 20 to 40	60 40 to 60	17 60 to 80 72.0	6 80 to 100	162	20.9

No.	Likelihood by 2030	Max	Med	Min	Avg	1st Quintile	2nd Quintile	3rd Quintile	4th Quintile	5th Quintile	Total	Standard Deviation
8	Use of global on-line simulations as a primary social science research tool	100.0	65.0	-0.0	61.73	9 -0.0 to 20.0	11 20.0 to 40.0	55 40.0 to 60.0	67 60.0 to 80.0	20 80.0 to 100.0	162	21.9
9	Use of public communications to reinforce pursuit of knowledge	100.0	75.0	-0.0	70.98	3 -0.0 to 20.0	5 20.0 to 40.0	31 40.0 to 60.0	88 60.0 to 80.0	30 80.0 to 100.0	157	17.9
10	Portable artificial intelligence devices	100.0	65.0	-0.0	61.18	11 -0.0 to 20.0	8 20.0 to 40.0	52 40.0 to 60.0	69 60.0 to 80.0	18 80.0 to 100.0	158	22.3
11	Complete mapping of human synapses to discover how learning occurs and thereby develop strategies for improvement of learning	100.0	45.0	-0.0	43.57	18 -0.0 to 20.0	33 20.0 to 40.0	78 40.0 to 60.0	20 60.0 to 80.0	3 80.0 to 100.0	152	20.6
12	Means for keeping adult brains healthier for longer periods	100.0	75.0	-0.0	68.51	7 -0.0 to 20.0	6 20.0 to 40.0	26 40.0 to 60.0	93 60.0 to 80.0	26 80.0 to 100.0	158	202
13	Chemistry for brain enhancement	100.0	80.0	-0.0	73.78	6 -0.0 to 20.0	3 20.0 to 40.0	21 40.0 to 60.0	73 60.0 to 80.0	51 80.0 to 100.0	154	20.2
14	Web 17.0	100.0	80.0	-0.0	78.39	2 -0.0 to 20.0	4 20.0 to 40.0	16 40.0 to 60.0	55 60.0 to 80.0	74 80.0 to 100.0	151	18.1
15	Integrated life-long learning systems	100.0	80.0	-0.0	76.57	3 -0.0 to 20.0	7 20.0 to 40.0	12 40.0 to 60.0	79 60.0 to 80.0	57 80.0 to 100.0	150	19.0
16	Programs aimed at eliminating prejudice and hate	100.0	45.0	-0.0	44.73	12 -0.0 to 20.0	41 20.0 to 40.0	78 40.0 to 60.0	16 60.0 to 80.0	8 80.0 to 100.0	154	21.2
17	e- Teaching	100.0	75.0	-0.0	69.82	7 -0.0 to 20.0	5 20.0 to 40.0	31 40.0 to 60.0	77 60.0 to 80.0	39 80.0 to 100.0	159	21.5

No.	Likelihood by 2030	Max	Med	Min	Avg	1st Quintile	2nd Quintile	3rd Quintile	4th Quintile	5th Quintile	Total	Standard Deviation
18	Smarter than human computers	100.0	50.0	-0.0	52.36	18 -0.0 to 20.0	19 20.0 to 40.0	70 40.0 to 60.0	28 60.0 to 80.0	20 80.0 to 100.0	155	26.5
19	Artificial microbes enhance intelligence	90.0	30.0	-0.0	30.37	37 -0.0 to 18.0	64 18.0 to 36.0	32 36.0 to 54.0	11 54.0 to 72.0	4 72.0 to 90.0	148	19.1

Working with the data contained in this table, we find that:

- The average judgments about likelihood range from 79 percent (Web 17, an advanced form of Internet) to 30 percent (artificial microbes for enhancing intelligence).

- Almost all items had individual at least a respondent or two who thought that the likelihood was zero; similarly, almost all items had at least a respondent or two who thought the likelihood was about 100 percent

- A relatively high order of agreement was achieved, with standard deviations ranging from 17.5 percent (lowest standard deviation was achieved in the spread of responses about the likelihood of an advanced Internet, Web 17). Similarly the highest standard deviation, 27% was achieved on the likelihood of smarter than human computers).

The likelihood of the possibilities was assessed as follows (presented in rank order by average likelihood):

| Possibility	Likelihood
Web 17.0	78.39
Integrated life-long learning systems	76.57
Chemistry for brain enhancement	73.78
Just-in-time knowledge and learning	71.15
Use of public communications to reinforce pursuit of knowledge	70.98
Use of simulations	70.08
e- Teaching	69.82
Means for keeping adult brains healthier for longer periods	68.51
Individualized education	64.30
Improved individual nutrition	62.98
Global on-line simulations	61.73
National programs for improving collective intelligence	61.68
Portable artificial intelligence devices	61.18
Smarter than human computers	52.36
Programs aimed at eliminating prejudice and hate	44.73
Continuous evaluation of individual learning processes designed to prevent people from growing unstable and/or becoming mentally ill.	43.05
Complete mapping of human synapses to discover how learning occurs	42.83
Genetically increased intelligence	39.43
Artificial microbes enhance intelligence	30.37

And graphically:

Likelihood of Education Possibilities—year 2030
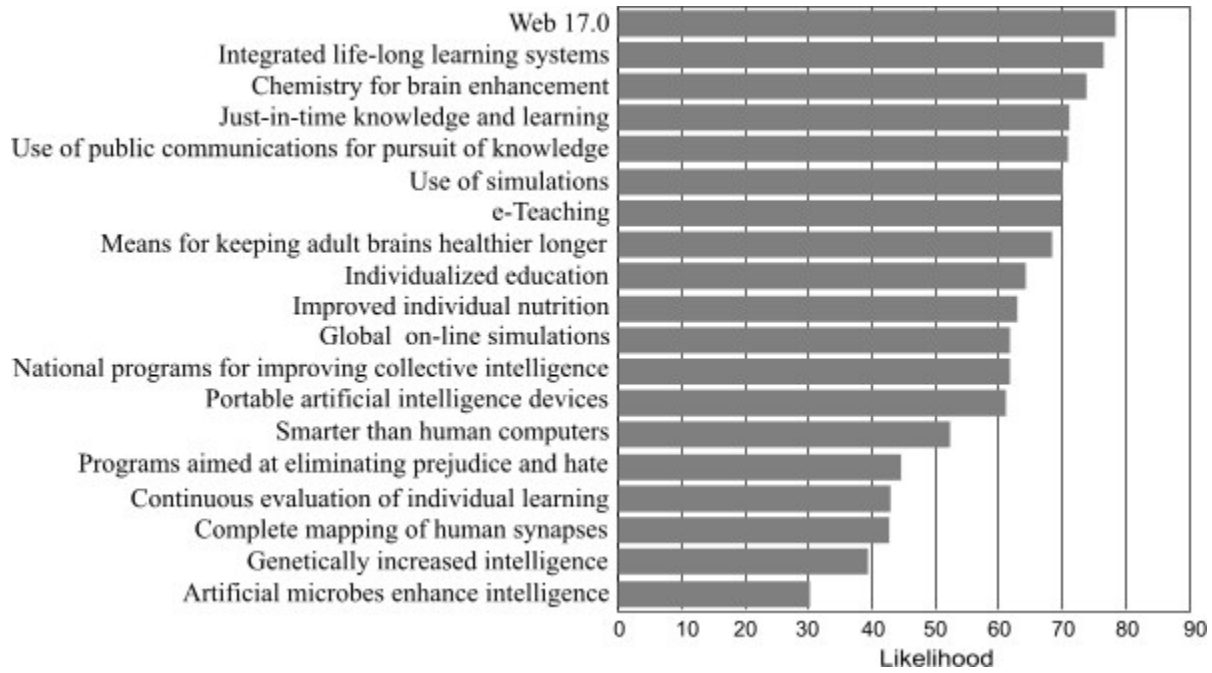
2.4 Distribution of Opinions

There is a unique relationship between the average likelihood and standard deviation. Agreement levels improved for both high likelihood and low likelihood possibilities; the possibilities in the middle range displayed the greatest levels of disagreement (although even for these, agreement was relatively high). The graph below displays this relationship:

Likelihood vs. Standard Deviation
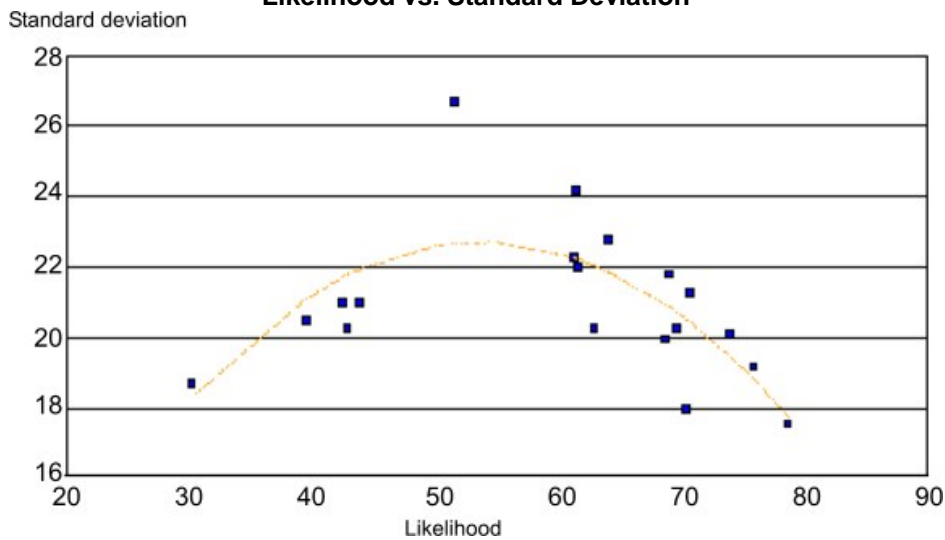
The curve shown is a quadratic which fits the data quite well; the correlation coefficient is 0.96.

As a further demonstration of the levels of agreement, consider the following graph which displays the percentage of people who answered in each quintile for three of the education and learning possibilities.

Percent of Responses in Each Quintile
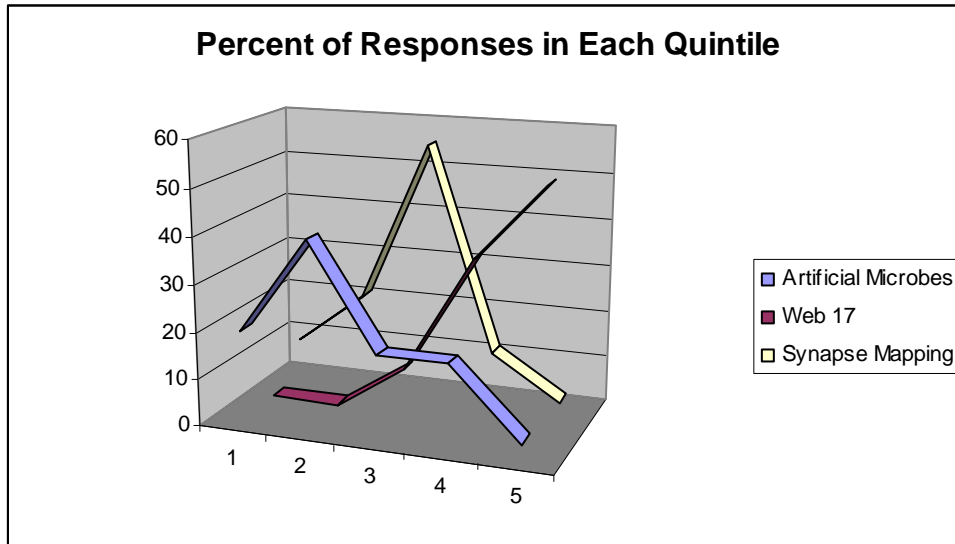
2.5 What Might Encourage or Discourage the Possibilities?

The respondents were encouraged to provide judgments about factors that could help or hinder the possibilities and assuming they occurred, to conjecture about consequences that might follow. The information provided by the participants was quite extensive and is contained in Appendix. A space-limited number of (edited) excerpts are listed below:

1. National programs for improving collective intelligence

encouraging and positive

> I recently discussed this with senior officials in South Korea, who agreed that this would be a good goal to add to the Ministry of Education. It may not happen, but this increases the likelihood that it will occur before 2030

> Venezuela had such a program in the 1980's, which was unfortunately discontinued by the following governments. The opportunities are incredible, not just to increase human potential, but also human-machine capabilities.

> Leadership that respects and encourages free thought and the rights of the individual (male and female, and of all religious and political backgrounds) is necessary to foster the improvement of collective intelligence.

> I doubt that this will occur on a national basis in the USA. It may occur in some Asian countries as they will likely determine that this is a method to improve their standing in the world, both in terms of respect and economic power.

…You will still have the "haves" and the "haves not" of intelligence or information.

A smarter society will reduce some of the costs of low-cognition individuals (in terms of crime, wasted education effort, failed life projects), get larger groups able to handle jobs of a given complexity and might have the benefit of attracting more clusters of creatives.

More and more research is showing that learning … is fundamentally a social process. This is in marked contrast to very traditionally held views that intelligence and knowledge are situated only in individual's brains. If we look at just how rapidly global, open-source, knowledge creation communities and mass collaborations have resulted in very widely used information, social sharing and learning resources (e.g., Wikipedia, YouTube, MySpace, FaceBook, and SecondLife), we are seeing a major behavioral shift. People are using collective intelligence, knowledge and "social know-who" to collaboratively create resources for themselves and others--often with no overt individual financial compensation or incentives

It depends on the kind of intelligence: for example the emotional intelligence will be lower, but abstract-logical intelligence will be higher...

International competition among countries. As a tool for accelerating the absorption of immigrant populations. As a complement to formal education. As a complement to formal education.

inhibiting and negative

Lack of a single point in many countries which can determine curricula. This increases the chance that many people will be involved in the decision and hence it could be defeated.

Also, the concept of individual intellectual 'property' is diametrically opposed to collective intelligence. Societies will need to find a way to reward the knowledge creation act, which is the act of advancing society, without giving ownership to the resulting knowledge.

Entrenched despots, regimes, and institutions that fear evenly distributed power impede the improvement of collective intelligence because it is a threat to the status quo. Denial of access to information and to connections with people in intelligence networks will continue because of this. The negative consequences can be found at every level, from the nano-sized to the planet-ending disaster.

One consequence could be psychological affects over time of diminishing points for individuality and authorship talents which could cause a student-based revolt of being part of a "collective."

Ongoing propagation of propaganda and group-think through media and politicking with primarily economic motives by few. The primary consequence being more and more sound-byte information with less and less "intelligence" (or even pursuit thereof) about what it all means.

(What could delay it :…) social inequalities, corruption in the public sphere and (lack of funding)

(Any…) intervention into cognition (mat be) politically controversial: issues of group cognitive differences, gender differences in cognition, the heritability of cognitive abilities, the use of biomedicine for enhancement and the relationship between individual and state

Even a successful cognition improvement program might have many unexpected side effects, both medical and social. If improved cognition for example reduces acceptance of traditional values it might be politically disruptive, while other forms of cognition enhancement might be supplied with subtle or not-so-subtle attempts of manipulation towards ideological ends.

(This development) …flies directly in the face of longstanding competitive, highly individualistic and "proprietary ownership" models of knowledge-creation and intellectual capital development. This means it requires a major change in attitude of just how learning and value creation really happen-- Even in college faculty tenure decisions, there is still little incentive for cross-disciplinary or web-based collaborative work, as these decisions largely depend on assessing individual faculty's publishing and citation records...regardless of how many other people have really been involved in the research or writing process.

2. Just-in-time knowledge and learning

encouraging and positive

I believe much of what has been traditional government(public) education will be replaced by web based, managed learning provided by open source collaboratives or vendors who compete on delivering measurable knowledge acquisition and retention with speed and effectiveness as the basis of payment. This approach will initiate another renaissance as people are freed of the Madrassas of Government Education.

Rote learning will continue to diminish in the future leaving room for reflective thinking which is indeed the corner stone of significant learning. Again truly compr5ehensive development of learning areas, additionally to the Intellectual Area, such as the Emotional Area, responsible for attitudes, Physical Areas, responsible for skills and dexterities and Social Area, responsible for human interests and social ethics; will make possible "learning to learn" and "learning to change" to achieve "life long learning".

As people become more able to choose knowledge they will not just acquire knowledge useful for their jobs but also for private activities, political and cultural project. The result is empowered individuals, hard to pin down by specialty.

Such an educational system will certainly make business more efficient and allow countries to become more competitive. I am not certain that this is necessarily positive in every sense. It certainly leads to advancements in science and technology, but history, civics, and other subjects will suffer.

The confluence of … nanotechnology, neuroscience, artificial intelligence, and avatar-based synthetic online worlds will make education more experiential and engaged in the developed world by 2030. Social/education networks developed through the new technologies will have altered the fabric of all relationships, creating an exponentially advanced knowledge weave. This will not be true across the globe.

Positive consequences may include a reduction in the 'power' of academic arrogance.

The increasing rate of social advance will add pressure to make learning and learning technology more flexible, modular, and accessible, but will also demand that it be custom-fitted to a particular purpose/application and will simultaneously cause it to be seen as transitory.
In a vast sea of information, it's necessary to improve learning methods (to make them) more effective. "Just-in-time knowledge" would be widespread due to reducing rote learning and inefficient study. It might improve public educational systems.

inhibiting and negative

Computer hacking, information manipulation and other forms of information warfare.

The negative consequences will be felt most in the least-advanced societies; the type of intellectual and personal disconnect we see between radical Islam and the Western world of today will be magnified. Those who benefit from the new realities of advanced technologies will evolve differently than the humans who are caught in the divide and left behind.

Potential for further dumbing down of society. I think this will most likely create poor learning habits for lazy-thinking, much like many people's current inability to concentrate or focus on a topic in-depth without intermission or a commercial break

In a world where everybody can look like a specialist there will be more risk of decisions made on looser grounds and less respect of true expertise, unless good ways of validating actual competence are developed.

Traditional education proponents will discourage this effort. Negative consequences of implementing this will include a public less engaged in political processes

Dictatorships wishing to control their people's development. I believe that democracies, however imperfect will sponsor and strive for this development

It may… (inhibit) innovative capability...

3. Individualized education

encouraging and positive

Young people who need to function intelligently and in their economic interests are already driving this process of the Individual Learning Plan that used to be only available to special needs children provided by special education teachers.

Adults who expect to maintain or increase their economic well being will find it necessary to continuously learn in this type of learner and web centric, managed environment.

As computing and virtual learning and just-in-time learning all converge, this type of education will be more available in regular public schools and charter schools… I expect to see it closer to 2015 than 2030 in US private schools.

This is already taking place, but it is reserved for the elite. Individuated instruction will be more commonplace in 2030 thanks to AI and the acceleration of computing power, but it will still only be available to those who are willing and able to access it

Designer learning could be accepted as no different than designer jeans, designer drugs, and designer vitamins for each person based upon his or her *unique* physical, emotional and intellectual makeup.

I think this is the most likely of all the statements...it is doable, it will become affordable and (there will even be) a 'will to act' ….This is a win/win for everyone.

… education tells people to act alike, to decide alike, and to choose alike. Individualized education would be something different,

Based on the assumption that … every individual is potentially a genius, and there is nothing more different than one genius to another one, (with this development) each person can be special; and … then he or she can be the best in whatever he or she chooses to do. … It could help people to be more than followers…

inhibiting and negative

With the extension of the education cycle, overpopulation, and the elderly financial dependency, the education system is going to suffer (from lack) of financing …in many countries and individualization will be very expensive in poorer countries

Problems will exist where resources are an issue. Poorer countries and/or poorer school districts will be unable to fully implement this. It will require PCs for each individual, and oversight by teachers with advanced technology skills. Individuals meeting these criteria will command higher than normal salaries.

New ideological or religious movement that sweeps the world into mono-thematic curriculum could reduce the possibilities for individualized learning.

A negative consequence of the wide spread use of very individualized learning could reduce social cohesion.

The type of education you would get from these systems depends upon the intellect, objectivity, empathy, and intent of the people or the AI designing them. It could be a great way to "brainwash" people to adopt a particular ideology and even act upon it in negative ways as well as in a positive fashion.

Academic arrogance (could delay it): the professor says I know best, and I have tenure so I will continue to say what education is best.

4. Use of simulations

encouraging and positive

As the lines between games and learning grow thinner, this may emerge in industry in next generation 'Second Life'-type solutions

…Facebook and MySpace will morph into avatar-based 3D synthetic worlds like Second Life but much more advanced. VR design and implementation costs are going to improve, and once the interface becomes more natural these worlds will explode. We need to begin to plan now to leverage this technology to best advantage for all people. Immersive experiential learning will benefit society on every level.

With good simulations students can experiment beyond curricula, and acquire tacit knowledge of the behavior of complex systems.

I believe in soul...the ability of the human 'to be' not just 'to think.' I believe much of the thinking aspects (of existence) can be simulated but not the being aspects.

The diffusion of 3D and the social acceptance of parallel on line realities like Second Life (is important to this development) …by now a real alternative world is growing. …This will … evolve into new forms of individualized educational platforms.

Standard data and simulation formats enable more scientific collaboration, and in turn allows cut-down versions of scientific simulations to be used in education. The spread of virtual reality and online games makes simulation a normal mode of interaction, and enables high performance hardware at low prices. With good simulations students can experiment beyond curricula, and acquire tacit knowledge of the behavior of complex systems.

inhibiting and negative

Even though my children used gaming to learn to fly a jet fighter at a very young age, I wouldn't put them in a real jet without actual experience and human qualification...again we need clarity between knowing and the transition to actual doing built into our global learning systems...we need much more clarity in purposes/goals of learning.

The challenge will be getting it into the more formal education system, and blending it with other forms of learning.

Negative consequences can include what some people refer to as a cyber "addiction" or a loss of touch with reality and face-to-face human contact. Worse consequences can include the purposeful design of immersive VR technologies to negatively influence human behaviors.

Many simulations are little more than ways of avoiding teacher effort, edutainment that often lack the complexity and interactivity of real experiments or teaching. When teachers do not understand the simulation mode of experimentation and learning, they may not make the best use of it.

This possibility could be thwarted by concern about video game violence, and lack of access by parents to the video technology used in the simulations.

The greatest obstacle to successful serious games/games … is the refusal of many to work strictly with open source software and open code. The government should require that all software be open source, and that standards be established so that all information can have time and geospatial attributes that allow them to be digested by serious games/games for change.

Many simulations are little more than ways of avoiding teacher effort, edutainment that often lack the complexity and interactivity of real experiments or teaching. When teachers do not

understand the simulation mode of experimentation and learning, they may not make the best use of it.

5. Continuous evaluation of individual learning processes designed to prevent people from growing unstable and/or becoming mentally ill.

encouraging and positive

The increasing awareness that single individuals can become massively destructive (SIMAD) has brought this about. Some of these programs, in some countries, have been called totalitarian, but their implementation is generally seen to be in the public interest.

(This is encouraged by) the continuous increase of security standards in driving blocks of the Western World and the drive towards more extremist ideologies, and the persistence of highly pressuring control by governments in several Asian countries (e.g., China).

Programs will have to be very creative and engaging to encourage widespread adoption.

This is scary in one sense (Big Brother) … Alice Walker's work showed that those who led troubled lives but still did well had one thing in common...The all had found some one person who loved them. A program like this could identify and match these youth with appropriate mentors.

This is a truly whacky suggestion and will never be implemented by free thinking societies.

Progress in psychology would stimulate (this) possibility, which would reduce mental illness and antisocial instable factors.

inhibiting and negative

Such programs might reduce creativity and innovation. All geniuses are always a little crazy!

Personal freedoms will be at stake.

Like any other system of "profiling" this statement was posed with good intentions but it is rife with too many negatives to find universal acceptance

There would be an enormous amount of resistance to this due to privacy and personal-freedom issues. Intelligence-gathering/police organizations have already been doing this sort of thing for hundreds of years in the nation-states with the worst histories in regard to human rights.

…Some of the world's brightest thinkers would have been classified in a negative fashion by such programs - what would have happened to them and their breakthroughs? In the future, if we begin to "cure" or isolate individuals with deviant personalities are we going to destroy something that could have been of benefit to the world? Who decides what is "deviant"?

Antisocial behavior including terrorist activities and violent criminality is not the problems of individual nurture, it has social causations.

Authority and impartiality of evaluation organization, and the problems such as human right, racialism, etc would counteract the possibility. It might bring negative influence in the field of individual privacy, human right and racialism, etc.

6. Improved individual nutrition

encouraging and positive

At least in some third world countries like Chile monitoring childhood development from the nutritional point of view has helped a lot to improve physical and mental development

It will be easy to detect the kind of nutrients that each person needs according to their DNA and background: nature and nurture can both be addressed.

Developments in individualized medicine, nutria-genomics, and functional food may make diet tailoring popular, possibly in a faddish fashion. Given current concerns about obesity, health paternalist governments might also promote improved nutrition. Since nutrition is "natural" compared to (say) cognition enhancement drugs this is likely to be easier to accept for many.

This has potentially huge benefits beyond education. It could greatly improve a nation's health and reduce the cost of health care. Countries that can separate outcomes from politics have a reasonable chance of implementing this.

…"Food cures better than medicine;" improving nutrition would reduce diseases, prolong natural life, and enhance intelligence.

inhibiting and negative

Many research findings in this area are weak or suffer low (sample) sizes: improved nutrition might be cheap and simple, but also could have relatively little effect …. The overall beneficial effects of full and diverse nutrition may overshadow the individual effects.

As with anything those that stand to lose economically will oppose this. Giant food companies and health care lobbies (may) discourage this

To improve individual nutrition (will be) a challenge in some places where the customs include really bad nutritional habits...

…only one factor could hinder (this)…poverty. There would be lots of needy population living in 2030; the most important thing for them (would be) "survival" rather than "nutrition."

7. Genetically increased intelligence

encouraging and positive

The possibilities of biologically increasing our intelligence are almost unlimited. Nature has slowly evolved our brains, but now we can do it faster and better.

The main form of near future genetic intelligence enhancement would be PGD, selecting away genes involved in pathologically lower intelligence. This would lead to a reduction in the lowest performing, in turn increasing the average. For this to happen PGD needs to become more common, which requires both improvements in technology, a way of automate it to bring down the price, standards making different treatments comparable and, most importantly, a cultural shift towards regarding genetic selection as acceptable. This cultural shift might be specific to some nations and not others.

I believe that it is imperative that prior to this development a tremendous boost be given to the learning of humanities in general including art and overall, ethics in order for humanity to have more balanced individuals and not only science super-beings. It is true that intellectually developed individuals are needed but, this development must be accompanied by development of other human capacities such as social ethics, acceptance of differences, respect for others and the like.

Genetic enhancement of intelligence should be combined into a single procedure that would also reduced criminal behavior.

Just as we "correct" our eyesight with glasses, we should also correct … low intelligence. Imagine two worlds: one with average IQ of 100 and another with average IQ of 150. … Which world would work better?

Parents want the best for the children, and once a safe procedure is available for increasing intelligence, parents will take their child to the country that first offers it.

. It might (open the) furthest the potentialities of human intelligence.

inhibiting and negative

Major moral issues will surface. What is normal? What is human? What is ethical?

The belief that life is an unalterable gift from God will discourage this possibility. Without a concurrent improvement in more ethical behavior the "war" between good and bad will get more complex.

Intelligent free-thinking societies will discourage this effort.

Science and Tech are developing too fast in relation to Moral Development, so these may cyclically raise issues that delay Tran humanistic ideas.

… may bring big risk, including genetic mutation caused by incorrect use of genetic technology.

8. Use of global on-line simulations as a primary social science research tool

encouraging and positive

We are very close to doing this today. I wouldn't be surprised is some preliminary experiments are not occurring right now, but in 25 years from now? (This) seems inevitable.

A great tool for social science experimentation

Researchers will certainly want to tap into these efforts for research purposes. Degrees will likely be awarded (on the basis of such research

Virtual educational simulation depends on internet, but it is easy to be destroyed or influenced by an unforeseen incident. For example, Taiwan Strait had a big sea quake at the end of December 2006, optical fiber cables were ruptured, so as to block the internet between Asia and North American and it needs 2 weeks at least to repair. Isn't it the sorrow of the virtual world?

inhibiting and negative

I do not see any real positive consequences for this in education development. It may have other useful applications but not in Education.

There are minimal ways to actually monitor the inputs to these computer societies. Social science requires detailed information on the participants in a study. Virtual societies will not provide this background reducing the value of the data.

…it is almost impossible to reproduce real social situations in a laboratory

Virtual realities are unable to substitute real life in deed, and it's difficult as transforming human subconscious mind to reality and trying to control it. Virtual realities would result in the tendency of split personality…

… ideas like "knowledge is the power; knowledge is the fortune" have been deeply rooted among the people.

9. Use of public communications to reinforce pursuit of knowledge

encouraging and positive

Any legal, ethical means to awaken the interest of youth in particular, and the population at large, to pursue knowledge will enhance the possibility of democratic governments and generally well being to societies.

A very plain extrapolation from current strong trends in technology and society!

…public communications influences people, and several organizations around the world are interested in promoting the pursuit of knowledge... Knowledge Society is still an ideal of equal opportunities for everybody to access to a better life; that ideal could become real if more and more people, institutions and countries, decide to go towards knowledge societies, thanks to the use of public communications to reinforce pursuit of knowledge.

People would realize (the) importance of knowledge and be accustomed to getting the information from media, so that (the) public media can play a main role in the … pursuit of knowledge.

inhibiting and negative

Social marketing could be compared to social engineering and be considered a new class of communism to be opposed by free societies.

I am somewhat skeptical on this topic. It would be great if it happened, but there are too many diverging viewpoints to make it happen. If it did happen the benefits could be many, including a much better educated population.

Limits on civil liberties- whatever are civil liberties in 2030- (might be inhibiting)

Pursuit of knowledge cannot be developed to (the) extreme…. otherwise it would disturb (the) natural development rules of human society, counteract human progress, even promote un-peaceful factors

Professional ethics of the public media is not standardized yet, (there are) differences in ideology and faith, etc. Different media would give diverse judgments to the same matter, so I don't think it can be realized in 2030.

10. Portable artificial intelligence devices

encouraging and positive

That's my laptop now. It is an artificial memory, a brain prosthesis.

…people's lives and experiences will be recorded - allowing people to better manage their lives, learn from their experiences, and re-live some of their life in older age. "Little Brother" will emerge - individuals will be able to control behavior just by recording their interactions and what goes on around them. Crime will drop significantly.

Technological convergence, on cellular phones for example, and the psychology that leads to the widespread use of gadgets, are very powerful drivers. Adaptation to a very rapidly changing world is a positive consequence

The growth of Social Networking can be a driver. Imagine … a small device in your pocket will identify and tell you who on the street has similar interests to you and help you to interact with them.

Imagine that you have a very advanced Google in your pocket. You put a question, not a keyword - for example, who is this guy? Or what should I do in this situation? Google in 2030 will answer to these questions for you.

This will likely happen, but it will be exclusive to the intelligence communities.

Maturity of recognition technology on voice, face and retina, etc. is the basis on which these applications can be adopted. Sometimes new technologies are applied in the field of military affaires at first, if there were a war of global proportion within next 25 years, it maybe accelerate the rapid development of new generation of technology.

It might break … the bottleneck of human brain in the field of memory, analysis, decision-making, etc. and make human competence advance rapidly.

inhibiting and negative

While I agree with the thought that portable AI will become a reality, I don't think it is necessarily good for each of us to have so much of our personal information readily popping into anyone with a gadget in their ear.

I am afraid that … the propaganda efforts of IT corporations (will equate) "intelligence" with "information." These are two utterly different things.

A 'race' to build portable 'anti-artificial intelligence devices' to protect oneself as an individual.

Intelligence agencies will prevent the general public from having access to this.

This will likely take more than a generation for most people to have such devices. However, it does seem inevitable.

…face recognition and helping with decision making are questionable.....because of privacy issues and   pace of life.

But consider the level of the economy in different (geographic) areas… this is just a device for a few (rich) crowds

These devices might be used for criminal acts.

11. Complete mapping of human synapses to discover how learning occurs and thereby develop strategies for improvement of learning

encouraging and positive

The Allen Brain Atlas project is an example of what is quickly happening in neuroscience. Just like the genome, the brain can be understood scientifically, and this will help to improve education.

The realization that higher IQ is the key competitive advantage in the knowledge economy stimulates massive brain research by several countries that fund the research over sufficient time to make breakthroughs

Complete mapping requires not just improvements in scanning methods and database management, but also improvements in image processing, computational neuro-science, and automated research. These (will be) very likely getting well on their way in 2030, (but) they may still be far from complete mapping. However, even partial mapping is likely enough to deduce important neuroscience about learning.

A deep understanding of neuroscience will empower most fields of cognition, from AI to learning enhancement drugs

Knowing HOW the brain works greatly enhances the possibilities of "learning to Learn" thereby enhancing the possibilities of "life long learning"

Highly-developed biomedicine and pertinent sciences would decode the connection pattern of human synapses. It might bring a qualitative leap and development in capability of learning and intelligence...

inhibiting and negative

Knowing how learning occurs in the small and in general may not be helpful in understanding how it occurs on a personal level for an individual.

The key issue is how intrusive this mapping is, which in turn determines how problematic it will be to get ethical approval, test subjects, and to employ it.

Negative: incredible power and prestige for the scientists and doctors at its forefront.

Like the gene code, the connection pattern of the synapses is not a panacea. Intelligence and emotions go far beyond these patterns in this kind of complex system. Emergent properties are very elusive even within this time frame.

Continuation of the current education mode would be the biggest resistance to put forward new one. There are certain solid characteristics in national education system, advanced method and idea may be adopted. Thus perhaps it would implement in corporate training rather than ordinary education.

The human brain is a complex system, (and) … decoding the connection pattern of the synapses (at the) micro level (may not lead to understanding) human thinking … at the macro level.

12. Means for keeping adult brains healthier for longer periods

encouraging and positive

Advances in Neurosciences and discovery of new natural biochemical brain enhancement products are already on its way as well as biofeedback equipment for mental states monitoring and improving behavior.

Interest among the elderly for keeping active is already high, and the baby-boomer generation is reinforcing this with both numbers and money. There is also national interest in avoiding large numbers of demented elderly. A more vital elderly population will construct a new concept of what late life means, possibly getting involved in entrepreneurship, education and politics.

People used to think that adults could not grow new cells. Research has now shown that new brain cells are created every day. Many of the new cells born each day die off, but running and a more stimulating environment reduces the death rate. Some research indicates that continued adult learning maybe be associated with the news brain cells. The process of adults growing new brain cells is Neurogenesis.

This will very much meet the ageing trend in advanced economies.

inhibiting and negative

The fear of tampering with the brain, the most complex structure in the known universe, will delay some developments in cognitive sciences. Making older people healthy might take longer than expected.

The positive breakthrough of effective life extension that reduces ageing-related impairments might redirect research but leave a group of non-treatable elderly behind. Vital elderly might feel locked out of a youth-directed society, possibly becoming discontent or forming isolated subcultures.

Cost, and/or, the appearance of a global pandemic that demands all medical effort for common and shared survival.

We are already seeing ethicists of all kinds trying to decide, for us, whether it's "fair" to let rich kids drink brain potions.

13. Chemistry for brain enhancement

encouraging and positive

Such drugs currently exist, although safety and efficacy remain an issue. The improvement is in general about 10-20% on different psychometric tests. Currently no drugs are being developed

specifically for (brain) enhancement, since current medical regulatory systems makes developing, testing, and marketing of these hard.

Changes in the view of enhancement are needed for enabling this, and development of an "enhancement culture" among people will be needed to set the social norms of when they are proper or not proper to use.

More persons have realized that drugs and productions of health care can improve memory, increase attention span, etc. Progresses of science and technology would accelerate to come out more powerful drugs

Such drugs currently exist, although safety and efficacy remains an issue. The improvement is in general about 10-20% on different psychometric tests. Currently no drugs are being developed specifically for enhancement, since current medical regulatory systems makes developing, testing, and marketing of these hard. Changes in the view of enhancement are needed for enabling this, and development of an "enhancement culture" among people will be needed to set the social norms of when they are proper or not proper to use.

inhibiting and negative

(The search for promising) psychoactive drugs might start a race among parents to enhance their children. However, if not properly studied, some of these drugs might have negative effects and delay further research in other more promising drugs.

Drug use is highly controversial in many societies both due to puritan anti-narcotics concerns, a high value placed on "the natural" and medical monopolies. These factors can block or limit development of cognitive enhancer drugs strongly.

The use of drugs to improve (learning) is extra controversial since it is usually viewed as occurring among children with limited consent, raising fears of competition forcing everybody into a drug race. While the main problem in that case may be more a competitive school system the use of any medical technology among younger people is a cause of concern.

Thinking that "miracle drugs" will solve all of the human problems will yield dangerous consequences.

Chemistry had ever contributed to the development of human society and material civilization, but it brings also many sickness-causing substances to human health. Using drugs could enhance intelligence, improve memory, but never forget that any drug has always a few toxins.

Suspicion of drugs' security would discourage the possibility.

14. Web 17.0

encouraging and positive

What's happened in the past 10 years is just the beginning of how to leverage a global information web. Governments will

continue to invest heavily and private capital will continue as well since the cost-benefit ratios are so favorable.

A very plain extrapolation from current strong trends in technology and society, especially in this area that is in the hands of all of us: co-creation will lead to massive co-development, and we are likely to leapfrog to Web 17.0 much sooner than solving much more radical problems or meeting much more crucial challenges...

…speed and distance (will) be no longer a problem.

(Inhibiting factors include) … inconsonance of frequency, restrictions of policy in each country... What interests the people is not technology itself and logical rules, but the evolution of contents brought by technology.

inhibiting and negative

New kinds of viruses and methods of manipulating information delivery could distort knowledge on the semantic web by those who don't like the new knowledge. In the past, cigarette companies distorted cancer research, today an oil company is distorting global warming research, and in the future, ideologues might want to distort research that counters their ideology.

The already present misuse of the net, illegal and other unethical activities will be likely to increase if more ethical ways of use are not implemented.

Biological and/or natural catastrophes or manmade cataclysms (due to terror and/or error) could slow or stop progress. At any point in time progress can be stopped by these or a wildcard the origins of which we are now unaware

Industries will fight open source software initiatives…. The good of the group requires that industries focus on "services science" and on natural capital

15. Integrated life-long learning systems

encouraging and positive

Lifelong learning is already a reality. People continue learning throughout their lives…. Furthermore, learning is now combined with leisure and entertainment, and it is growing so fast as to become the largest industry in the world. More people are devoted to education (teaching and learning) and for more years than in any time in history before. Life has become learning, with a lot of leisure added

In knowledge-based society, the spiritual needs of people, as well as more humanistic educational idea would promote the emergence of such possibility.
Nowadays there is already the curriculum across all age groups, but its content would be much richer in 2030 and practical for the various stages of life to learn the necessary knowledge and skills.

inhibiting and negative

Increasing poor-rich, south-north gaps, may delay worldwide developments.

Too much dependency (on) computers trying to substitute the epistemological process of learning. We must not forget that computers are IT and are instruments for us to use to our benefit in learning.

The widening gap between rich and poor and imbalance in development of different countries would result in breaking out conflicts and interrupt the course of education.

Almost nothing can hinder the occurrence of this possibility.

16. Programs aimed at eliminating prejudice and hate

encouraging and positive

There have been programs of this kind (for example, to promote tolerance) for years, and there will be in 2030. The fundamental question is whether these programs in 2030 can be significantly more effective than existing ones.

Move the concept of diversity toward a concept of individual 'giftedness' and away from strictly a concept of race/creed. Positioning diversity as a race/creed concept simply creates new, though

perhaps more equitable divisions, while it fails to solve the core issue of division in the first place… A focus on personal giftedness with clarity for how one contributes in industry and/or society encourages engagement and cooperation at all levels without creating 'new social divisions.'

Changing emotionally learned material requires emotion, either pain or some positive feeling ..."for the good of others, my self, my children, the planet," I am not certain this can easily be taught in schools and may require generational growth. That is one of the reasons long term thinking should be built into an educational system so that we accept a pace of life that allows ideas to grow and mature into new generational beliefs.

Learning from parents, peers, religions, etc is a much different process than from data bases. It carries all the emotional content and meaning that most people build their lives and behaviors around. So changing this learning (of hate) requires recognition, unlearning, commitment to a new belief and then emotional change. Whereas learning educational material simply means adopting a new idea that is recognized as better than the first.

Left brain use and so called "intelligence" alone will not do it; emotional learning capacities must be tapped for success in this area.

To avoid the war and extremist in dealing with the conflicts among various countries or regions with might and main and reduce violence in media and entertainment programs, it would conduce to build a harmonious world.

inhibiting and negative

If this were successful, (it would mean)… that you can control human mind …. Somebody will try to control people for his or her own benefits. For example, cult leaders might use these methods or technologies to have people behave in a way they desire.

For both the better and the worse, some programs might want to interfere too much with people's knowledge, believes, feelings and emotions. Totalitarian States might want to control people like "Big Brother."

There is one danger-that such programs would become part of routine political correctness and its institutionalized hypocrisy. I.e., they won't become efficient, but only ridiculous.

Entrenched values, extremists view and age old hatred will continue to endanger this development.

Extremist would hinder this possibility.

Just with education, it would not be enough to eliminate prejudice and hate. The programs must include specific means to achieve social justice.

17. e- Teaching

encouraging and positive

… It is likely that educational opportunities in virtual or synthetic … will be perfected as tools for teaching. Avatars or 3D holographic recordings will allow top teachers to send their lessons to the underprivileged.

It's possible that by 2030 accelerating technologies could even advance humans to the point at which the elite will be educated through direct brain downloads or nanotechnology and the people in poorer areas will have to "settle" for 3D VR teachers and learn the "old-fashioned" way, by listening and trying to remember.

Education is becoming a commodity. As such, basic economics will force providers toward methods that are more effective and/or more efficient. The live teacher is one of the least efficient, and perhaps least effective way of teaching. The artificial constructs will become more and more the norm.

E-teaching might help to exchange information among educational institutions in a country, and with those in other countries. … What might encourage this possibility is to focus efforts among the educational institutions, the governments, the companies, the banks, and other organizations, cooperating and collaborating together

It might (help) to eliminate poverty, popularize science and culture, and make everyone enjoy advanced education.

inhibiting and negative

…evil regimes and entrenched institutions are likely to either: a) stifle the proliferation of educational technologies, which they generally (and rightfully) perceive to be a threat to their power; or b) utilize the technologies in a limited fashion only to further inculcate belief systems tied to their own narrow ideologies.

… Education could loose the human dimension. The personality of teacher and experience of interpersonal communication is an important part of the educational process

…why not use humans..?

Existing groups and systems providing learning today will oppose the change. Self interest controls much of what we have in education. Overall, I foresee a huge political battle, with the learner being the eventual winner. But this is not a certainty

Education is not only teaching the knowledge, but also how to be an upright person.

Rigidity of the educational system and backward of reformation of teaching system would delay the realization of the possibility.

18. Smarter than human computers

encouraging and positive

If Moore's Law continues, then this is clearly possible by 2030, but processing power may yield very different "thinking" than humans and provide an interesting cross-reference to understanding reality

There is …. (confusion about the) difference between intelligence (smartness) and genius. Intelligence is simply knowledge stored and accessed…Genius, on the other hand, is high-volume knowledge creation. This is totally distinct from storage and retrieval. This is commonly what people mean when they say "artificial intelligence," which is really a misnomer… Confusion of these concepts has stagnated AI … but clearly differentiating these will open up a new social era on many fronts, not just this one.

If you speak of memory or specific functions, the net has already accomplished that. If you speak of creative and conceptual knowledge that includes all the physical, psyche, social, emotional, sexual of the human (and all of humanity), I think it may be mimicked but never accomplished. And who would trust it?

If superhuman AI emerges, it is going to require learning. So besides AI's being copied, these entities are also going to require some form of education. Most likely that would be extremely different from human learning in terms of pure fact acquisition, but learning social interactions and dealing with the physical world (important skills even for a superhuman entity) they would require something not unlike schooling or childhoods.

It might … be the best working tool created by human beings

inhibiting and negative

> Backlash by people who are threatened the robots and computers will grow in power to control our lives beyond our control

> The fear of humanity splitting between the Enhanced and the Naturals (not Enhanced) will be a constant worry in the development of artificial intelligence and its direct application to human beings.

> We might not recognize superhuman intelligence for what it is, especially since it may be distributed and not a being per se (compare how "the invisible hand of the market" and Google solve problems

> It's impossible absolutely to make machines which are clearly smarter than humans in any way.

> The difficulty of cognition would not be inferior to exploring outer space

> Isn't there possibility that human world would be controlled by these intelligent machines like in some science fiction?

19. Artificial microbes enhance intelligence

encouraging and positive

> There is little doubt in my mind that physical performance could be enhanced this way.

> Besides artificial microbes, there might be nanobots that will also help increase overall human performance

> Symbiotic organisms have many advantages over gene therapy, but also require ways to circumvent the immune system. Symbiotic gut bacteria producing drugs seem very plausible, and could probably be used for enhancement. Anti-cavity mouth bacteria have already been demonstrated.

> I think this will occur in other ways -- through psychopharmacology and augmented cognition (through the use of computer brain interfaces) -- we are already seeing this in the military.

> Another question, "Shouldn't there be a global human review board that challenges science that questions our humanness?" (i.e. human genetic engineering.) Another, "Shouldn't all science be required to be transparent so that all humanity can decide on any issue that affects large portions of all of humanity?" It is not the right of a few to decide the good of humanity challenging concepts without such input

> Symbiotic organisms have many advantages over gene therapy, but also require ways of circumventing the immune system. Symbiotic gut bacteria producing drugs seem very plausible, and could probably be used for enhancement. Anti-cavity mouth bacteria have already been demonstrated.

inhibiting and negative

> Many people will be afraid of artificial microbes, new bacteria, and nanobots.

> (concern about mutating of) the microbes mutate and causing mental disease… Craig Venter's work on writing genetic code to create unique life-forms might develop some life-forms by 2010, then maybe another ten years to such microbes to live in and assist the brain, then another ten years to test on other mammals; hence, by 2030 (we might) have safe microbes assisting the brain keeping neurons healthy…

The good news is that it will eventually become available to everyone. The bad news is that it will eventually become available to everyone -- including those who wish to harm others or promote violence.

It might be condemned by ethical (considerations)

if genetic codes could really be written or modified, and this technology controlled by the person who wants to use it in illegal way or follow one's inclinations, it would be a tragedy for the human society.

2.6 Demographics of Participants

There were some 274 people who signed in for the education and learning study and of these 213 provided at least one answer to the questionnaire (77.7%). Almost half (48%) of the people who answered at least one question visited the site more than once. Some of the people who visited the site more than once did so many times, the record (excluding the organizers) being a dozen.

The respondents answered approximately 3,000 questions. Average number of questions answered per participant was 11.3. The maximum number of answers to any question was about 181 and the minimum, about 100.

Region

Sub Sahara Africa, 4
South East Asia, 6.2
Pacific Asia, 4.8
Europe, 26.7
North America, 34.3
Latin America, 20.5
North Africa, 0.7
Middle East, 2.6

- Europe
- Latin America
- Middle East
- North Africa
- North America
- Pacific Asia
- South East Asia
- Sub Sahara Africa
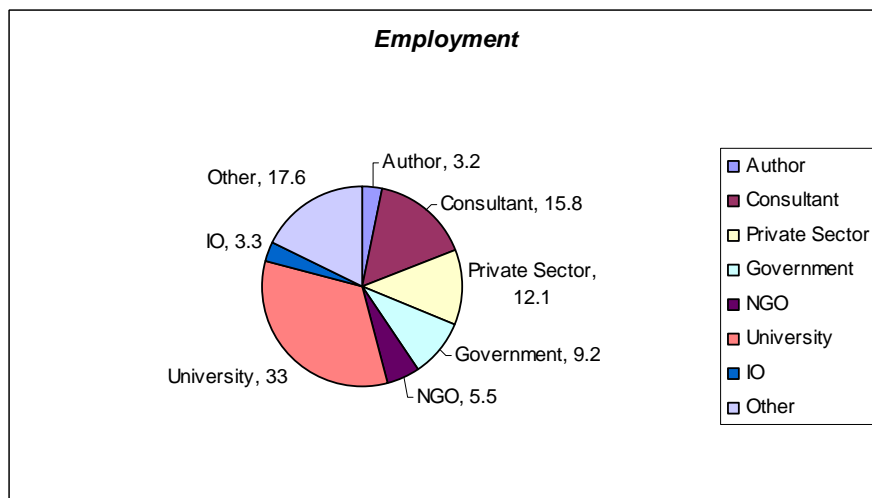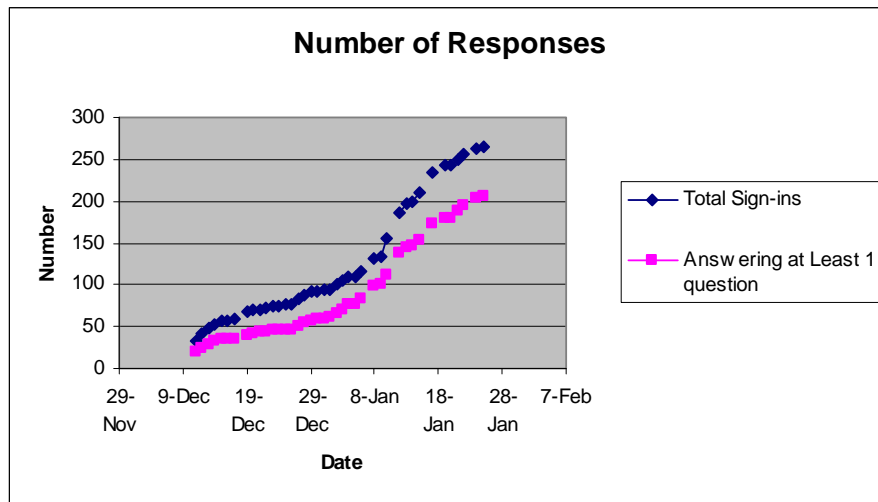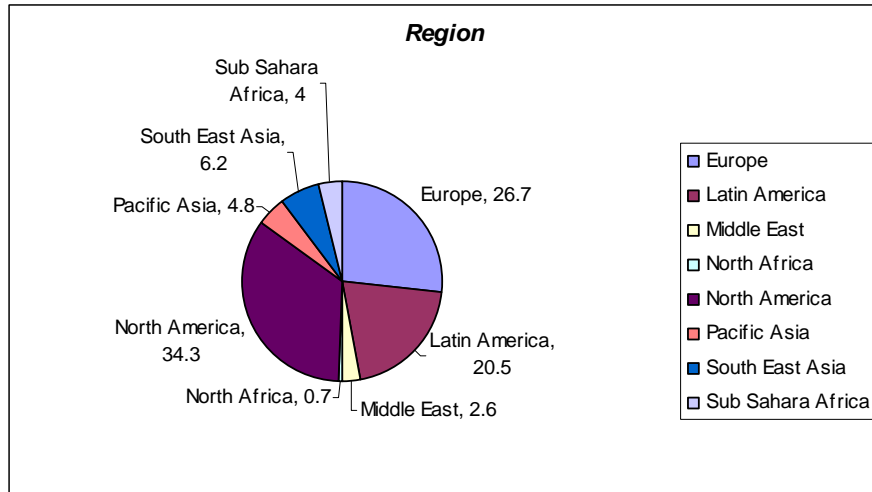
2.7 Insights and Conclusions

This study has covered a vast amount of material on the topic of future education and learning possibilities; it has attempted to avoid repeating commonplace knowledge about changes-in-progress and highlight those truly revolutionary developments that might appear in the next 25 years or so. Almost three hundred respondents provided about 3,000 answers to the questions posed in the Real Time Delphi questionnaire; the comments about factors encouraging or impeding the developments and the consequences of the developments were extensive (and even in a small type face covered some 40 pages). While many of these narrative answers expressed divergent views, the numerical judgments about the likelihood of the developments showed reasonable agreement.

Key conclusions and insights include:

> The most likely possibilities for education and learning (above 70% likelihood by 2030) from among those considered were judged to be
> > Web 17.0
> > Integrated life-long learning systems
> > Chemistry for brain enhancement
> > Just-in-time knowledge and learning
> > Use of public communications to reinforce pursuit of knowledge

> The least likely possibilities for education and learning (below 40 % likelihood by 2030) from among those considered were judged to be
> > Genetically increased intelligence
> > Artificial microbes enhance intelligence

> It is possible that the advances discussed in this study will not be available to all students, thus creating gaps in knowledge and capacities that are not present today. The lack of universal availability may be due to cost, political pressures (including the politics of academia), or reactions from existing institutions.

> Since some political regimes will view the new educational capacities as a threat to their power, one can expect that some of these techniques will be outlawed or distorted to perpetuate the existing regimes, ideologies, and belief structures in various places in the world.

> The advent of learning enhancing drugs may result in a drug competition race and raise questions about distribution and the ethics of charging for so important a commodity.

> Some of the techniques discussed here might be used as a tool for accelerating the absorption of immigrant populations.

> It is possible that an international competition in intelligence may develop.

> The shift to a collective intelligence appears to be already underway, as evidenced by (paraphrasing one respondent) mass on-line collaboration, open source software, knowledge creation communities, and social sharing of learning resource (e.g., Wikipedia, YouTube, MySpace, FaceBook, and SecondLife) often without overt individual financial compensation or incentives

> The drive toward collective intelligence may give rise to its counterforce and effort by outstanding individuals to opt out of the "collective" (anti-borg)

Developments lead to their counter developments and safeguards, even in education. For example the advent of portable artificial intelligence devices may lead to a 'race' to build portable 'anti-artificial intelligence devices' to protect oneself as an individual.

Improvements in intelligence will make even the bad guys smarter.

A "trickle down" strategy might be exploited to obtain new educational technologies; one respondent said, for example: "Standard data and simulation formats … allow cut-down versions of scientific simulations to be used in education." Perhaps the military and industry could be "mined" for similar applications.

When teaching goes on line, computer hacking into the curriculum and information will be an issue.

Just-in-time information can make everyone who has access look like an expert and true expertise will become hard to find and take on new meaning.

Since nutrition is "natural" compared to (say) cognition enhancement drugs, it is likely to be easier to accept for many.

Cultural differences may lead one nation to adopt technologies and practices that lead to increased intelligence while other countries reject them based on cultural taboos or beliefs.

Rather than being used to enhance the intelligence of many people, genetic techniques might be used to remove or modify genes that result in lower intelligence

Any intervention may have unexpected medical and social consequences

Attempts to change curricula will inevitably bring questions about the ideologies that drive the changes

Respondents raised interesting and important questions about some of the possibilities:

Can simulations be so real and captivating that real life looses its significance?

Will intelligent machines think and reason in ways that are different than human thinking?

Will people migrate to countries that offer a means of increasing intelligence?

Does everybody become smarter, or does the gap grow?

Are the less intelligent made smarter, thereby raising the average or is everybody boosted?

From a methodological standpoint, the Real Time Delphi technique worked well.

There appears to be a distinct relationship between the levels of agreement among the respondents and the likelihood of the items being considered. The highest agreement was achieved at the extreme likelihoods; the least agreement at the mid range of likelihood.

Several people wrote the administrator asking for the access code since they had forgotten it or misplaced it. Only one or two people expressed difficulty in using the system and at least in one case this was traced to a problem with the respondent's company firewall which didn't allow outgoing messages from a company computer.

Several respondents had problems or suggested changes that led to modifications in the study (e.g. minor rewording of a given possibility) while under way and possible revisions for consideration in a future study. Among these were:

> Use the median response rather than the group average to avoid distortion of the group response by far outliers.

> Hiding the average or median under an icon to reduce its influence on the first entry

> Providing translations on line

> Periodic publication of a list of respondents so that the node leaders could see who, from among their invitees, had responded in their areas

The request for a list of respondents by country was met in this study by downloading the names of the respondents and sending the lists by email to the appropriate nodes. In the future, this feature may be automated.

Several nodes asked for hard copies of the questionnaire so that they could be answered off line. These requests were met, although as was pointed out, using the hard copy prevented the respondents from seeing up to minute feedback.

Comments about the method included the following:

> I completed the exercise moments ago, spending four hours doing it fast, and could have spent 40 on comments.

> Like the original Delphi process, which is such a generic tool, RTDelphi now enables convergence of expert assessment (for decision support) in a distributed, asynchronous, and more timely manner. I see even greater value it can bring forth, when we get the chance to integrate it into the full SOFI system
> …we'll use ideas from and elements of the survey for start-up workshops on futures…

> You've developed a great system that serves a big need. Congratulations on a job well done.

> Thanks to all who are involved in this vital work, and especially to Jerry Glenn for the invitation to contribute to this discussion.

> Done my bit for your project. If I could understand it, anyone can. Pass my congratulations on to your web guy, I found nothing confusing. This now works easily for me. Always glad to support you.

APPENDICES

Appendix 1: Real Time Delphi Study of Education and Learning Possibilities 2030 (questionnaire)

By pass introduction

Introduction

You do not have to complete this questionnaire in one visit. When you return to the questionnaire you will see your previous answers and may change them if you wish. You are encouraged to return to this questionnaire several times before the deadline of January 17, 2007.

Focus

This study requests that you provide judgments about important learning and educational possibilities over the next 25 years. The study is broad and all ideas are invited, even those that seem far out today but may become real in the next 25 years. As you will see the study includes the transfer of knowledge, improving intelligence, training, socialization, changes in technology, institutional change, and delivery methods. As you answer questions about the likelihood of future developments in the next 25 years, please consider what has happened in the last 25 years: the acceleration of systems that transfer information, growing knowledge of the functioning of the brain and the genetic basis for development. Things not dreamed of 25 years ago are commonplace today. You are encouraged to be adventurous in your thinking and speculate about the futures of education and learning that are based on an acceleration of today's acceleration.

The Questionnaire

Your answers will remain anonymous although your name will be listed as a participant. Please answer only those questions about which you feel comfortable. Leaving sections blank is acceptable.

You will note that the column calling for your judgments has several entries:

1) A place for you to enter your estimate of the likelihood that a given educational or learning possibility will be in use at least experimentally by 2030, in formal or informal settings, in schools, on line, by business- or in modes we may not have yet thought of- somewhere in the world. **Please enter a number between 0 and 100 which represents your judgment about the possibility's likelihood by 2030.**

2) The current group average assessment of likelihood.

3) The number of responses received so far

4) A "click here" button that takes you to a second page where you can provide a variety of judgments about each possibility, and see a list of inputs provided by other participants.

Finally

A box at the bottom of the questionnaire invites your further suggestions.

There are two ways to enter your answers. **1) You may enter your answers one at a time by pressing the "go" button in each cell or 2) you may press the "submit" button at the bottom of the form** to enter your answers all at once. If you choose to enter your responses one cell at a time by pressing "go" in each cell, please make sure that new inputs in other cells have been entered or they will be lost. In either case, your answers will be entered immediately, and the form will return to your screen. When you see the form it will contain your answers, the group's answers will have been updated to include your estimate, and you may change your answers if you wish.

Please return to the questionnaire often. When you come back you will to see how the group's answers have evolved and you will be able to change your answers if you wish.

This questionnaire is not like questionnaires with which you may be familiar. You need not complete it all in one sitting. It will be available to you through January 17, 2007.

Please remember to press SUBMIT at end of questionnaire.

Questionnaire

Number	Possible Development	Likelihood by 2030 (%)
1	**National programs for improving collective intelligence** Some richer as well as lower income countries have (by this year of 2030) made improving collective intelligence a national goal; this includes improving individual as well as intelligence for their nations-as-whole.	Likelihood by 2030 The average group answer: 36.9 Respondents: 37
2	**Just-in-time knowledge and learning** Rote learning has diminished in importance. With ubiquitous computing and education for life-long learning, 'just-in-time knowledge' has become the norm. Reasoning, problem solving, and learning strategies form the core focus of public educational systems.	Likelihood by 2030 The average group answer: 36.1 Respondents: 23
3	**Individualized education** Through tests of various sorts, including simulations, the needs of individual students are being assessed and curricula and instructional methods are tailored to individual students. Twenty years ago this used to be called 'special needs' but now it is recognized that all students have special needs and those needs are being largely met in many places in the world.	Likelihood by 2030 The average group answer: 36.1 Respondents: 11
4	**Use of simulations**	Likelihood by 2030

	In 2030, virtual reality simulations with programmed learning are available and used internationally, accounting for nearly a third of the tele-educational experience in elementary and secondary schools. These simulations allow people to progress at their own pace alone or in groups. They are designed on the basis of insights derived from cognitive science. They diagnose and adapt to the individual's and/or group's learning style and need for hints and other forms of prompts. This is a means of providing artificial experience and social experimentation in a safe environment	The average group answer: 37.7 Respondents: 6
5	**Continuous evaluation of individual learning processes designed to prevent people from growing unstable and/or becoming mentally ill.** The objective of these programs which have appeared in several countries is to identify persons who seem likely in later life to exhibit antisocial behavior including terrorist activities and violent criminality. Special nurturing programs are provided to people identified in this way to help them from becoming unstable or mentally ill in later life.	Likelihood by 2030 The average group answer: 32.4 Respondents: 5
6	**Improved individual nutrition** Self-administered diagnostic tests identify individualized nutrition requirements for improved cognitive development. These tests are used in the more affluent areas and are beginning to be used in lower income areas with government and insurance company support.	Likelihood by 2030 The average group answer: 26.7 Respondents: 3
7	**Genetically increased intelligence** Genes that contribute to increasing intelligence and learning have been identified and used by many parents in the upper and middle classes of the world to change the potential intelligence of their future children. Treatments have been subsidized for many people in the poorer regions.	Likelihood by 2030 The average group answer: 58.7 Respondents: 3
8	**Use of global on-line simulations as a primary social science research tool** Virtual realities like Second Life (which in 2006 had more than a million and a half inhabitants) are used by leading cognitive scientists, curriculum experts, behavioral scientists to evolve the equivalent of natural laws for social behavior and new tele-virtual educational simulations. In these e-universes, people act as societies, form laws, build new cultures and provide a means to experiment with the glue of society without concerns that might accompany human experimentation.	Likelihood by 2030 The average group answer: 55.0 Respondents: 2
9	**Use of public communications to reinforce pursuit of knowledge** In 2030, social marketing of learning concepts or memes is widespread. Some of the themes have been: Intelligence is Sexy; Knowledge is Cool; Knowledge Matters; Ignorance Equals Poverty, and other such concepts. Public media leaders often meet with educational leaders, cognitive scientists, and entertainers to discuss promoting the message that learning is a	Likelihood by 2030 The average group answer: 69.0 Respondents: 3

	central pursuit of life.	
10	***Portable artificial intelligence devices*** Most people carry tiny computers that contain extensive personal memories, and interact with their owners in human fashion. Meet a person on the street and the ear buds whisper on the basis of facial pattern recognition,' That's Billy Johnson who you met at a party three years ago. He is a pilot and his wife's name is Angie.' More seriously, the machine also participates in personal decision making and on the spot need for information. Some individuals have been technologically augmented with nanobots, brain chips and nanotech transceivers in clothing.	Likelihood by 2030 The average group answer: 18.3 Respondents: 3
11	***Complete mapping of human synapses to discover how learning occurs and thereby develop strategies for improvement of learning*** Just as the gene was decoded so was the connection pattern of the synapses in the human brain. From this complex map came information about cognitive development, intelligence, emotion, how to design artificially intelligent machines, and ultimately how to improve the speed and depth of learning.	Likelihood by 2030 The average group answer: 22.0 Respondents: 1
12	***Means for keeping adult brains healthier for longer periods*** In our time (2030) we have techniques for keeping adult brains healthier during the aging process. For example, adult neural stem cells have been cloned and injected into adult brains to keep them far healthier for longer times then formerly believed possible, making old age learning and an older knowledge-based work force possible.	Likelihood by 2030 The average group answer: 26.0 Respondents: 2
13	***Chemistry for brain enhancement*** Brain chemistry research has led to safe drugs that enhance intelligence, improve memory, increase attention span, improve visual acuity, and hand/eye coordination.	Likelihood by 2030 The average group answer: 22.0 Respondents: 1
14	***Web 17.0*** By 2030 the trend toward data integration on the Web that started around the turn of the century (Google Earth, Wikipedia, the MIT course material) has progressed to the point that a large part of the world's knowledge - data, analyses, discussions - has been integrated into Semantic Web 3.0. That structure is organized according to a logical framework of concepts (both precise and fuzzy ones), has a natural language interface, is dynamically maintained, and contains an intelligent subsystem that 'understands' the logical rules that govern the interactions of entities. The interface makes heavy use of virtual reality type graphic techniques for presenting knowledge and processes.	Likelihood by 2030 The average group answer: 18.0 Respondents: 2
15	***Integrated life-long learning systems*** Today (2030) education ranges across all ages groups from pre-natal programs to programs for the elderly that provide	Likelihood by 2030 The average group answer: 22.0 Respondents: 1

	knowledge, work, and leisure enjoyment.	
16	**Programs aimed at eliminating prejudice and hate** Our psychologists (2030) believe that many wars and extremist activities are fueled by overt or subtle teachings of parents, peers, and teachers. Significant efforts have been made to reduce these influences in the education of young people.	Likelihood by 2030 The average group answer: 22.0 Respondents: 1
17	**e- Teaching** Most of the poorer areas, as well as the more affluent ones use global outsourcing for e-teachers on-demand. These e-teachers are increasingly artificial constructs using artificial intelligence, rather than live humans.	Likelihood by 2030 The average group answer: 22.0 Respondents: 1
18	**Smarter than human computers** Machines exist today (2030) which are clearly smarter than humans in any way that 'smartness' can be measured. With this threshold having been passsed, the roles and methods of education and learning are being reassessed everywhere.	Likelihood by 2030 The average group answer: 22.0 Respondents: 1
19	**Artificial microbes enhance intelligence** Genetic codes have been written for new microbes which improve neural performance when co-habiting the brain.	Likelihood by 2030 The average group answer: 22.0 Respondents: 1

Please suggest other important educational and learning possibilities that you think might be possible by 2030. If you have references, please include them as well.

Please come back in a few days to see how your views match others and to see if there are new insights that might change your views. You are encouraged to return many times before the deadline to review your entries. If you have difficulties please send your questions to acunu@igc.org.

To go to the top of this form

To sign out

Date: 1 January, 2007

==============Please use your browsers back button to return to the questionnaire====================

1. National programs for improving collective intelligence.

Some richer as well as lower income countries have (by this year of 2030) made improving collective intelligence a national goal; this includes improving individual as well as intelligence for their nations-as-whole.

...1. October 13, 2006 MIT opened a new center for Collective Intelligence. http://cci.mit.edu/launch.html

...2. Collective intelligence examples: http://www.socialtext.net/mit-cci-hci/index.cgi?examples_of_collective_intelligence

...3. Are dramatic increases in collective human-machine intelligence plausible within 25 years? Yes – 70%, The Millennium Project S Delphi, 2003 http://www.acunu.org/Delphi/SciTechScenariosRnd2.html#humach

==============Please use your browsers back button to return to the questionnaire====================

2. Just-in-time knowledge and learning.

Rote learning has diminished in importance. With ubiquitous computing and education for life-long learning, 'just-in-time knowledge' has become the norm. Reasoning, problem solving, and learning strategies form the core focus of public educational systems.

...1. Computerworld: Just-in-time Learning, 2000 http://www.computerworld.com/news/2000/story/0,11280,44312,00.html

...2. Just-in-Time Education: Learning in the Global Information Age, 2000 http://knowledge.wharton.upenn.edu/signup.cfm;jsessionid=a83027f532806037603a?CFID=16859563&CFTOKEN=73811409&jsessionid=a83027f532806037603a

...3. Just-in-time learning; the acquisition of knowledge or skills as they are needed. http://www.wordspy.com/words/just-in-timelearning.asp

==============Please use your browsers back button to return to the questionnaire====================

3. Individualized education.

Through tests of various sorts, including simulations, the needs of individual students are being assessed and curricula and instructional methods are tailored to individual students. Twenty years ago this used to be called 'special needs' but now it is recognized that all students have special needs and those needs are being largely met in many places in the world.

...1. Individualized Education Plans, 2003 http://www.childtrendsdatabank.org/indicators/98IndividualizedEducationPlan.cfm

...2. Special Education Resources on the Internet, 2001 http://seriweb.com/

==============Please use your browsers back button to return to the questionnaire====================

4. Use of simulations.

In 2030, virtual reality simulations with programmed learning are available and used internationally, accounting for nearly a third of the tele-educational experience in elementary and secondary schools. These simulations allow people to progress at their own pace alone or in groups. They are designed on the basis of insights derived from cognitive science. They diagnose and adapt to the individual's and/or group's learning style and need for hints and other forms of prompts. This is a means of providing artificial experience and social experimentation in a safe environment

...1. Jong-Heon Kim, et al., Virtual Reality Simulations in Physics Education
http://imej.wfu.edu/articles/2001/2/02/index.asp

...2. Virtual Reality: History; Expo/Theater/Virtual Environments, 1995
http://archive.ncsa.uiuc.edu/Cyberia/VETopLevels/VR.History.html

...3. Wikipedia, Virtual Reality, 2006 http://en.wikipedia.org/wiki/Virtual_reality

==============Please use your browsers back button to return to the questionnaire====================

5. Continuous evaluation of individual learning processes designed to prevent people from growing unstable and/or becoming mentally ill..

The objective of these programs which have appeared in several countries is to identify persons who seem likely in later life to exhibit antisocial behavior including terrorist activities and violent criminality. Special nurturing programs are provided to people identified in this way to help them from becoming unstable or mentally ill in later life.

...1. Jean-Pierre Voyer, The Pre-conditions for a Constructive Social Inclusion Reearch Agenda, 2003
http://www.ccsd.ca/events/inclusion/papers/voyer.pdf

==============Please use your browsers back button to return to the questionnaire====================

6. Improved individual nutrition.

Self-administered diagnostic tests identify individualized nutrition requirements for improved cognitive development. These tests are used in the more affluent areas and are beginning to be used in lower income areas with government and insurance company support.

...1. Foods that Build and Foods that Drain the Brain, 2000 http://www.askdrsears.com/html/4/T040400.asp#T040405

...2. Foods and Vitamins that Help Brain Development and Repair Damage
http://www.yourfamilyclinic.com/nutrition/brainboost.html

...3. UN FAO, Fish is food for the brain as well as good protein, http://www.fao.org/FOCUS/E/fisheries/nutr.htm

==============Please use your browsers back button to return to the questionnaire====================

7. Genetically increased intelligence.

Genes that contribute to increasing intelligence and learning have been identified and used by many parents in the upper and middle classes of the world to change the potential intelligence of their future children. Treatments have been subsidized for many people in the poorer regions.

...1. Wesley Smith, Biohazards Advances in biological science raise troubling questions about what it means to be human, 2005 http://www.discovery.org/scripts/viewDB/index.php?command=view&id=3005

...2. João Pedro de Magalhães, Defining Our Children's Traits, 2006 http://jp.senescence.info/thoughts/genetics.html

...3. Everett Mendelsohn, The Eugenic Temptation, Harvard Magazine, 2006 http://www.harvardmagazine.com/on-line/0300126.html

==============Please use your browsers back button to return to the questionnaire=====================

8. Use of global on-line simulations as a primary social science research tool.

Virtual realities like Second Life (which in 2006 had more than a million and a half inhabitants) are used by leading cognitive scientists, curriculum experts, behavioral scientists to evolve the equivalent of natural laws for social behavior and new tele-virtual educational simulations. In these e-universes, people act as societies, form laws, build new cultures and provide a means to experiment with the glue of society without concerns that might accompany human experimentation.

...1. Second Life Home Page, 2006 http://secondlife.com/

...2. Popular Science, Your Second Life is Ready, 2006 http://www.popsci.com/popsci/technology/7ba1af8f3812d010vgnvcm1000004eecbccdrcrd.html

...3. Roger Segelken, Artificial worlds used to unlock secrets of real human interaction, 2003 http://www.news.cornell.edu/releases/Feb03/AAAS.Macy.hrs.html

==============Please use your browsers back button to return to the questionnaire=====================

9. Use of public communications to reinforce pursuit of knowledge.

In 2030, social marketing of learning concepts or memes is widespread. Some of the themes have been: Intelligence is Sexy; Knowledge is Cool; Knowledge Matters; Ignorance Equals Poverty, and other such concepts. Public media leaders often meet with educational leaders, cognitive scientists, and entertainers to discuss promoting the message that learning is a central pursuit of life.

...1. The Socoal Marketing Institute, http://www.social-marketing.org/sm.html

...2. Wikipedia: Social Marketing, 2006 http://en.wikipedia.org/wiki/Social_marketing

...3. Center for Disease Control, Social Marketing, 2003 http://www.cdc.gov/communication/practice/socialmarketing.htm

==============Please use your browsers back button to return to the questionnaire=====================

10. Portable artificial intelligence devices.

Most people carry tiny computers that contain extensive personal memories, and interact with their owners in human fashion. Meet a person on the street and the ear buds whisper on the basis of facial pattern

recognition,' That's Billy Johnson who you met at a party three years ago. He is a pilot and his wife's name is Angie.' More seriously, the machine also participates in personal decision making and on the spot need for information. Some individuals have been technologically augmented with nanobots, brain chips and nanotech transceivers in clothing.

...1. Stanford Research Center, Artificial Intellignece Center, 2006 http://www.ai.sri.com/

...2. MIT, Computer Science and Artificial Intelligence Laboratory, 2006 http://www.csail.mit.edu/index.php

...3. Journal of Artificial Intelligence Research, 2006 http://www.jair.org/

==============Please use your browsers back button to return to the questionnaire====================

11. Complete mapping of human synapses to discover how learning occurs and thereby develop strategies for improvement of learning.

Just as the gene was decoded so was the connection pattern of the synapses in the human brain. From this complex map came information about cognitive development, intelligence, emotion, how to design artificially intelligent machines, and ultimately how to improve the speed and depth of learning.

...1. Mapping miniature synaptic currents to single synapses using calcium imaging reveals heterogeneity in postsynaptic output, 2006 http://www.ionchannels.org/showabstract.php?pmid=7619520

...2. Society for Neuroscience, Scientists Map Maturation Of The Human Brain; Make Advances In Understanding The Lasting Effects Of Stress, Nicotine And Alcohol, 2006 http://www.sfn.org/index.cfm?pagename=news_11082003a

...3. Allen Institute for Brain Research, 2005 http://www.alleninstitute.org/content/about_the_institute.htm

==============Please use your browsers back button to return to the questionnaire====================

12. Means for keeping adult brains healthier for longer periods.

In our time (2030) we have techniques for keeping adult brains healthier during the aging process. For example, adult neural stem cells have been cloned and injected into adult brains to keep them far healthier for longer times then formerly believed possible, making old age learning and an older knowledge-based work force possible.

...1. Monika Guttman, The Aging Brain; Scientists are amassing a greater understanding of the long-term risk factors that adversely effect the brain in order to halt cognitive deterioration, 2001. http://www.usc.edu/hsc/info/pr/hmm/01spring/brain.html

...2. The Brain Aging Journal, 2006 http://www.brainaging.ro/Pub-BAJ.htm

...3. Medical News Today, With Few Factors, Adult Cells Take on Characteristics of Embrionic Stem Cells, December 9, 2006 http://www.medicalnewstoday.com/medicalnews.php?newsid=49405

==============Please use your browsers back button to return to the questionnaire====================

13. Chemistry for brain enhancement.

Brain chemistry research has led to safe drugs that enhance intelligence, improve memory, increase attention span, improve visual acuity, and hand/eye coordination.

...1. Wikipedia: Psychoactive Drug, 2006 http://en.wikipedia.org/wiki/Psychoactive_drug

...2. World Health Organization: Psychotropic Drugs, 2006 http://www.who.int/topics/psychotropic_drugs/en/

...3. Psychotropic Drugs and Children; Use, Trends, and Implications for Schools, 2004 http://www.healthinschools.org/sh/psychotropic.pdf

==============Please use your browsers back button to return to the questionnaire====================

14. Web 17.0.

By 2030 the trend toward data integration on the Web that started around the turn of the century (Google Earth, Wikipedia, the MIT course material) has progressed to the point that a large part of the world's knowledge - data, analyses, discussions - has been integrated into Semantic Web 3.0. That structure is organized according to a logical framework of concepts (both precise and fuzzy ones), has a natural language interface, is dynamically maintained, and contains an intelligent subsystem that 'understands' the logical rules that govern the interactions of entities. The interface makes heavy use of virtual reality type graphic techniques for presenting knowledge and processes.

...1. The Futurist: The Intelligent Internet http://www.gcn.com/online/vol1_no1/26338-1.html

...2. Bill Gates, Now for an Intelligent Internet, 2000 http://www.microsoft.com/presspass/ofnote/11-00intelligenti.mspx

...3. Artificial Intelligence Foundation, 2006 http://alice.pandorabots.com/

==============Please use your browsers back button to return to the questionnaire====================

15. Integrated life-long learning systems.

Today (2030) education ranges across all ages groups from pre-natal programs to programs for the elderly that provide knowledge, work, and leisure enjoyment.

...1. Elderhostel; Adventures in Lifelong Learning http://www.elderhostel.org/

...2. Life in the USA- Retirement and Aging New Careers, 2005 http://www.lifeintheusa.com/aging/careers.htm

==============Please use your browsers back button to return to the questionnaire====================

16. Programs aimed at eliminating prejudice and hate.

Our psychologists (2030) believe that many wars and extremist activities are fueled by overt or subtle teachings of parents, peers, and teachers. Significant efforts have been made to reduce these influences in the education of young people.

...1. US Department of Justice, Preventing Youth Hate Crimes, http://www.usdoj.gov/crs/pubs/prevyouhatecrim.htm

...2. Kathleen Cotton, Fostering Intercultural Harmony in Schools: Research Finding http://www.nwrel.org/scpd/sirs/8/topsyn7.html

...3. Canada's Fourth Report under the International Covenant on Civil and Political Rights, 2006
http://www.canadianheritage.gc.ca/progs/pdp-hrp/docs/iccpr/notes_e.cfm

==============Please use your browsers back button to return to the questionnaire====================

17. e- Teaching.

Most of the poorer areas, as well as the more affluent ones use global outsourcing for e-teachers on-demand. These e-teachers are increasingly artificial constructs using artificial intelligence, rather than live humans.

...1. John Harris, Why We Need Better E-Teaching, Not More E-Learning, 2005
http://meld.medbiq.org/divergent_views/better_eteaching_harris.htm

...2. Wikipedia, e- learning, 2006 http://en.wikipedia.org/wiki/E-Learning

...3. Wikipedia, Advanced Distributed Learning, 2006 http://en.wikipedia.org/wiki/Advanced_Distributed_Learning

==============Please use your browsers back button to return to the questionnaire====================

18. Smarter than human computers.

Machines exist today (2030) which are clearly smarter than humans in any way that 'smartness' can be measured. With this threshold having been passsed, the roles and methods of education and learning are being reassessed everywhere.

...1. The Singularity Institute for Artificial Intelligence http://www.singinst.org/overview/whatisthesingularity/

...2. Nick Bostrom, Futurist Magazine, When Machines Outsmart Humans, 2000
http://www.nickbostrom.com/2050/outsmart.html

...3. Raymond Kurzweil, Will My PC Be Smarter Than I Am?, 2000
http://www.kurzweilai.net/meme/frame.html?main=/articles/art0354.html?

==============Please use your browsers back button to return to the questionnaire====================

19. Artificial microbes enhance intelligence.

Genetic codes have been written for new microbes which improve neural performance when co-habiting the brain.

...1. Antonio Regalado, The Wall Street Journal, Biologist Venter aims to create life from scratch, 2005
http://www.post-gazette.com/pg/05180/530330.stm

...2. David A. Relman, The human body as microbial observatory
http://www.nature.com/ng/journal/v30/n2/full/ng0202-131.html

...3. Michael Purdy, Gut microbes' partnership helps body extract energy from food, store it as fat, 2006
http://mednews.wustl.edu/news/page/normal/7328.html

nstructions for Adding Your Comments (Page 2)

Introduction

This page poses questions about positive and negative developments associated with each education and learning possibility. You can enter new answers or change your old answers; the answers that others in the group have already provided are listed below.

The questions are posed in two sets:

1. What developments would encourage the possibility and what beneficial results might follow the realization of the possibility?

2. What developments would discourage the possibility and what detrimental results might follow the realization of the possibility?

Please provide your answers to BOTH questions below and SUBMIT them at the bottom of this page. You can use your browser's BACK button to return to the first page.

==

The possibility: National programs for improving collective intelligence

Some richer as well as lower income countries have (by this year of 2030) made improving collective intelligence a national goal; this includes improving individual as well as intelligence for their nations-as-whole.

1. What might encourage this possibility? What positive consequences might follow?

Please enter positive developments and consequences. If you wish to change your prior input, type it here:


```
***it will improve the economy of the country if the national intelligence is
***Review of the Venezeula "national intelligence" program in the 80's. If I
***Moving to an industrial economy
***There is a great need for this, I believe
***Since knowledge is one, there is natural benefit in bringing knowledge
***Virtual learning and decision making communities will gradually supplar
***It is already on the political agenda and competing activities in this direc
***This process is already well underway as can be seen in the effective

Positive consequences will be material mitiagation of water, food and ene
```
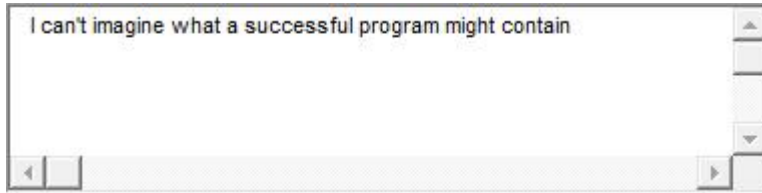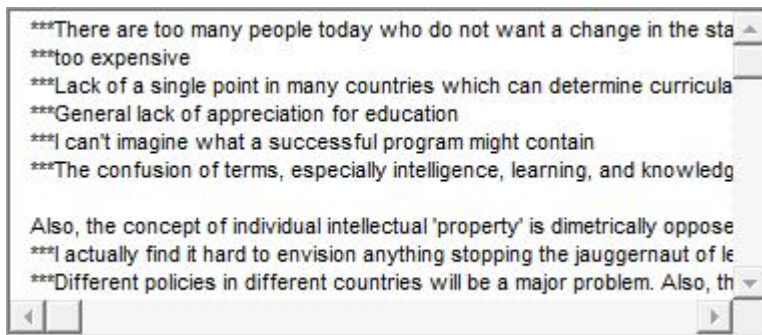
2. What might discourage this possibility? What negative consequences might follow?

Please enter impeding developments and negative consequences. If you wish to change your prior input, type it here:

> I can't imagine what a successful program might contain

Other input provided by the group:

> ***There are too many people today who do not want a change in the sta
> ***too expensive
> ***Lack of a single point in many countries which can determine curricula
> ***General lack of appreciation for education
> ***I can't imagine what a successful program might contain
> ***The confusion of terms, especially intelligence, learning, and knowledg
>
> Also, the concept of individual intellectual 'property' is dimetrically oppose
> ***I actually find it hard to envision anything stopping the jauggernaut of le
> ***Different policies in different countries will be a major problem. Also, th

To submit your precursor developments and consequences

Please use your browser's back button to return to your place in the questionnaire.

To return to the top of the questionnaire

To go to the top of this reasons form

To sign out

Date: 1 January, 2007

Appendix 2: Comments by Respondents on Other Education and Learning Possibilities

- From this part of the world, where substantial differences between rich and poor co-exist, many advantages -characteristically of the rich and powerful world-, will be melt with the poorest tools related with educational programs. There in South Cone it is central -as in the rest of the world- that the State takes the risk with this issue. Many reforms should be done, but first of all, the State must guarantee the inclusion to the society first an -especially to the educational system-, to each member of the country. Then an equal standard of education can be guarantee to everybody. Personally we are quite far away from many e-tools, technology and nanotechnology instruments that are very useful and can perfectly incorporate in the educational item.

- Single individual leadership could compete with most educational institution

- Will be able to consciously remember and learn from experiences in former lives (if any)?

- Virtual Reality simulations will extend to learning history in simulated, historically-accurate settings.

- It strikes me that the words "culture" and "religion" are totally absent at this point. By 2030 (hopefully), cross-cultural and cross-religious teachings should be available, if only to enable young minds to build their own opinions and make their personal decisions in these crucially "formative" areas.

- Learning and education can be integrated in movies, games, and music in order to integrate learning and leisure. In this way a huge number of students can be reached, who in the "normal" education system is lost.

- Self-organizing "wisdom of crowds." Reference: book by Swariecki (?)

- That we starting taking issues like Wisdom, (i.e. values driven attitudes and behavior), and how it is learned, much more seriously....

  References available if required.... see The Wisdom Page (via Google) and Wikipedia entry for Wisdom ... as a start ...

- Education methods will be more equalized worldwide

- I would suggest that by 2030 knowledge might be unified generalized in one universal knowledge base, in form of a modular units with the management tool so that every student, learner freely could download it. Modular units will be present itself as a piece of a knowledge – an answer of a particular question. A management tool will bring together only the contents of all necessary units in one documents create a new book that consumer will order. Here may be notions, concepts, operations, formulas, explanations, models. Today the knowledge for a particular question is in many books and is not full and often not true and fresh. Because is difficult to learn and use

- I think that much more emphasis has to be given to ethical considerations. Some of the new technologies might produce a significant "yuck" factor and will make some people talk about the dangers of "playing God."

Another fundamental issue is the flattening off the demographic pyramid, since more and more people are becoming older, living much longer, and having fewer children. This demographic trend will significantly change the population dynamics, not only in countries like Korea but around the world. The education of the future has to seriously consider the shrinking size of fresh, young, new people.

Finally, with a quickly globalizing world, more consideration should be giving to tolerance and understanding of different cultures. Religions themselves will be under increasing threats, and most other basic believes will have to be reconsidered among countries. Truth will not come anymore from religion but from science.

- Human action is future-oriented to the extent that it is goal-oriented.
  For that reason our expectations and visions of the future are relevant to our current thinking, understanding, and deciding." Masini (1993): Why future studies?, zitiert in Enders, u.a. (2005): The European Higher Education and Research Landscape 2020, S. 22

- I think one ought to consider the pedagogy of Waldorf education, for which there are many outcome studies -- too many to list here.

- The abolition of schools, home education being the norm.

  Education being redesigned with brain development & needs taken into consideration. Herman Epstein [www.brainstages.com]

- Look at the learningpapers web site :

  http://www.elearningpapers.eu/index.php?lng=fr&page=home

- 1. The future that is being shaped by genetic engineering, weapons of mass destruction and unsustainable practices for the environment asks for a new spirituality for a transformation in human consciousness and cope with the global chaos and complexity. So, there may be a new relationship in the realm of education between teachers and students, or guru-disciple relationship that fosters a trustworthy effort to help accelerate change and prepare new citizens for a new future. New outcomes of teacher/student relationship could create new educational systems based on a new kind of learning cooperation.

  2. Futures studies being incorporated into fundamental schools in the same proportion as programs related to the past

- Due to urban congestion and global warming, government and employers will make it very attractive for more parents to tele-commute, which will increase the number of children being home schooled with the aid of tele-education and virtual schools.

- Emphasis on the need to learn how to learn. Not merely the acquisition of new facts and inputs, but the capacity to discard the unnecessary and to transform the useful information into effective and productive realities.

- Artificial microbes totally unharmful to humans would add specific and temporary comprehension capabilities to an individual: i.e. pre-programmed artificial microbes labeled "PT" would permit an individual to temporarily understand and speak fluently the Portuguese language.

  Artificial intelligence-based software and devices would recreate, interpret, and analyze extinct languages. These would enhance enormously issues, facts, etc. not yet understood by pre-2030 times. Studies on History, Archeology, Egyptology, etc. are to be extremely

boomed by this technology.

- 1- Training in rational scientific thinking will be part of basic education
  2- Social simulations will guide political decisions
  3- Knowledge per se will be less important than today as society will be less prone to promote new knowledge

- Sheldrake's morphogentic field ideas may help to develop new models for collective knowledge and intelligence developments, a step ahead from cyberculture and towards a global brain and new stages of human consciousness.
  Suggested link : http://www.integralinstitute.org/public/static/default.html

- The support of global access to internet becomes one of the global development goals.

  -The right to equal access to information becomes one of the globally recognized human rights.

  -The developments in research of mental techniques [hypnosis, suggestion, extrasensory perception] bring revolutionary improvements of human learning capacities.

- The human society can helps the education evaluation in some factors:

  (1) To improve the social inclusion using the new information technologies (tics), creating spaces - communities - that could be possible to implement that,

  (2) To get better the quality education - we must to win these particular needs,

  (3) We need to evaluate the quality education in the future but we need to take care the environment planet.
- If we analyze each one of the cases and investigations presented in the different professional and scientific fields, in complementary and so diverse environments that cover the psychological thing, cognitive, nutritious, genetic doctor and the great variety of technological applications that go since the web to the bionic implants, and above all what as a group they represent for the study and development of the learning and the management of the knowledge, but from the institutional point of view, the educational systems with their schools and universities whose structures and traditional ways to operate are not favorable to the innovations, do not they appear to foretell a promising future, unless the law have any change that convert to the educational institutions in organizations that learn.

  It remains clear that the educational solutions are beyond the education and their institutions, this required decisions and actions to level macro, from integral politics and integrated to general social politics.

- Privatization of education.

  Public education moves more and more out of the public, and into the private, sector.

- The use of brain imaging to fine-tune education by actually testing what modes of teaching work best.
- I believe you have covered the exciting possibilities well. Great survey.

- The claims presented easily reflect current trends, I think. Extrapolation prevails. I think that ever more often there will be anti-trends which promote diversity and anti-trends emerge parallel to those time periods when individual values are favored: people are "alluded" to be

"different." This makes anticipation complicated, because there are a variety of trends and anti-trends on the way to 2030, but which trends or anti-trends prevail then, at that specific year, is a difficult question to answer. Further on, technical development will evidently be huge, but we might ask: if we suppose that everything will technically be possible, is the named trend or anti-trend then going to be true or not and is it going to be true in the field of application that has been selected (here: education). Answers to that question comes near ethical considerations and might be much more interesting that trying to evaluate forthcoming technical possibilities.

- Huge data collection (from a dense distributed global network of sensors), constant recording of personal experiences.

  Universal translators available will make education international and global.

  Use of augmented reality.

  Direct integration of human brains with computers using brain-computer interfaces.

  Reference: http://future.wikia.com/wiki/Education

- Domination by ignorance is over!!

  Humanity understands that knowledge is a Humanity Belongings. Stop de loss of competitive mental models and listen with attention and respect to different children like young Einstein and use tech to understand all the people with "disabilities" as Stephen Hawking.

- Humanity makes the Quantum Jump that was trying to do and is the final key to Worldwide Sustainable Development and Peace.

- Human robot (2030) that exceeds human mental capabilities is a tutor or a teacher in classroom. http://www.ed.ams.eng.osaka-u.ac.jp/research/SocialRobo/HumanRoboCom/HumanRoboCom_jp.htm

- use of augmented cognition devices; increased use of gaming for learning

- Please consider: teaching morals, measurements of characteristics other than intelligence (e.g. emotional intelligence).

- Learning by interactive online-games

- Contests on specific projects to be performed by school students live television brainstorming sessions with open participation from the audience leaning system where the "books" are written by the students under the form of projects to be implemented collectively multimedia and animation projects to recreate facts and organize information

- "Smart Nations" will discover that the bulk of the money they spend on secret sources and methods (traditionally called "national intelligence" is in fact only producing 10% or less of the relevant information for dealing with the ten threats, twelve policies, and eight challengers (see www.oss.net/EIN). They will redirect at least one half of their secret budget toward free online education, serious games/games for change, and national online budget simulations that show the best scenarios from local to national for specific budget allocations.

- Please consider that insufficient time and human energy are being given to the examination of certain global overgrowth activities of the human species. These activities, now overspreading the surface of Earth, are to be the focus not only of education and learning

possibilities but also of knowledge acquisition by human beings with regard to the human species.

If it is all right to do so, I would like to recommend that human intelligence be directed toward what appear now as three global challenges that loom ominously before humanity on the far horizon.

Specifically, these global challenges are: 1) the current scale and rate of growth of unrestrained per human consumption of limited resources resulting in the rapid depletion (that is, dissipation) of nature; 2) the seemingly endless expansion of business industrialization and conglomeration activities on a planet with a finite productive carrying capacity; and 3) the skyrocketing, determinable increase of absolute global human population numbers between now and 2050.

For repeated references to distinctly human challenges that could be posed to humankind by the human species in Century XXI, please use the following links,

> http://sustainabilityscience.org/content.html?contentid=1176

> http://journals.aol.com/sesalmony/HumanandEnvironmentalHealth/

Questions and comments are welcome. Please feel free to contact me directly …
THANKS TO ALL WHO ARE INVOLVED IN THIS VITAL WORK, AND ESPECIALLY TO DR. JERRY GLENN FOR THE INVITATION TO CONTRIBUTE TO THIS DISCUSSION.

- Organized individual learning is considered less important than tapping the capacity of groups and communities (and whole societies) to take in, evaluate, effectively use, and creatively transcend the existing knowledge relevant to a given situation, creating new, potentially more powerful knowledge in the process. The results of such group and community "collective intelligence" will be broadly available to all individuals and groups, which makes individual "education" (as we commonly think of it re broad learning the lessons of the past) obsolete. (see "Using Citizen Deliberative Councils to Make Democracy More Potent and Awake" http://www.co-intelligence.org/CDCUsesAndPotency.html for a current political forerunner of this)

- Heutagogy, which covers the approach to learning in which the learner is self-directed, unsupervised, and must be prepared to learn how to learn, and know where to encounter the information he/she seeks at any time, and filter it for reliability and appropriateness for his/her needs. In a knowledge-based society, this will be the principal form of learning.

- Individualized and experiential learning will be enhanced

  Knowledge based objects shall be used in pedagogy

  Use of mass media will expand

- Continuous evaluation will replace examinations in most education systems

- Much more should (and may by 2030) be done to recognize the crucial first 5 years of the development of the human brain/mind. It evolved to experience and understand all aspects of the real world, especially social behavior, dominated by the infant-mother bond. Yet we "protect" so many of our infants from that reality, restricting their experience to "safe havens" like prams, cots, nurseries, etc... Changing this approach will not only have a dramatic effect on individuals reaching closer to their potential level of intelligence, but will also significantly improve their physical and mental balance/health.

A particular area of immediate improvement could be to give each infant the opportunity to develop at least 2 languages in their first 2 years of life (see Pinker for details). Natural multi-lingualism (as opposed to the much more difficult and less effective (but prevalent) path of learning other languages after the "infant window" has closed) has many other benefits for the development of individuals, including social benefits related to the early recognition of different cultures, etc...

Appendix 3: Comments on Encouraging and Discouraging Factors

1. National programs for improving collective intelligence

encouraging and positive	inhibiting and negative
There is a great need for this I believe	I can't imagine what a successful program might contain
it will improve the economy of the country if the national intelligence is higher	too expensive
I recently discussed this with senior officials in South Korea, who agreed that this would be a good goal to add to the Ministry of Education. It may not happen, but this increases the likelihood that it will occur before 2030. Another reference for improving intelligence: http://en.wikipedia.org/wiki/Intelligence_amplification and another at: http://www.socialtext.net/mit-cci-hci/index.cgi?handbook_of_collective_intelligence	
This process is already well underway as can be seen in the effectiveness of social networking sites and millions of Communities of Practice organized on the Web and spanning the globe of people working together toward the achievement of human goals that Nation State Politicians are afraid to resolve. Positive consequences will be material mitigation of water, food, and energy shortages. Democracy will be much more firmly rooted across Nation States, if not in most of them. Learning will be primarily accomplished on the Web as continuums of new structured knowledge are developed on the Web by a Wikipedia type collective which will enable anyone to do a self assessment of prior knowledge, and then be placed into the particular knowledge continuum just where they need to be to progress in a guided learning experience at their own pace of learning.	I actually find it hard to envision anything stopping the juggernaut of learning that is and will be required by a society where the human intellect is the factor of production.
Virtual learning and decision making communities will gradually supplant nation states in effective decision making. Nation states will only maintain relevance with respect to land management legislation, and that too may be devolved to smaller units as nation states will fractionate (but aggregate at a higher federative level)	
	There are too many people today who do not want a change in the status quo and do not want the generally available level of education to increase because they are currently in a position to buy better education for their children thus giving them an advantage over other children in later life.
Since knowledge is one, there is natural benefit in bringing knowledge together in collective intelligence programs. Increasing complexity and knowledge chaos will continue to drive the world toward collective intelligence approaches. The natural consequence of these is less knowledge repetition, overlap, and confusion.	The confusion of terms, especially intelligence, learning, and knowledge creation. Even in this item, does "improving collective intelligence" mean learning more about knowledge that exists, or creating knowledge that does not exist, or bringing together disparate knowledge bases, or all of the above, or something else? We will need to become much more precise in how we use these terms. Also, the concept of individual intellectual 'property' is diametrically opposed to collective intelligence. Societies will need to find a way to reward the knowledge creation act, which is the act of advancing society, without giving ownership to the resulting knowledge.
Review of the Venezuela "national intelligence" program in the 80's. If I remember correctly they had a Minister of Intelligence and he managed to increase school achievement. Program was called successful.	Lack of a single point in many countries which can determine curricula. This increases the chance that many people will be involved in the decision and hence it could be defeated.

encouraging and positive	inhibiting and negative
Moving to an industrial economy	General lack of appreciation for education
Venezuela had such a program in the 1980's, which was unfortunately discontinued but the following governments. The opportunities are incredible, not just to increase human potential, but also human-machine capabilities.	Different policies in different countries will be a major problem. Also, there will probably be "conspiracy theories" about some of these developments.
It is already on the political agenda and competing activities in this direction have started.	
Technology, and for some countries, necessity (e.g. economic competitiveness, perhaps social stability), will probably be key drivers. Positive consequences may include social stability, better national and global policy for larger segments of populations (e.g. "middle classes").	
Leadership that respects and encourages free thought and the rights of the individual (male and female, and of all religious and political backgrounds) is necessary to foster the improvement of collective intelligence. Those nation/states in which power is most evenly distributed tend benefit most. The continuing advance of information-sharing technologies enhances this and will continue to do so by magnitudes. Positive consequences ripple throughout every possible aspect of life on this planet and possibly beyond.	Entrenched despots, regimes, and institutions that fear evenly distributed power impede the improvement of collective intelligence because it is a threat to the status quo. Denial of access to information and to connections with people in intelligence networks will continue because of this. On the human-to-human scale, as Barlow put it so well, ideas regarding intellectual property must be reassessed. And, if you solve both of the problems above, which are generated by greed, you have still to deal with information overload - knowledge chaos. This it is vital to find better ways to focus intellectual energy. The negative consequences can be found at every level, from the nano-sized to the planet-ending disaster.
CI is a next step social application of immersive technologies. Bringing CI to learning programs entirely makes sense. MIT or another tech-based, academic institute will provide great service to learning by building a prototype as downloadable open source which will expedite process.	One consequence could be psychological affects over time of diminishing points for individuality and authorship talents which could cause a student-based revolt of being part of a "collective."
1. In our opinion, knowledge is the result of the epistemological process of the human brain triggered by information from the surroundings. What is possible is that a group of persons, preferably comprehensively developed, in a community with shared goals work together, a synergy is generated yielding results greater than the sum of its parts, often awesome. We firmly believe that this cooperation will be widely spread around the world by the year 2030.	Governments fighting globalization and or interference on their social ethics
For a start I might say I disagree with this proposal, being a bit arrogant due to the fact that I am not having all the material and information about it myself. Anyway, I believe that intelligence is a parameter too thin which does not encourage a social behavior such as the proposed "collective intelligence." I think intelligence is an opposed concept for the adjective collective, that says a shared issue, not being this an "intelligence" matter. On one hand the possible applications of this proposal might be great and variate; on the other hand, it might not be a positive politic to encourage problems to be solved in a collective way. As a matter of fact, I think it is not being considered the real individual aspects as well as the differences that will be much deeper in the future years to come. We are living in different "intelligence" worlds, as our own comprehension of our world is being taken within each individual.	I wish to leave this space blank for the moment...
Venezuela had a national program to improve intelligence collectively some 20 years ago and its results are being seen today. Thus, this possibility has already been realized	Lack of interest in long term projects
Growing awareness in civil society about the importance of intelligence beyond bytes of filtered information could be a key driver, and enhanced and more meaningful participation of civil society in national intelligence would be a very positive outcome.	Ongoing propagation of propaganda and group-think through media and politicking with primarily economic motives by few. The primary consequence being more and more sound-byte information with less and less "intelligence" (or even pursuit thereof) about what it all means.

encouraging and positive	inhibiting and negative
I believe that public and private investments in social aspects and in education of the members of the society they can contribute.	Social inequalities, corruption in the public sphere and no investment in education. As consequence servitude due to the great potencies and delay in the development
I doubt that this will occur on a national basis in the USA. It may occur in some Asian countries as they will likely determine that this is a method to improve their standing in the world, both in terms of respect and economic power.	
This could be positive but much more research is needed to better understand the relationships between "intelligence" and the dynamics of relationships between people in communities.	What is really meant by the term "collective intelligence"? I am not sure that a community of "highly intelligent" humans by any one measure will ensure a happy fully functional long-term community. In my opinion many of the present measures of intelligence are too single focused for this path to lead to any more positive outcomes for a greater number of people in a community than some of the communities today.
They will improve something else but they call it collective intelligence. The system is about giving selective information to some. So you will still have the "haves" and the "haves not" intelligence or information. The objective is clearly achievable but the mind set will not allow that.	
complex and urgent national and international problems and disasters	increased nationalism
As nations better understand the demands of a knowledge economy and creative work as a powerful determinant of wealth, improving cognition will be seen as one way of not just competing in the international arena but also to improve well-being. A smarter society will reduce some of the costs of low-cognition individuals (in terms of crime, wasted education effort, failed life projects), get larger groups able to handle jobs of a given complexity and might have the benefit of attracting more clusters of creatives.	Many ideological blinders make any intervention into cognition politically controversial: issues of group cognitive differences, gender differences in cognition, the heritability of cognitive abilities, the use of biomedicine for enhancement and the relationship between individual and state, all these issues may prove discouraging in different places or limit approaches to "politically correct" interventions. Even a successful cognition improvement program might have many unexpected side effects, both medical and social. If improved cognition for example reduces acceptance of traditional values it might be politically disruptive, while other forms of cognition enhancement might be supplied with subtle or not-so-subtle attempts of manipulation towards ideological ends.
International competitions involving schools like the international space settlement contest, industry needs through brainstorming sessions, web forums sponsored by institutions, magazines, possibility to cooperate in multiauthored books, jam sessions, brainstorming based reality shows in TV on particular projects will help the cooperation of people around defined projects and goals. An important role as a tool will be played by the web.	censorship by governments, lack of laws and regulations concerning authorship, intervention of political interest or religious groups lack of freedom of thought in particular countries
More and more research is showing that learning (especially in the age of the Internet and global telecommunications/connectedness) is fundamentally a social process. This is in marked contrast to very traditionally held views that intelligence and knowledge are situated only in individual's brains. If we look at just how rapidly global, open-source, knowledge creation communities and mass collaborations have resulted in very widely used information, social sharing and learning resources (e.g., Wikipedia, YouTube, MySpace, FaceBook, and SecondLife), we are seeing a major behavioral shift. People are using collective intelligence, knowledge and "social know-who" to collaboratively create resources for themselves and others-- often with no overt individual financial compensation or incentives	The emerging paradigm shift towards more global collaboration and knowledge-sharing/collective intelligence development flies directly in the face of longstanding competitive, highly individualistic and "proprietary ownership" models of knowledge-creation and intellectual capital development. This means it requires a major change in attitude of just how learning and value creation really happen--while we continue to measure and reward individual performance (competitively) in almost all K-12 school and college admissions. Even in college faculty tenure decisions, there is still little incentive for cross-disciplinary or web-based collaborative work, as these decisions largely depend on assessing individual faculty's publishing and citation records...regardless of how many other people have really been involved in the research or writing process.
	Distribution of the population will decrease possibilities. Large part of population is inactive and will stay the

encouraging and positive	inhibiting and negative
	same.
	Maybe there is going to be a romantic period with focus on feelings?
	I do not believe that nation states will be in good shape by 2030. A similar kind of stimuli on education might be provided by the local governments of "city states", e.g. Greater London or Singapore, but in general my confidence in the political form of state aggregation is low, hence the rating.
The technological capability will make large scale intelligence improving programs possible. The question will arise of what groups inside a country-like system gain access to these programs and a national program will usually be an answer.	
It is a normal step in the globalization of research. The social and international interest in that matter is huge.	All enemies of globalization. Wars and global destabilization are very costly in terms of people and money. It could slow down the evolution of science.
One can always hope -- and focus our positive thoughts and intentions towards achieve such a goal -- if we realized this, we might actually be able to accomplish other things, too.	
- Perceptions of peer countries gaining political and economic competitive advantage. - Merit-driven and performance-validated education systems (not necessarily anything like those of the present.	- cost escalation with benefits too far in the future to be seen as 'real'. - Security (of any of seven fields) uncertainties that reduce priority of education consequences all relate to 'falling behind' in all sectors.
It depends on the kind of intelligence: for example the emotional intelligence will be lower, but abstract-logical intelligence will be higher...	The relations among the people will be worse.
C.K. Prahalad in his book "The Fortune at the Bottom of the Pyramid," and varied authors such as Barry Carter in "Infinite Wealth," Thomas Stewart's "The Wealth of Knowledge," and Alvin & Heidi Toffler, "Revolutionary Wealth" have all clearly shown that increasing information sharing and education leads to the creation of wealth beyond the understanding of classical economics. If this is combined with "True Cost" knowledge to inspire Natural Capitalism or Capitalism 3.0, then the adopting Smart Nation will be wealthier in economic, cultural, and security terms.	The primary obstacles to this change are the entrenched bureaucracies afraid of change--the government regulators, the industrial companies, the teachers associations. Learning to learn rather than rote learning, and learning to share, rather than hoarded secrets, are the foundation for an open economy that will grow faster than a controlled economy.
What might encourage this possibility could be using successful experiences as examples for others to repeat and reproduce them. The most beautiful thing about improving collective intelligence, is that it could challenge people to work together to solve problems; problems that can not be solved by one person, not even by some few people.	A negative consequence I can imagine, is that it could become into a more powerful way to indoctrinate people, than those we know nowadays, if it is used to tell them what choices they should make, instead of challenging them to see new alternatives.
International competition among countries. As a tool for accelerating the absorption of immigrant populations. As a complement to formal education.	A temporary social pressure on the part of highly conservative sectors of any society which view any attempt at organizing both popular and specialist thought in useful, accessible bundles as an invasion of privacy and a regimentation of thought itself.
	Comparing with richer countries, tempo of lower income countries is slower; it might enlarge the gap between rich and poor worldwide.
To improve individual as well as intelligence for their nations-as-whole has already become common understanding of leaders in most of countries.	Famine and war compel people to pursuit objective in short term.
Enhancing the means of management and maturity of elaborating project management are the directorial precondition to improve collective intelligence. To create national important project of fund, and to limit strictly duty, authority & profit are the base of policy to promote collective intelligence. Equitable, fair, & open distribution system is the institutional guarantee to mobilize positivity of each one and ensure collective solidarity. To exert the predominance of "1+1>2" could create more values for the country and make out more achievements.	The pilot of the national policy and the giving resources are the main factors of hampering the realization of the possibility.

encouraging and positive	inhibiting and negative
National economy increases stably, society stabilize, there is a government which thinks of the plebs, and workers take up an occupation for exerting their intelligences and obtain reasonable income. As the result, rich countries become richer as well as lower income countries become middle-income or rich countries.	Autarchy; chaos of political situation; economic depression; and the masses have no means to live. All these developments would discourage the possibility, and it would lead rich countries to become poor, as well as situations of lower income countries are aggravated．
In order to enhance the country's integrated competitiveness, achieve human progress, improve the quality of human existence, and protect the Earth's environment, we need this national plan. With the realization of this possibility we would have many useful results. For example, the human life would be more civilized and the resource on earth would be treasured, the mankind's survival environment would be develop and utilize in reason.	War, social convulsion, disease, poverty, ignorance and religious prejudices, etc. would hamper the efforts of mankind to improve their collective intelligence, even result in a vicious cycle, and self-destruction.
The development of the concept of (competitive) human capital within national education programs	The concept of "collative intelligence" will be less used because the paradigm of cultural differences will deny its existence. That is to say, in the near future the idea of "many (different) intelligences" will triumph over the idea of "(only) one (collective) intelligence."
Attaching importance to basic education. With the realization of the possibility, the gap between rich and poor in different countries would be reduced.	Ignoring basic education. It's possible to result in enlarging the gap among different countries.
I looked at the responses. They are thoughtful, and agreeable with some of my views in some cases. I'll just say this: it's not likely, in my mind, that today's adults will be able to achieve this. If the current U.S. President is in any way a hint of how today's adults are thinking, we are doomed. But, I am an optimist in the sense that I think the right thing to do is to implement Engelbart's call for NICs, not for the adults and their commerce, but for children the planet over. I don't think that zero-sum game-theoretic competition among those children is the right recipe; rather, I suspect some new mechanism of cooperation is indicated. I cannot claim to be smart enough to point to that mechanism, for it will, itself, not be a mechanism (in the reductionistic simplistic sense) but organismic and complex in its own right; far more complex that my ancient brain can surround. But, there are snippets of evidence accruing in this so-called Web 2.0 social computing; rather creative things are happening now, unfortunately all tied to the "sustainable model" of bilking people for all they can get with obnoxious advertising. Sorry to sound so socially Darwinian, but there needs to be means generated to render *public knowledge resources* self-sustaining without hanging on the advertising tit. I've said enough. I'll go take my meds now.	
* this will probably be happening in a lot more near-term than 2030, partly because web technology is finally matured enough to make distributed collaboration a reality at the consumer level, and partly because "collective intelligence" has been picked up by major academic institutions (MIT, Univ. of Pennsylvania,etc.) as a strategic research focus. It will soon be elevated to "buzzword" status and a good part of the world will engage because it is quite accessible, and cost a lot less to implement and get results.	

2. Just-in-time knowledge and learning

encouraging and positive	inhibiting and negative
Life is way to complex to know what I need to know when I need to know it, so this will occur by necessity	Computer hacking, information manipulation and other forms of information warfare.
I believe much of what has been traditional government(public) education will be replaced by web based, managed learning provided by open source collaborative or vendors who compete on delivering measurable knowledge acquisition and retention with speed and effectiveness as the basis of payment. This approach will initiate another renaissance as people are freed of the Madrassas of Government Education. Learning is something the individual does. Education is something a teacher does. Before 2030, many individuals will have learned and evolved as an independent, interdependent, responsible global citizen reaching for those things that are in their best interest and helping others to pursue the knowledge that allows others to be independent, interdependent, responsible global citizens.	Once again, I think we are already on this track and that it is inevitable. If the internet went down this could not happen.
	Curricula based on reading, writing, and arithmetic will endure, even in the age of Internet and on line instruction. Teaching decision making and learning strategies is a good idea but no one has discovered how to do this.
Failure of rote learning to achieve educational objectives	Continuation of establishment educational administrators.
Economic checks and balances will continue to dictate the optimal learning approach. The increasing rate of social advance will add pressure to make learning and learning technology more flexible, modular, and accessible, but will also demand that it be custom-fitted to a particular purpose/application and will simultaneously cause it to be seen as transitory.	Not answering the question, "Just-in-time" for what? In other words, how will the knowledge be applied or what are we learning to do? It's been my experience within industry that the chasm between industry, society, and education is growing because education is replacing applied knowledge with concepts and principles. In general, knowledge is applied within industry in performance and in society in the balance of interests. Any knowledge outside of practical application is 'mental infrastructure.' Necessary, but not directly contributing to the final outcome of a society. Trying to use this 'mental infrastructure' for a practical outcome will cause confusion, waste, and missed opportunities. For an example, just look at Wikipedia and ask yourself what specific purpose it serves within society. I'm not implying that it doesn't have one, but asking that question makes one identify its rightful place in the context of social goals.
Information will be at our disposal continuously. Then we have to use such information to create knowledge.	One major threat could be cutting our connections to the Web and other forms of information.
The confluence of advances in nanotechnology, neuroscience, artificial intelligence, and avatar-based synthetic online worlds will make education more experiential and engaged in the developed world by 2030. Social/education networks developed through the new technologies will have altered the fabric of all relationships, creating an exponentially advanced knowledge weave. This will not be true across the globe.	Some people in power are still leveraging the types of education systems seen during the 15th-20th centuries on Earth - they are struggling to maintain that status quo. But in advanced nations these antiquated systems will be overcome by accelerating technologies. The negative consequences will be felt most in the least-advanced societies; the type of intellectual and personal disconnect we see between radical Islam and the Western world of today will be magnified. Those who benefit from the new realities of advanced technologies will evolve differently than the humans who are caught in the divide and left behind.
"QFK" - Quick-fix knowledge allowing people more self-confidence; much as Google or Wikipedia do for people whose needs are time-sensitive. A great addition to rote learning, but not a great replacement for it.	Potential for further dumbing down of society. I think this will most likely create poor learning habits for lazy-thinking, much like many people's current inability to concentrate or focus on a topic in-depth without intermission or a commercial break.
2. Rote learning will continue to diminish in the future leaving room for reflective thinking which is indeed the corner stone of significant learning. Again truly	Dictatorships wishing to control their people's development. I believe that democracies, however imperfect will sponsor and strive for this development

encouraging and positive	inhibiting and negative
compr5ehensive development of learning areas, additionally to the Intellectual Area, such as the Emotional Area, responsible for attitudes, Physical Areas, responsible for skills and dexterities and Social Area, responsible for human interests and social ethics; will make possible "learning to learn" and "learning to change" to achieve "life long learning". We are convinced that development of the generic capabilities proposed by UNESCO, OECD, The Partnership for 21st. century Skills, 21st. Century Learning Initiatives and other equally prestigious organizations will bring about the leap, indeed a quantum leap in human development by tapping on the yet untouched possibilities of other learning areas of the human mind. The possibilities of enhancing problem solving and decision making in uncertain situations will indeed greatly improve assessing risks permanently.	
Presence, sensibility of the managers in education.	Cartesianism in the vision of the education. consequence: brutalized humanity
Rote learning will continue because it "trains" the educational brain. But "Just-in-time knowledge" works..it gets us what we want..and so it will thrive..It does not imply or require that we know the future .. only that we are ready to take a step into it.	Poverty and any inability to see a hopeful future and to even have "wants"...such as problem solving, and learning strategies. Also, the inability to see the "big picture" i.e. "for the good of the planet..."
Rote learning will diminish but will still be used in theatre and poetry as part of the creative process. Just-in-time knowledge will be seen as reactionary and 20th century thinking. We will be learning in ways that challenge hegemonic processes and corporate thought as citizens gain power at the community level. Computers will assist in connections but their 'thinking' is suspect as the notion of who decides what is in the computer is challenged on a regular basis as citizens become less compliant to 'boss mentality'. People are learning skills to do work that makes them happy and self-reliant -- not just a paycheck. So computers may actually be less used as the joy of working with ones hands and connected to the Earth is once again valued. This will not be limited to 'reasoning' in our present thinking.	
In a more dynamic, global setting where new technologies emerge and spread just-in-time knowledge clearly becomes useful. As people become more able to choose knowledge they will not just acquire knowledge useful for their jobs but also for private activities, political and cultural project. The result is empowered individuals, hard to pin down by specialty.	Slow and old validation systems of education may slow adaptation of just-in-time education. Worries about bias and shallowness, as well as problems in teaching robust information gathering skills, might slow adaptation. In a world where everybody can look like a specialist there will be more risk of decisions made on looser grounds and less respect of true expertise, unless good ways of validating actual competence are developed.
The need to know specific issues, the constant change, and advances in every branch and human activity, the need to be constantly updated on new developments will require transferring the teaching from specific subjects to those needed for specific purposes with fast, practical learning procedures and new methods of teaching. We will learn more about methods of learning than about specific subjects, is more important to know how to learn and use specific information than the information itself.	The current system based in ld traditional way of teaching, where the teacher is the only active subject and the student a passive element. In a web related society , teachers and students must be part of a team where the teacher is just a coordinator since the information is collected by the team and the accessibility of information is the same for the teacher and the students
Because of the desire after efficiency learning is "personalized" whenever somebody wants to learn	
No comment here.	The fact that you indicate a set of rational epistemic paradigms as the reference is likely to be wrong. I would expect a set of rational learning references to be complemented by creative approach (e.g., rise of design education in China) as much as dogmatic, religious indoctrination becoming the standard in communities and countries (e.g., the \"bible belt\" in the US)

encouraging and positive	inhibiting and negative
Rote learning has diminished in importance at higher levels of education. 'Just-in-time knowledge' implies a huge assumption: we know the future and its needs and can determine what knowledge is right to exploit it. Positive consequences may include a reduction in the 'power' of academic arrogance.	People wanting to do what they want - not what others want, or want them to do. The major negative consequences can only be approached if there is no 'rote learning'; when none of all we know is within al all of it has to be accessed.
What might encourage just-in-time knowledge and learning could be creating and generating ways to access information, trough more and more intelligent ways. Though information is everywhere, to find what we really want is not always so easy, specially for hi task research; that is why, more and more, "just-in-time knowledge and learning" will need better and better information search helpers… and that means creating them… for now, by humans… who knows by 2030?...	What might discourage "just-in-time knowledge and learning" could be: not having ways to access information "on time"… That could bring unequal opportunities for people, companies, and countries.
Given the current information overflow, mainly in children there is a growing tendency to look only for useful information for the tasks at hand. When grown up, they shall encourage this possibility. Consequence could be a very practical and efficient society.	Just-in-time knowledge and learning could produce a very practical, but a very superficial world of knowledge. Innovation could suffer.
Such an educational system will certainly make business more efficient and allow countries to become more competitive. I am not certain that this is necessarily positive in every sense. It certainly leads to advancements in science and technology, but history, civics, and other subjects will suffer.	Traditional education proponents will discourage this effort. Negative consequences of implementing this will include a public less engaged in political processes, which leads to more control by governments since there will be les oversight by the public. If we don't understand history we will be doomed to repeat it.
	It would be nearly impossible. Because it might be impossible for lower income countries that their economy could develop enough to this level.
More and more countries carry out compulsory education in elementary and secondary schools; IT industry develops swift, especially development of internet in high speed makes people to acquire knowledge easily and agilely. Thereby training costs would be played down greatly, and it's easier to change the job so that we can take full advantage of human resources.	Inertia of traditional education system since hundreds of years and some conservative religion culture would discourage the possibility.
Reforming of the education system could weaken gradually the characteristic which is oriented to address examines. So that paying attention to cultivate the capabilities of students, such as innovative thinking, competence of analyzing the issues and resolving practical problems.	Relative insufficiency of education resources at all times would discourage the possibility.
With social progress, education reforming, equalization in opportunity of taking up an occupation, workers study for their interests. Thus it would facilitate to become a harmonious society and make for the economic development.	Due to conservative society, timeworn education system, difficulties in obtaining employment and unfair distribution, it results certainly in many problems like persons select their major or job according to the earning of this occupation, for example, the team of the teleplay "dream of the red chamber" wanted to select several roles recently, unexpectedly there were hundreds of thousands of persons entered for the selection.
In a vast sea of information, it's necessary to improve learning method and make it more effective. "Just-in-time knowledge" would be widespread due to reducing rote learning and inefficient study. It might improve public educational systems.	Ignorant, backward, stubborn prejudices would be obstacles to realize the possibility.
Accomplishment education. It would enhance the competence of analyzing and solving problems.	Education for coping with examines. It maybe causes the innovative capability to play down.
It's clear to me that the factory model of learning doesn't work well anymore, perhaps if only because of increasing populations coupled with declining funding for schools everywhere. This seems, metaphorically, like a stress-strain diagram for a material that's approaching its elastic limit. Just-in-case has been the mantra of schools as long as I can remember. My kids got into a just-in-time charter	Adult-driven inertia. While the adults in the middle east try to kill their neighbors, it has been shown that taking the children of the respective countries to a mutual playground results in happy campers. What's wrong with that picture? Everything. It strongly suggests letting the kids run the countries. That's what. <forgive me, I'm on a roll here

encouraging and positive	inhibiting and negative
school; the results were awesome. However, Nancy Glock-Grueneich says the proper epistemology would be called "just for me." I like that. What odds of doing that in institutionalized schools? Zip, imho. What odds of doing that publicly given we can support a public-domain knowledge infrastructure that centers on children the world over? Well, they're right up there with the odds of surviving some cancers these days, and improving all the time. That is to say, you don't nuke the public schools. That would piss off far too many teachers, not to mention union stewards. But, you build an infrastructure that the teachers can use but which is available to kids 24x7 the world over, and now you've got the recipe for a brighter 2030.	
Development of artificial intelligence would encourage the possibility. It might greatly improve human competence and IQ.	

3. Individualized education

encouraging and positive	inhibiting and negative
Young people who need to function intelligently and in their economic interests are already driving this process of the Individual Learning Plan that used to be only available to special needs children provided by special education teachers. Adults who expect to maintain or increase their economic well being will find it necessary to continuously learn in this type of learner and web centric, managed environment.	Taking down the Internet could discourage this process of learner centric interactive multimedia learning experiences. The consequences would be more terrorist behavior.
	I believe this will happen but only in a few rich countries, at a few grade levels, and often outside of the normal educational system.
	I believe that individualized education is progressing but I have ranked this possibility much lower than many due to the complexity and time commitment necessary for truly individual education. Until the educator has tools through which they can read the students minds there will never be "individualized" education.
People are different, thus they require individualized education. The more, the better.	High costs are always a big problem, particularly to have individualized, and continuous, education for 9 billion people in 2030.
My partner has a 10-year-old in a private school for the mentally gifted where each child works at their own pace, and the teacher/student ratio is low enough for individual attention to each child. As computing and virtual learning and just-in-time learning all converge, this type of education will be more available in regular public schools and charter schools. It is not a big leap from what Open Windows (the school referenced above) provides today to an even more individualized curriculum. I expect to see it closer to 2015 than 2030 in US private schools. There are many people working on creating sub-100 dollar student computing devices which will provide the building blocks/foundation for wider dissemination.	
"Many places in the world" is vague, but improved low cost individualized educational software will make this more likely.	New ideological or religious movement that sweeps the world into mono-thematic curriculum could reduce the possibilities for individualized learning. A negative consequence of the wide spread use of very individualized learning could reduce social cohesion.
Individualized education depends on the instructor, human or computer, and/or the learner, knowing what he or she knows as well as what he or she doesn't know. This can be represented in personalized, perhaps even life-long, curriculums. Proliferation of reusable learning modules at all levels of society and validation that one 'knows' as it is learned. Requiring standards and single-sourcing for learning modules at all levels, so that there is no confusion or overlap in what has been learned. This implies cooperation across all persons/groups that create learning material.	Not answering the question, individualized learning to what end, or for what purpose? Within industry, qualification is the assuring that one can know and then do, not that one knows only. Simply knowing something doesn't close the loop on doing within industry or society. So the unanswered question would be...does individualized learning also translate into eventual individualized doing within industry and society? And who will qualify industry/society or education? Today in education we focus on know and then come to industry and are often expected to learn 'as we do.' Individualized learning should be learning to know and do something and qualification should be on the 'specifics' within industry, but an easier jump from what on has learned in education than it is today. Confusing assuring what one knows with assuring what one can do. Not answering the question, why do you need to know what you know? Or...what do you need to do? Continuing to embrace the concept of 'general studies' in higher education.
This is already taking place, but it is reserved for the elite. Individuated instruction will be more commonplace in 2030	The type of education you would get from these systems depends upon the intellect, objectivity, empathy, and

encouraging and positive	inhibiting and negative
thanks to AI and the acceleration of computing power, but it will still only be available to those who are willing and able to access it.	intent of the people or the AI designing them. It could be a great way to "brainwash" people to adopt a particular ideology and even act upon it in negative ways as well as in a positive fashion.
The marketplace search for talents will create special individualized programs for training and empowering professionals as well as demand personal trainers and gurus, to attend specific needs of specific business	
Designer learning could be accepted more no different than designer jeans, designer drugs, and designer vitamins for each person based upon his or her *unique* physical, emotional and intellectual makeup.	Downside could a lack of integration in all levels of society due in large part to academic snob-set and schools vying for top positioning. This must be addressed at the onset.
Not only traditional education but total development of generic capabilities, key to sustainable development will most probably be possible by 2030 with the proper use of IT and "coaching in line" to address individual learning not only in K to 12 schools, and institutions of higher learning but also of adults making a reality "life long learning".	Non democratic governments
Most of the ideas already presented by the group are valid and may be implemented along the way , particularly through development of better methods for monitoring learning on the Knowledge Society ; and considering UNESCO proposal for Education for the XXI Century (www.education.unesco.org/pdf/15_62.pdf) : Learning to Learn, to do , to be together , and to be	Shifts toward new stages of Social Consciousness developments, according to Graves Spiral Dynamics, take longer that expected; or Apocalyptic planetary events may happen (global warming).
I think this is the most likely of all the statements...it is doable, it will become affordable and I even think the 'will to act' will happen on this one. This is a win/win for everyone, and , if facilitated by mentors -in-kind, it should be the core of the new educational paradigm	
A different type of educational system more personal oriented in accordance with the individual needs and tailored for the optimization of the development of each individual could be a welcomed alternative to the traditional one. But that means a complete change compared to the existing school system as well as some entrenched ideas about equal schooling rights	the current system try to squash the individual with few exceptions, allowing few degrees of freedom by deciding single subjects, school programs , standard courses all based on a lower than average student capability. the major risk could be to develop a class of extremely educated people and as such in contrast with most education policies that require average education for everybody independently of IQs and individual capabilities
The paradigm of 'human security' has already encouraged the shift. Positive: satisfaction and empowerment	Academic arrogance: the professor says I know best, and I have tenure so I will continue to say what education is best. Individuals will create new learning ways and means that divide society over education.
Based on the assumption that each and every individual is potentially a genius, and there is nothing more different than one genius to another one, each person can be special; and once each person's education is for that specific person, then he or she can be the best in whatever he or she chooses to do. To encourage that to happen, there could be schools where children have the opportunity to choose what they want to study among several options, and what activities they want to develop; with teachers that awaken the curiosity and creativity in each and everyone. If that continues up the educational levels to what we call nowadays "college", it could help people to be more than followers… and even someday, maybe, everyone will be a leader in a different aspect of life and Society… and maybe governments will change, and leaders will need leaders among them, not to tell them what to do, but to be coaches so that teams get to work effectively and efficiently; and also leaders among leaders could be like referees, to help competition be fair,	What might discourage individualized education could be not changing; letting things be like they are now. Negative consequences? People that become into followers, even of projects they don't understand, don't believe, and sometime even disagree… but to be part of something bigger, the group's decisions prevail, and sometimes, someone asks: why that decision? Are there not other possibilities? There are, but education tells people to act alike, to decide alike, and to choose alike. Individualized education would be something different, but it might not happen, at least not necessarily, unless it becomes some people's will, and that "some people" affect the rest of society. To say "it will happen" is to have hope, to say it "might not happen everywhere" is to realize that change is difficult… though, it could occur.

encouraging and positive	inhibiting and negative
and to help different teams to be able to live together: to agree in main aspects of living together, though their differences.	
Progressive education systems will certainly encourage this effort. Problems will exist where resources are an issue. Poorer countries and/or poorer school districts will be unable to fully implement this. It will require PCs for each individual, and oversight by teachers with advanced technology skills. Individuals meeting these criteria will command higher than normal salaries.	Limited resources will discourage this possibility as will teacher unions that abhor the prospect of rewarding their superior colleagues.
	Most of lower income countries would not have enough money to do that.
Everyone has requirement for individualized education.	It's too difficult to design the method which can be used to assess the needs of individual students. There are also the problems of reliability of evaluation results, quality of teachers and etc.
Perfecting social welfare system would make people have no economic pressure, it's basic to resolve social all-pervading problems like housing, medical treatment, education, old-age care and etc. Basic living condition should be fulfilled at first and then objective of education can be changed. Nowadays the motive to let the children educate in many families is to make great efforts to study for finding the good job in the future. And what is called "good job" is stable occupation or with large income. It's the inevitable result due to the living & economic pressure.	Fettered by traditional concept on education, individualized education market still needs to be cultivated. The course of maturity & specialization of organizations which provide individualized education.
Individualized education could be implemented in some individualized vocations, such as culture, art, athletic sports and etc. but in the field of industry, agriculture, architecture, transportation, business, service and etc., it needs plentiful, basic and all-pervading education to instruct students, doesn't adapt to individualized education.	For individualized education, one student needs more than ten teachers at least, but there would not be so many teachers with specialties available.
Social progress and development of medicine would make people have a better scientific understanding to individual particularity. It might bring an old saying "everyone is destined to be useful" come true.	Ignorance in religion, racialism, underdevelopment of economy, lacking of social awareness would delay the process of individualized education.
Teaching students in accordance of their aptitude. It can exert well individual potential competence.	Spoon-feed education which gives priority to teaching material. It'll wear away individuality.
	With the extension of the education cycle, overpopulation, and the elderly financial dependency, the education system is going to suffer of financing problems in many countries and individualization will be very expensive in poorer countries. This won't be a problem in richer countries however.
Based on improving genetic information it is possible to find people with different learning strategies. First perhaps already now identified minor groups. A clear example is ADHD children. In the far future perhaps all belong to some minority group. On the other hand learning is a social activity and needs common goals for learning.	

4. Use of simulations

encouraging and positive	inhibiting and negative
Simulations are very sophisticated and are becoming more so. Further this development is encouraged by the spread of video games (will X Bot become a teaching tool?) and the growing participation in simulated societies like Second Life.	This possibility could be thwarted by concern about video game violence, and lack of access by parents to the video technology used in the simulations.
	There will be a backlash to this trend. Some groups will claim the value and importance of 'real' interaction and will deny the benefits of virtual simulations. Whether this backlash becomes violent or not will partly depend on the proportion of population with access to this technology.
It mind sound obvious, but simulations are probably the best way to "simulate" reality.	We always need to be aware that there is a reality beyond all simulations. Life is not just virtual reality, but a real reality.
This is simply gaming technology/sim tech like "Second Life." The difference I see is that this statement implies a more controlled environment than is likely to happen. Think Wiki technology and group simulation like Second Life applied to specific learning environments.	This is, to some experts, is already happening informally. Think Second Life and sophisticated multiplayer gaming. The challenge will be getting it into the more formal education system, and blending it with other forms of learning.
This is done by advanced militaries today, not sure 33% of all tele-educational experience will be achieved by 2030, but with the continued advance of Moore's Law, nano processes, bandwidth, and the needs of the knowledge economy, this might be possible.	
	Virtual reality applications can be surprisingly difficult and costly to implement, so I'm skeptical that a third of countries will readily adopt in 27 years. 10% comes to mind. If we're talking things like Second Life - that may be 1/3 of teleducation within 27 years - but serious VR educational apps will be tougher.
At the elementary and secondary school levels, gaming approaches may continue to emerge here. Since this is cost prohibitive, it really requires agreement of approach, methodology, and development standards. Subsidized gaming? There is a sophisticated gaming technology emerging and it is quite expensive to produce. For local, national, or global participation this would optimally be done as a single source, and therefore a one-time cost. This is the same concept seen across learning as a whole. Knowledge is really very expensive to learn when it is treated as a multi-source. For example, a subsidized wiki for simulations with modules used globally. As the lines between games and learning grow thinner, this may emerge in industry in next generation 'Second Life'-type solutions. While having 'fun,' my children technically learned to fly a jet fighter and land on an aircraft carrier at a very young age. They sat down with my father, who was a commercial pilot for small aircraft for many years, and showed him specific mechanics of the jet aircraft. I see this as an example of where fun and 'actual doing' intersect. As these lines blur, the solution may actually be commercial and not subsidized.	Multi-sourcing knowledge instead of treating it as one. Multi-sourcing learning is always more cost-prohibitive. Even though my children used gaming to learn to fly a jet fighter at a very young age, I wouldn't put them in a real jet without actual experience and human qualification...again we need clarity between knowing and the transition to actual doing built into our global learning systems...we need much more clarity in purposes/goals of learning.
Applications in the military and some aspects of industry are already here. Over the next two decades, the game industry will pull education into more extensive use of VR. Young people in advanced nations with open access to computing power are evolving differently and the ways they learn are changing. They will be best reached through the uses of social networks. Facebook and MySpace will morph into avatar-based 3D synthetic worlds like Second Life but much more advanced. VR design and implementation costs are going to improve, and once the interface becomes more natural these worlds will explode. We need to begin to plan now to	The fear that negatives will outweigh the positives is always one that can delay the adoption of new technologies. Negative consequences can include what some people refer to as a cyber "addiction" or a loss of touch with reality and face-to-face human contact. Worse consequences can include the purposeful design of immersive VR technologies to negatively influence human behaviors. See Edward Castronova's excellent book "Synthetic Worlds."

encouraging and positive	inhibiting and negative
leverage this technology to best advantage for all people. Immersive experiential learning will benefit society on every level.	
Another form of designer learning, which is in keeping with individual needs and collective learning experiences.	Psychological retardation due to lack of "team" effort, group activities and "sharing," all essential for a healthy personhood. The learning environment being "simulated" is superfluous in this regard in light of potential psychological affects aforementioned.
Further research. Obviously some subject matters, such as sciences, are more easily represented in VR than social sciences for the impossibility of recreating social events with accuracy. For K to 12 schools this tool could offer great possibilities.	Costs and difficulty to implement
I believe in soul...the ability of the human to 'be' not just think. I believe much of the thinking aspects may be simulatable(?)but being is not. If you assume the primacy of the need for human interaction , I can go along with the rest. You are also dealing here with the issue of who , what constitutes core beliefs of the simulation. You might have to make it so universal (or generic) (I presume we are talking about being able to put this on the internet) that it might lose meaning...	
Standard data and simulation formats enable more scientific collaboration, and in turn allows cut-down versions of scientific simulations to be used in education. The spread of virtual reality and online games makes simulation a normal mode of interaction, and enables high performance hardware at low prices. With good simulations students can experiment beyond curricula, and acquire tacit knowledge of the behavior of complex systems.	Many simulations are little more than ways of avoiding teacher effort, edutainment that often lack the complexity and interactivity of real experiments or teaching. When teachers do not understand the simulation mode of experimentation and learning, they may not make the best use of it.
Happens if the reality can be 100% simulated, but I doubt if this happens and if it does not happen, understanding "real" reality with all the nuances that cannot be simulated is profitable knowledge capital with high value	
The diffusion of 3D and the social acceptance of parallel on line realities like Second Life, where by now a real alternative world is growing. There is no way that this will not evolve into new forms of individualized educational platforms.	
new technologies development, video games and other familiarity with simulations , advanced teaching concepts such as the UN simulation or other programs in use in advanced schools will make simulations an important part of the teaching experience	Costs and mentality. like most of the innovations discussed here also this one means a higher level of democracy at school. It seldom exists.
NOT "a third"; maybe somewhat less in strongly led countries like Singapore. What will encourage it is leadership willing to commit the funds over time enough to - at the very least - demonstrate the benefits are no less than neutral. Positive? A larger number of truly educated citizens/individuals. funds	No leadership and insufficient funds over time. Negative? Promote a cult of the brilliant individual over that of society as a whole. Widen the gap between the education and smartness of citizens of different nations/regions/cultures.
Changes that used to take 10,000 years now take 3 years. Real-time science is absolutely essential, as is continuous real-time governance and continuous real-time learning. Simulations are the best means of connection real-time public intelligence and information to budgets--simulations can be the basis for dialog and decision.	The greatest obstacle to successful serious games/games for change is the refusal of many to work strictly with open source software and open code. The government should require that all software be open source, and that standards be established so that all information can have time and geospatial attributes that allow them to be digested by serious games/games for

encouraging and positive	inhibiting and negative
	change.
See Holopticism http://www.thetransitioner.org/wiki/tiki-index.php?page=Holopticism	
The use of simulations could challenge people to believe that if a problem is simple to solve in virtual reality, more possibilities appear in front of each individual, and more opportunities to solve the problems in the non virtual reality (what we still call the "real world").	A negative consequence could be that the Universe of possibilities to affront in the "non virtual reality" (what we know as life up to now), could be limited to those options offered by the "virtual reality" system.
This is a truly innovative prospect that would have many positives for education of the masses.	Costs will discourage this.
It would be realized in richer countries.	
Industrialization and popularization of virtual reality technology would encourage the possibility. From the point of view of technique, it will be realized absolutely.	
Technological preconditions would be developments of automatization technology, popularization & application of numeric TV, IPTV.	Difficulties in popularization & dissemination; how to control the cost of simulation system would influence the realization of the possibility. Education is the domain where have many interpersonal mutual actions, virtual reality simulations can educate knowledge but have no way to transfer the sensibility and moral character. After all the objective of education is impart knowledge and educate people.
With the higher development of economy, ratio of urbanization reached more than 80% and every family would have computer and use the internet. At the same time, there should be a common language. But there is no beneficial result to be made out, because it acts against the disciplinarian of education for human being, and people cannot leave the cotemporary group to live like Robinson.	
Development of the global economy, the popularization of high-tech, autonomy of people's awareness would encourage the possibility. It might certainly have a positive effect on the further development of human being.	
Reinforcing to construct modern teaching styles. It might enhance learning effect.	Due to conformism, it's difficult to ameliorate teaching effect.
With the progress of the technologies on computer science such as digital image, virtual reality simulation, etc. and the cognitive science, we would make use of the simulations in many fields and find it's very practical and useful. It would let us open eyes to outside world and give us many new experiences.	Although these simulations allow people to progress at their own pace and adapt to the individual's learning style, it would be more useful to the person who is spontaneous and self-controlled on study. And after all, the students of elementary and secondary schools need more communications face to face, and it's different between real world and the virtual reality, even the simulations are very vivid.
a. Developments of network communication technology. b. The space to develop personality might be enlarged.	a. Restricted by social ethic. b. Network crime in e-universes.
Development and popularization of computer technology, research in software & system of virtual reality simulations as well as creation & improvement of corresponding database of hearing & vision would encourage the possibility. It might exploit furthest human creativity, and reduce outlay of learning and training.	Economic stagnation would make education & research lacking finances and cannot actualize the possibility. It might encourage selfish desire and ambition because people might achieve certain desirability in e-universes which cannot be actualized in real life.
The progress in Virtual reality technology. Its beneficial results might be to enrich the content of primary and secondary education and improve greatly the effect of education.	The restrictions of Virtual reality technology would prevent the possibility. It would not have detrimental results.

5. Continuous evaluation of individual learning processes designed to prevent people from growing unstable and/or becoming mentally ill.

encouraging and positive	inhibiting and negative
The increasing awareness that single individuals can become massively destructive (SIMAD) has brought this about. Some of these programs, in some countries, have been called totalitarian, but their implementation is generally seen to be in the public interest.	If it was seen as a one time classification and used by governments to control or eliminate deviant behavior. This could lead to neo-socialist realism, preventing more new forms of art.
	Will be perceived a "big brother" and raise fears of loss of privacy and freedom. A big risk. Also, psychology will have to make very large advances since today no one has a clue about how to do this.
Such programs might reduce creativity and innovation. All geniuses are always a little crazy!	Personal freedoms will be at stake.
This may prove to be a relatively inexpensive way to deal with certain mental health issues - especially as lifespans increase.	Individuals can do "mental exercises" today but widespread adoption seems to be a problem. Programs will have to be very creative and engaging to encourage widespread adoption.
In a model where people do what they are rewarded or recognized for doing this is approaching a problem that is largely environmental. For example, the only opportunity a youth sees is dealing drugs....that is what is rewarded in his or her environment. At the core, it is about the decision an individual makes on how to engage society...do they contribute to it, not contribute to it, or even attack it? This engagement decision is often made at an early age, when peer pressure is at its highest. So making it 'cool' and 'rewarded' to engage society appropriately is far more important than any kind of learning intervention.	The decision on how to engage a society is based on personal values and beliefs. The social institutions that support values and beliefs are extremely likely to continue to be separate from those that support learning.
Like any other system of "profiling" this statement was posed with good intentions but it is rife with too many negatives to find universal acceptance.	There would be an enormous amount of resistance to this due to privacy and personal-freedom issues. Intelligence-gathering/police organizations have already been doing this sort of thing for hundreds of years in the nation-states with the worst histories in regard to human rights. In addition to these facts, there is also no doubt that some of the world's brightest thinkers would have been classified in a negative fashion by such programs - what would have happened to them and their breakthroughs? In the future, if we begin to "cure" or isolate individuals with deviant personalities are we going to destroy something that could have been of benefit to the world? Who decides what is "deviant"?
Monitoring Behavior and States of Being High Tech is developing fast, particularly since involves risks and opportunities. Insurance and Terrorism Risks are an example, as well as seeking for quality of life and longevity , preventive health and medicine represent opportunities where investment may go.	Clearly an optimal solution for Liberty, Equality, and Fraternity may take longer than expected in some countries than others.
This is scary in one sense (Big Brother) but if developed in a human environment could identify young people at risk. Alice Walker's work showed that those who led troubled lives but still did well had one thing in common...The all had found some one person who loved them. A program like this could identify and match these youth with appropriate mentors.	
It could be possible in countries with lower population. It's a way to address easily social problems like suicide or drugs	The failure of this model is the impossibility of controlling everybody especially on those countries with highest rates of population. Besides, the desire of watching people would lead governments to reduce private lives, freedom to acting, etc

encouraging and positive	inhibiting and negative
This possibility sound very much paranoid. The evaluation of "learning process" can only show the outputs but not the inputs. Do we want to create a "clockwork orange" society?	Maslow's hierarchy should be satisfied for all individuals. Learning is just one of the needs.
The continuous increase of security standards in driving blocks of the Western World. The drive towards more extremist ideologies based on the Islamic original faith - which is different than its political implications- in some Muslim countries. The persistence of highly pressuring control by governments in several Asian countries (e.g., China).	
Encourage? In all but the richest and most 'thoughtful', chronic crisis. Positive? Mitigate existing and prevent further/more crisis??	Lack of money for continuing state-wide application. Profiling stereotypes that endure.
This is a truly whacky suggestion and will never be implemented by free thinking societies.	Implementation of this leads to group speak and should never be allowed to happen. Unfortunately, there may be countries and/or societal pressures that could implement this on those individuals preselected as potential threats.
	Antisocial behavior including terrorist activities and violent criminality is not the problems of individual nurture, it has social causations.
Anti-terrorist activities and violent criminality have already become the common understanding of whole human being.	Hegemony and ultra religionary force. Method of identification.
Perfecting the theory and method of evaluation; developments of IT and database technology.	Veracity of modeling of evaluation system needs be validated by lots of individual samples. But cycle of this kind of validation would be very long.
	That is special education for the affairs that are in small probability, and it should be the job of security branch, but not the contents of the traditional education. I think that "Man's nature is good at birth." Due to his bad social experience, he would come into being antisocial psychology and behavior.
Advanced technologies, the need for peaceful development, human survival needs and etc. would provide the condition for the implementation of these programs.	Problem of racial segregation, war and an individual consciousness might promote human to reject such assessment.
To reinforce psychology consultation, and mitigate mental pressure.	Overbalance of burden in study. It might make students having ill nature.
The mentally ill are not helped much by people who have an unrealistic view of what it means to be human. Perhaps "normal" people need to take a closer look at themselves, at the placement of the human species within the natural order of living things, at the implications of advocating infinite human consumption/production/propagation in a finite world.	If the human culture is itself deluded, though not so severely alienated from reality as the mentally ill, then humankind could be put at risk by its own failures to recognize the requirements of biological and physical reality.
In the turbulent society, the people feel more and more menaced by criminals or terrorists, and they are anxious to change these situations. It would be very useful and helpful for the persons who seem to become unstable or mentally ill in later life.	But the problem is the method of evaluation; otherwise, it would become a form of discrimination.
a. Developments of psychology and pertinent evaluation technologies.	a. Restricted by ethical problems. b. Without privacy.
Developments of research on psychology and deepen knowledge about human arcanum would encourage the possibility. It might make positive influence to the future of the human being and harmoniousness & stabilization of whole society.	Authority and impartiality of evaluation organization, and the problems such as human right, racialism, etc would counteract the possibility. It might bring negative influence in the field of individual privacy, human right and racialism, etc.
The progress in Psychology would stimulate the emergence of the possibility, which would reduce mental illness and antisocial instable factors.	Social inequality, the widening gap between rich and poor, pornography, television violence, the proliferation of web sites, etc. would discourage the possibility.

6. Improved individual nutrition

encouraging and positive	inhibiting and negative
Alliances among health insurance companies, education programs, and businesses.	Fear the diagnostics could be faulty.
	This will result in further separation between the rich smart people who can afford special diets and the poor less smart people who can't.
It will be easy to detect the king of nutrients that each person needs according to their DNA and background: nature and nurture can both be addressed.	DNA testing might have to be compulsory, and some people will be opposed to that.
	The sensual pleasure of inherited eating habits and meals will override such prescriptions.
At least in some third world countries like Chile monitoring children development from the nutritional point of view has help a lot to improve physical and mental development, and this may represent a trend in Third World countries (www.rlc.fao.org ,www.fnde.gov.br/home/alimentacao_escolar) . Environmental and Nutritional Security may become a high priority sooner that we think.	Again same restrictions as previous item, in particular lack of political support in the short run.
This is very doable and globally needed. General Patton said, "Fatigue makes cowards of us all." so does poor health..	
Developments in individualized medicine, nutrigenomics, and functional food may make diet tailoring popular, possibly in a faddish fashion. Given current concerns about obesity, health paternalist governments might also promote improved nutrition. Since nutrition is "natural" compared to (say) cognition enhancement drugs this is likely to be easier to accept for many.	Many research findings in this area are weak or suffer low effect sizes: improved nutrition might cheap and simple, but also have relatively little effect or be hard to tailor. The overall beneficial effects of full and diverse nutrition may overshadow the individual effects.
The necessity to self manage one's own health and well being will increase in the advanced economies, and it makes sense that nutritional culture will be twisted to such kind of utilitarian needs, just like nowadays we diet to avoid cholesterol. It is a plain extrapolation of very strong current trends, as far as advanced economies are referred to.	
This has potentially huge benefits beyond education. It could greatly improve a nation's health and reduce the cost of health care. Countries that can separate outcomes from politics have a reasonable chance of implementing this.	As with anything those that stand to lose economically will oppose this. Giant food companies and health care lobbies will discourage this.
Something that could help could be to have new and more food that contain "protein" accessible for the people to buy it at markets. More variety also means to educate the consumers about new food. To improve individual nutrition might not be something that happens by itself, but that institutions interested in it have to promote.	To improve individual nutrition is a challenge in some places where the customs include really bad nutritional habits. It is also a challenge to change the offer, where the companies are used to produce and sell low nutritional food, and it means really good benefits, with low costs... And when that means also low prices, it makes those products accessible to people that have low income, making it difficult to replace, or even substitute most of the components of the traditional diet.
Along with improving the technology of gene and testing, cognition level for mechanism of human body, it's possible absolutely to improve cognitive development according to individualized nutrition requirements. But the cost of application would influence its extensive use. With its implementation, human intelligence and physical strength would advance fleetly, and it would make an important breakthrough in remolding the world.	The realization of the possibility would be delayed since the developments of pertinent technologies would be influenced by undulation of economic level and peaceful development in the world. Its realization may result in making bigger difference in growth among various economic zone, and increasing farther gap in economic level and human intelligence.
To make great efforts to create social wealth at first, only when the revenues of the workers are much more than their expenditures, they would pay attention to improve their nutrition requirements.	

encouraging and positive	inhibiting and negative
Developed regions may be able to achieve such goal.	In the lower income areas and poor areas, such aspiration can not be realized. Even if NGO may be involved in some countries, it is difficult to fully popularize.
Development of regional economy. It might improve physical performance.	Lag in economy. It might be not sound in body and mind.
With the improvement of level of living, health problem becomes more and more serious. Of course there are many reasons and solutions, but one of important solution is to improve individual nutrition.	
a. Pertinent information is expanded and widespread. b. To conduce to all-round development of human.	a. 1) level of economic development; 2) making slow progress in human performance; 3) impediment of exchanging information. b. unbalance of physical development.
Augment of the material wealth and prolonging the human life would encourage this possibility.	Considering there would not be much amelioration in lower income group in 2030, so that they cannot pay attention for improving individual nutrition.
Developments in mechanism and means of self-administered diagnostic tests; new discovery in nutriology. It might make people having reasonable nutrition configuration.	Backward in development of life science, nutriology and means of self diagnostic tests. No detrimental results follow the realization of the possibility.
Developments of nutrition and nutritionist. So-called "Food cures better than medicine;" improving nutrition would reduce diseases, prolong natural life and enhance intelligence.	It seems that only one factor would hinder the possibility, namely "poverty." There would be lots of needy population living in 2030; the most important thing for them is "survival" rather than "nutrition."

7. Genetically increased intelligence

encouraging and positive	inhibiting and negative
	Once a limited number of people become so intelligent, the rest might stop 'thinking' and the population will be divided into two groups. One group to think and manage everything, and the other group to 'consume' or simply live in a given environment.
	This will happen but not so soon
The possibilities of biologically increasing our intelligence are almost unlimited. Nature has slowly evolved our brains, but now we can do it faster and better. Parents wish for a better life of their offspring.	Major moral issues will surface. What is normal? What is human? What is ethical?
Genetic eng. As well as neurosciences are developing fast and no doubt a synergy on these areas may bring benefits regarding our human hardware.	Science and Tech are developing too fast in relation to Moral Development, so these may cyclically raise issues that delay transhumanistic ideas.
I believe that it is imperative that prior to this development a tremendous boost be given to the learning of humanities in general including art and overall, ethics in order for humanity to have more balanced individuals and not only science super beings. It is true that intellectually developed individuals are needed but, this development must be accompanied by development of other human capacities such as social ethics, acceptance of differences, respect for others and the like. Since the Industrial Revolution, an unbalanced development of the intellect has occurred and mankind, in my opinion is taking a big risk at loosening or diminishing an equally important part of individual, sensitivity, something that have been called the human soul.	It is difficult to predict the negative consequences of one sided development of individuals but I fear it would have disastrous consequences. We must prevent it to happen.
I am ignorant here of any "intelligence gene". although the PGD option mentioned here makes sense. The suppression of negative genes (therefore raising intelligence) is possible. Interference RNA already exists to suppress some genetic expression. Most intelligence enhancement today is chemical....drugs. "Uppers" to add energy. and "Depressors" to suppress anxiety and add relaxation. Some would add hallucinogens, LSD, etc. to explore the psyche. Would also add steroids, the feel good and powerful overall drug. There is great (100%) chance that all of these will develop remarkably. This could be good... if we all made our important decisions in a relaxed state....or bad if we use these to suppress behavior... such as Ritalin is often used.	
The main form of near future genetic intelligence enhancement would be PGD, selecting away genes involved in pathologically lower intelligence. This would lead to a reduction in the lowest performing, in turn increasing the average. For this to happen PGD needs to become more common, which requires both improvements in technology, a way of automate it to bring down the price, standards making different treatments comparable and, most importantly, a cultural shift towards regarding genetic selection as acceptable. This cultural shift might be specific to some nations and not others.	High prices of PGD and other prenatal medicine would keep both practice and research from much use. Naive selection criteria may lead to favoring a few detectable "intelligence genes" although they do not represent the full range of human capacity (on the other hand, even assuming broad approval and use of the technology this limiting is unlikely to affect a very large number of people by 2030).
	I think it is technically possible, but is mainly meant for a special group of "world leaders" and not extensively used
I believe in progress of human brains and its limited advantages but this could be enjoyed for those who could afford this. In countries underdeveloped this kind of technology it could be only dreamed.	The high cost of this technological progress enables certain countries to develop it easily. The great risk is the manipulation of human beings, their desires, aspirations, their concepts of integration, respect and equality

encouraging and positive	inhibiting and negative
Genetic enhancement of intelligence should be combined into a single procedure that would also reduced criminal behavior. Just as we "correct" our eye site with glasses, we should also correct our low intelligence. Imagine two worlds: one with average IQ of 100 and another with average IQ of 150. And then remember that we are talking about 2030 - a world more complex than today with a greater percent of knowledge workers. Which world would work better 100 or 150? Parents want the best for the children, and once a safe procedure is available for increasing intelligence, parents will take their child to the country that first offers it.	The belief that life is an unalterable gift from God will discourage this possibility. Without a concurrent improvement in more ethical behavior the "war" between good and bad will get more complex.
Rich people who are everything but democratic parents. I can think of few positive benefits were this to become so common that "many parents" engaged in it	Common sense not to go so fast that children would no longer have 'time' to be children. Super kids, in mostly unfortunate ways.
Genetic engineering for improve our brain capacity should be free to everybody. Only in such case it could represent a benefit for mankind	if not a free choice for al such proposition could lead to class wars between the haves and the have not's
Dictatorships wishing to develop another "super race" (can you say Nazi) will support this.	Intelligent free-thinking societies will discourage this effort. There are no real negative consequences.
	Bioscience could not carry out the possibility yet.
Continuous progress in human scientific activities would encourage the possibility. But too expensive cost would hold back its extensive use.	Continuity of development of world economy and whether it's a peaceful world would be essential reasons to prevent its realization. Although human techniques have been able to realize it, it still needs to invest long time, human resource and finance and may bring big risk, including genetic mutation caused by incorrect use of genetic technology. If this kind of gene with frangibility is able to transfer rapidly, its harm will be fatal to human being.
There is a long way between the medical achievement and changing the potential intelligence of children, and I think that the education methods of the mother of Mencius are more efficient and convenient than genetic treatments.	
Richer people would have the possibility to change the potential intelligence of their future children, and they have enough money and advanced technologies to do it. It might make the future generation more intelligent.	Due to the imbalance in international economic development, in many needy areas, they still use mankind's oldest means of reproduction, even with the subsidization it's impossible for them to use this kind of treatments.
Development of medical technology would conduce to increase intelligence.	
Due to the progress of the life sciences, it would be come true. It would help and cure the children who have genetic illness in intelligence.	This kind of treatment always relate to the ethic problem, and prerogative of the rich people.
Developments of life science, biomedicine, and social economy. It might explore furthest the potentialities of human intelligence, and improve level of human intelligence.	
The miraculous progress in Gene would lead to the possibility. It might become the greatest evangel for those unfortunate retarded children no doubt.	Limitations of study in Genetics would discourage the possibility.

8. Use of global on-line simulations as a primary social science research tool

encouraging and positive	inhibiting and negative
A great tool for social science experimentation.	
This is already a reality today. It is only starting, but the trend is very clear.	There might be opposition by those we want to stay "natural." For example, think of the Amish in large numbers.
	People will get bored being used as lab mice.
An inexpensive research method.	Acceptable controls using such tools may be a bit of challenge.
I agree with the hypothesis, but think that the VR environment must be far better than what I have seen of SECOND LIFE.	This is all in 2 dimensions and will not have the same relevance of face to face.
Why use "Second life" style websites? It's working already very well and it will continue to evolve, without the need of "second life" style VR. The positive consequences are obvious: anyone anywhere will have access to the education they want.	
Frankly I do not see any real positive consequences for this in education development. It may have other useful applications but not in Education.	I am sure that much could be learned from the behavior of animals that could be used for human life. However, I believe that it is much too dangerous to assume that this knowledge could be taken as certain for human behavior. The main trouble is that animals act mainly by instinct, whereas human beings reason and have many other learning capacities. Additionally, it is almost impossible to reproduce real social situations in a laboratory.
We are very close to doing this today. I wouldn't be surprised is some preliminary experiments are not occurring right now, but in 25 years from now? Seems inevitable.	Abuse of people in cyberspace, the same way experimenters have abused humans in research in the past.
A very plain extrapolation from current strong trends in technology and society!	This might exist but limited to the have's and the have more's... I do not see practical possibilities of trickle down from the super-rich who will afford it.
The nearness that is now.. Huge 'track' (set) for research that - even if it turns out to be vulnerable to unreality - will offer superb 'straw men' for comparative analysis.	Some really bad 'results' and governments which do not like being shown how far from the 'right' path they are. BIG mistakes and GREAT cost.
Researchers will certainly want to tap into these efforts for research purposes. Degrees will likely be awarded.	There are minimal ways to actually monitor the inputs to these computer societies. Social science requires detailed information on the participants in a study. Virtual societies will not provide this background reducing the value of the data.
It would be realized partially in richer countries.	
	Virtual realities are unable to substitute real life in deed, and it's difficult as transforming human subconscious mind to reality and trying to control it. Virtual realities would result in the tendency of split personality, and make against the evolution of human society.
Virtual educational simulation depends on internet, but it is easy to be destroyed or influenced by an unforeseen incident. For example, Taiwan Strait had a big sea quake at the end of December 2006, optical fiber cables were ruptured, so as to block the internet between Asia and North American and it needs 2 weeks at least to repair. Isn't it the sorrow of the virtual world?	
Developments in network technology and the application of simulation technology as well as the changes in people's attitudes to the pursuit of new technologies. It might reduce costs of investigation and research, and stimulate the imagination to promote development of creative culture.	Non-standard application or the abuse of network technology, the excessive dependence on traditional means would make people resist using virtual reality.
Government attaches importance to this kind of application and the economic development. It might enhance efficiency.	

9. Use of public communications to reinforce pursuit of knowledge

encouraging and positive	inhibiting and negative
Social marketing will become very well developed	The message might be come dulled with overuse.
If well used, social marketing can be a tool to improve education.	Social marketing could be compared to social engineering and be considered a new class of communism to be opposed by free societies.
This is doable and practical...look at Project Red for AIDS with Bono as a celebrity....and it is an essential part of movement from poverty and social injustice...	
Any legal, ethical means to awaken the interest of youth in particular, and the population at large, to pursue knowledge will enhance the possibility of democratic governments and generally well being to societies.	Those governments interested in keeping their people uneducated
	The value of something within a society is more effectively conveyed by the shared culture and assumptions than top-down messaging. While marketing producing bottom-up effects may have reached maturity by 2030, it is likely that pro-education messages will have to compete with all other messages a society generates. Only if the society is actually pro-education will these messages be very dominant.
It could be a necessary tool to increase the education of population especially when not everybody has completed their studies. Improved Knowledge would help to choose ways of acting with intelligence.	Sometimes governments don't pursue this goal in education and leave this to market. By 2030 things could be changed with public policy that let knowledge be as attractive and convenient as it is considered in other well developed where education is a protagonic chapter of citizen's lives.
Informal meetings like this happen in the U.S.A. with the Ad Council, so in 25 years it seems very likely this will be widespread.	
A very plain extrapolation from current strong trends in technology and society!	
Lack of educated workers. This could result in traditional shifts in public opinion and attitude.	There might be more powerful factors influencing people's choice. Such as their future personal transformation and development, etc., for which they need to study.
We're there. New tools and new toolboxes that wise people could use in constructive ways	Governments that fear - validly - losing even more control. Limits on civil liberties (whatever are civil liberties in 2030)
I believe this could happen more and more often, for it is known public communications influence people, and several organizations all around the world are interested in promoting the pursuit of knowledge... and with social marketing, it could also make more companies interested. And, though knowledge workers are a majority in many countries, Knowledge Society is still an ideal of equal opportunities for everybody to access to a better life; that ideal could become real if more and more people, institutions and countries, decide to go towards knowledge societies, thanks to the use of public communications to reinforce pursuit of knowledge.	Something that could discourage this possibility is if it becomes into a fashion to talk about knowledge, about Knowledge Society, and so on; and people forget what really matters, that is sustainable and human development. Knowledge Society is just a concept, a way to reach the ideal of a better World, but a better World is the objective.
I am somewhat skeptical on this topic. It would be great if it happened, but there are too many diverging viewpoints to make it happen. If it did happen the benefits could be many, including a much better educated population.	Too many diverging viewpoints for prospects to be very high.
The ideas like "knowledge is the power; knowledge is the fortune" have been deeply rooted among the people.	
Development history of human society, which is to accumulate and apply knowledge, progress with exponential increase since 100 years. For individual, society even whole country, knowledge competition is the basis of other competitions, and learning capacity is the essential element to succeed in this competition. Learning knowledge would be the social trend, and social progress would be accelerated.	Pursuit of knowledge cannot be developed to extreme trend, otherwise it would disturb natural development rules of human society, counteract human progress, even promote unpeaceful factors.

encouraging and positive	inhibiting and negative
	Professional ethic of the public media is not standardized yet, still exists the differences in ideology and faith, etc. Different media would give diverse judgments to the same matter, so I don't think it can be realized in 2030.
With changing notions in the era of knowledge-based economy, the importance of knowledge and intelligence would be highlighted, and the media would need to conform this tendency. It might promote the development of people's imagination and creativity to reinforce innovation, invention, and creation.	
To reinforce to communicate with the society and expand learning mode.	To refuse to make progress, and conformism.
People would realize more and more importance of knowledge and be accustomed to get the information from media, so that public media can play a main role in the movement of pursuit of knowledge.	
To sharp a learning society, and make knowledge economy advance to higher stage.	a. Education for coping with examines. b. making slow progress in society, backward of technology.
Developments of network and media instrument; fierce social competition. It might help to improve human intelligence, knowledge, social productivity.	
Knowledge economy and the information revolution would stimulate the emergence of the possibility. It might create a good social atmosphere for learning and promote the further development of knowledge-based economy.	Needs for individualized learning and a variety of technologies and channels of it would reduce the functions of public media.

10. Portable artificial intelligence devices

encouraging and positive	inhibiting and negative
The growth of Social Networking can be a driver. Imagine technologies that allow SNS to become off-line - i.e. a small device in your pocket will identify and tell you who on the street has similar interests to you and help you to interact with them. Imagine that you have a very advanced Google in your pocket. You put a question, not a keyword - for example, who is this guy? Or what should I do in this situation? Google in 2030 will answer to these questions for you.	
That's my laptop now. It is an artificial memory, a brain prosthesis. This is a feature that will appear in cell phones.	
This will allow to continuously increase human intelligence by external means.	Some people will question what it means to be human! Some will even say that we want to play God and violate "human nature."
only in rich nations, not all over the world	
Technically soon feasible, question is if accepted by people. My guess: yes!	
This is slightly off topic, but people's lives and experiences will be recorded - allowing people to better manage their lives, learn from their experiences, and re-live some of their life in older age. "Little Brother" will emerge - individuals will be able to control behavior just by recording their interactions and what goes on around them. Crime will drop significantly.	This will likely take more than a generation for most people to have such devices. However, it does seem inevitable.
While I agree with the thought that portable AI will become a reality, I don't think it is necessarily good for each of us to have so much of our personal information readily popping into anyone with a gadget in their ear.	
Very high chance that the ubiquitous computing and on-site data will happen. but face recognition and helping with decision making are questionable.....because of privacy issues and pace of life.	
Loss of privacy is a noteworthy dangerous potential adverse consequence. It is not easy to implement ethical usage of such development.	I am afraid that usage and the propaganda efforts of IT corporations are equating "intelligence" with "information." These are two utterly different things.
Tiny devices do come and it is up to a person's own will if and how she/ he will utilize them, I would guess most in healthy purposes that include education purposes	
I think that the term "most people" in the world maybe too much to expect. Certainly the possibility of portable AI devices is nearly 100% by 2030, but for most people? would have to lower the rating.	
Very rich individuals. Some interesting experiments	Democracy; privacy! A 'race' to build portable 'anti-artificial intelligence devices' to protect oneself as an individual.
Technological convergence, on cellular phones for example, and the psychology that lead to the widespread use of gadgets, are very powerful drivers. Adaptation to a very rapidly changing world is a positive consequence.	Slower AI advances.
This will likely happen, but it will be exclusive to the intelligence communities. Agencies like the CIA will end with proprietary use due to the possibilities for use by foreign agents.	Intelligence agencies will prevent the general public from having access to this.
Developments of the image analysis technology.	Complexity of facial pattern recognition.
Developments of chip technology impel micromation of intelligence devices, and make them more portable. Maturity of recognition technology on voice, face and retina, etc. is the basis on which these applications can be adopted. Sometimes new technologies are applied in the field of military affaires at first, if there were a war of global proportion within next 25 years, it maybe	Anxiety about intervening degree to human life through the computer technology may discourage the possibility. With the development of computer technology and popularization of the internet, life style of ordinary people makes great changes, people are surveying this change. In next 25 years, people perhaps make some adjustment. At the same time, ethical

encouraging and positive	inhibiting and negative
accelerate the rapid development of new generation of technology.	criterions and law about individual privacy, etc. would limit the application of this kind of technologies even though it's advanced.
Development of IT can attain this objective.	But considering the level of economy in different areas, for example, minimum wage in USA is 5.5USD/Hour, but in Chinese city it's only 30 cents/Hour. Can you image that they carry tiny computer or brain chips? So this is just devices for a few crowds.
With the development of computer technology, nanobots, brain chips, and nanotech transceivers would be possible to realize. It might conduce to human communication.	As the people know more about dual character of the computer, it might not be used continually. Because excessive dependence on the computer would reduce human emotional interaction and influence development of intelligence.
Development of science & technology. It might exchange a great deal of information easily and fleetly.	
a. Developments of computer technology and nanotech. b. To shorten the distance among people, and promote the communication.	Parts of people are too slothful to think, so that the brain begins to degenerate.
According to the development of artificial intelligence technology, it would be come true absolutely. But how many persons could enjoy the success and this kind of products?	The widening gap between rich and poor would counteract these products are used by most of normal people.
It depends on developments of computer technology, nanotech, and biomedicine. It might break through the bottleneck of human brain in the field of memory, analysis, decision-making, etc. and make human competence advance rapidly.	Depending on "machine" overly might make people to be dissimilated in a certain extent.
The progress of artificial intelligence and the study in robots. It might conduce to enhancing human memory, knowledge, reasoning ability.	These devices might be used for criminal acts.

11. Complete mapping of human synapses to discover how learning occurs and thereby develop strategies for improvement of learning

encouraging and positive	inhibiting and negative
The Allen Brain Atlas project is an example of what is quickly happening in neuroscience. Just like the genome, the brain can be understood scientifically, and this will help to improve education.	The "yuck" factor is a negative factor in understanding how neurons work. Is love only chemical reactions? Also, problems with animal testing, before doing any experiments with humans, might delay further advances in neuroscience.
The realization that higher IQ is the key completive advantage in the knowledge economy stimulates massive brain research by several countries that fund the research over sufficient time to make breakthroughs.	
I think this had 2 parts ..I give this a 70% for the concept of mapping the human brain (as Kurzweil suggests)......but only 40% that it will lead to emotion, higher intelligence, good decisionmaking.....that is monstrously more complex	
Continuous research. Knowing HOW the brain works greatly enhances the possibilities of "learning to Learn" thereby enhancing the possibilities of "life long learning"	
Complete mapping requires not just improvements in scanning methods and database management, but also improvements in image processing, computational neuroscience, and automated research. These are very likely getting well on their way in 2030; it is just that they may still be far from complete mapping. However, even partial mapping is likely enough to deduce important neuroscience about learning. The key issue is how intrusive this mapping is, which in turn determines how problematic it will be to get ethical approval, test subjects and to employ it. A deep understanding of neuroscience will empower most fields of cognition, from AI to learning enhancement drugs.	Knowing how learning occurs in the small and in general may not be helpful in understanding how it occurs on a personal level for an individual.
What I have read and been told about in the last 12 months indicates this is possible by well before 2030. New well-being strengths.	Cost? Negative: incredible power and prestige for the scientists and doctors at its forefront.
Research and advances in complex theory. Incremental advances on this theme.	Like the gene code, the connection pattern of the synapses is not a panacea. Intelligence and emotions go far beyond these patterns in this kind of complex systems. Emergent properties are very elusive even within this time frame.
	It would be only the fruit of research.
There are a series of progress in cognition of human brain, more and more complete and scientific evaluation methods such as intelligence quotient, emotion quotient, etc. appear gradually. Cerebral anatomy technology would evolve in 25 years, and socialist & pedagogy would bring forward renewed annotation to human brain. There progresses would be very helpful to improve method of learning and design new education mode.	Continuation of the current education mode would be the biggest resistance to put forward new one. There are certain solid characteristics in national education system, advanced method and idea may be adopted. Thus perhaps it would implement in corporate training rather than ordinary education.
Progresses in medical science and life science would encourage the possibility. It might shorten the time of learning and study with pertinence.	
Development of science & technology might enhance the speed and depth of learning.	
It would be a great progress not only in life sciences, but also in human history to complete the map of human synapses.	But it's too complex to complete this map within 25 years.
a. Development of life science. b. people can work and study efficiently.	
To realize this possibility, we should enhance the research on human synapses. And its realization would conduce to comprehend more human body and human beings themselves.	

encouraging and positive	inhibiting and negative
Highly-developed biomedicine and pertinent sciences would decode the connection pattern of human synapses. It might bring a qualitative leap and development in capability of learning and intelligence.	
The emergence of the possibility need to make miraculous progress in human science. It might make a leap in development of robot.	The human brain is a complex system, even though decoding the connection pattern of the synapses in the human brain in micro level, there is still doubt that whether the human thinking mode can be occurred again On the macro level.

12. Means for keeping adult brains healthier for longer periods

encouraging and positive	inhibiting and negative
Of course, the likelihood answer depends a great deal on how much deterioration the new techniques prevent. A bit is highly likely, elimination of Alzheimer's is a fine goal but less certain.	
Alzheimer's and Parkinson's disease will be cured and eventually completed eliminated. Those and other brain disorders will be studied in medical history books.	The fear of tampering with the brain, the most complex structure in the known universe, will delay some developments in cognitive sciences. Making older people healthy might take longer than expected.
People used to think that adults could not grow new cells. Research has now shown that new brain cells area created every day. Many of the new cells born each day die off, but running and a more stimulating environment reduces the death rate. Some research indicates that continued adult learning maybe be associated with the news brain cells. The process of adults growing new brain cells is Neurogenesis. Research in neurogenesis should keep brains healthy longer, certainly by 2030. And this is only one line of research. Some background: http://www.wellesley.edu/Biology/Concepts/Html/neurogenesiswhat.html http://www.medterms.com/script/main/art.asp?articlekey=18200 http://en.wikipedia.org/wiki/Neurogenesis	People believing it is not possible and hence do not invest in the necessary research.
Advances in Neurosciences and discovery of new natural biochemical brain enhancement products are already on its way as well as biofeedback equipment for mental states monitoring and improving behavior.	Techniques like fMRI, like functional genoma may take longer that expected to develop.
I believe that adult brains will definitely stay healthier longer...but I think it will come through active use and training for adults, and with medications .. Stimulants. I question the validity, ethics and integrity of stem cell injections....in order to make someone "better than well"	
Continuous research will very probably make it possible to almost eliminate brain diseases affecting humanity today	
Interest among the elderly for keeping active is already high, and the baby-boomer generation is reinforcing this with both numbers and money. There is an also national interest in avoiding large numbers of demented elderly. A more vital elderly population will construct a new concept of what late life means, possibly getting involved in entrepreneurship, education and politics.	Ageist assumptions that decline is inevitable. The positive breakthrough of effective life extension that reduce ageing-related impairments might redirect research but leave a group of non-treatable elderly behind. Vital elderly might feel locked out of a youth-directed society, possibly becoming discontent or forming isolated subcultures.
This will very much meet the ageing trend in advanced economies. However, once emerging markets will be emerged, this specific need will cease to exist. China might be the balance point in this demographic process: with the profile of Western Europe in terms of age and number of children per family, it will likely reinforce this trend indeed.	
Continue many of the existing research paths, with no less priority and support. Longer old age that is more satisfying and productive	Cost, and/or, the appearance of a global pandemic that demands all medical effort for common and shared survival. A break in many/most proactive neural research that, when returned to, demands extra catch-up time and cost.
	It might be a research project.
High-speed development of medical science on brain would encourage the possibility. With enhancing the standard of living, human would be more critical of existing status and these requirements would be driving power of the possibility.	Whether technology of clone can be a lawful application, and validated by clinic in long-term would influence the realization of the possibility. And it would be restricted also by whether current social life style (length of service, retirement) can be changed.
Progress in medicine.	Although keeping adult brains healthier during the aging process, but it can not be equated with increasing the vitality of life, so it might cause to imbalance in quality of life.

encouraging and positive	inhibiting and negative
With the development of science & technology, it would be possible to reinforce human health and natural life.	
Boy, would I love to see this one...There are so many experiments fiddling with brain chemistry, I suspect we will land on something sooner rather than later.	We are already seeing ethicists of all kinds trying to decide, for us, whether it's "fair" to let rich kids drink brain potions. I have to wonder what they are smoking...
With the progress of the life sciences, we would understand more and more about the brain. It would allow us to use this kind of techniques to therapy some mental illness and would be very useful to resolve the problem of work force in our "elder" society.	It'll touch the problem of ethic.
a. Development of medical technology. b. People can enjoy the changing of society.	a. Development of medical ethic. b. Not to respect the vital order of nature.
More and more aged population will inspirit this kind of research.	Too expensive costs would influence the usage of this achievement widely.
The progress of Biology, medicine and clone technology. It might make it possible to study not only the elderly, but the benefits seem to cure diseases of brain.	Restrictions of technologies would hamper such possibility.

13. Chemistry for brain enhancement

encouraging and positive	inhibiting and negative
Current research by DARPA will spray in non military uses	Preserve military secret
Sure we have Ridiln, Vallium, pain killers, uppers, and downers; so this possibility seems almost certain. 60 Minutes just had a segment about the use of adrenalin to erase traumatic memories.	
Prozac is an example of one of the new psychoactive drugs, just like Viagra was for the male reproductive system. Those two drugs are examples of the success of chemical enhancement, and much more will come.	Psychoactive drugs might start a race among parents to enhance their children. However, if not properly studied, some of these drugs might have negative effects and delay further research in other more promising drugs.
According to the following website, it is already going on, not to mention the advances by 2030. http://books.google.com/books?hl=en&lr=&id=9ykQOkpFFu EC&oi=fnd&pg=RA1-PR9&sig=qKHKN5wzw88tl2lzgZN0eYM8vtk&dq=%22Pardri dge%22+%22Brain+Drug+Targeting:+The+Future+of+Brain +Drug+Development%22+#PPP1,M1 http://www.smart-kit.com/s59/brain-enhancement-with-flax-seed-oil-and-vitamin-c// http://www.smart-kit.com/s89/calorie-restriction-reverses-memory-loss/	
This is already available..and being used ..go to a college dormitory in the USA.....and the market to develop stimulants and relaxors is just beginning.....and the potential is extremely high for these drugs. Instant relaxation drugs: valium, vistaril and their followers if used properly can assist healthy development and decision making..but these do not "enhance" human intelligence , they only allow it to function normally to its fullest...	
Possitive consequences will follow these developments provided that ethical consequences are evaluated. Again, development of better balanced individuals supported by the two formidable pillars of human development history: To Know and To Be. Unbalance of these will probably yield dangerous consequences.	Thinking that "miracle drugs" will solve all of the human problems will yield dangerous consequences.
Such drugs currently exist, although safety and efficacy remains an issue. The improvement is in general about 10-20% on different psychometric tests. Currently no drugs are being developed specifically for enhancement, since current medical regulatory systems makes developing, testing, and marketing of these hard. Changes in the view of enhancement are needed for enabling this, and development of an "enhancement culture" among people will be needed to set the social norms of when they are proper or not proper to use.	Drug use is highly controversial in many societies both due to puritan anti-narcotics concerns, a high value placed on "the natural" and medical monopolies. These factors can block or limit development of cognitive enhancer drugs strongly. The use of drugs to improve schooling is extra controversial since it is usually viewed as occurring among children with limited consent, raising fears of competition forcing everybody into a drug race. While the main problem in that case may be more a competitive school system the use of any medical technology among younger people is a cause of concern.
	Technically possible yes, but there are ethical rules about how (and who) to use them
A level of well-being sufficient and sufficiently distributed to allow allocation of time and effort and funds to raise well-being to a new level. More well-being.	Fear of the unknown effects of 'wonder drugs'. Indiscriminate constraints on research and development of leading-edge health ways and means
More and more persons have realized that drugs and productions of health care can improve memory, increase attention span, etc. Progresses of science and technology would accelerate to come out more powerful drugs.	The drugs always have side effect in a certain extent, and it would touch the extensive application of these drugs.
	Chemistry had ever contributed to the development of human society and material civilization, but it brings also many sickness-causing substances to human health. Using drugs could enhance intelligence, improve memory, but never forget that any drug has always a few toxins.
Theoretically it would be possible. It might be magic key to enhance human intelligence.	It might ignore the complexity of human being.
Enhancing the medical technology might dream up the miracle.	
Progress in the research of brain chemistry. b. To reduce the probability of contingency.	Suspicion of drugs' security would discourage the possibility.

encouraging and positive	inhibiting and negative
Development of biochemistry and biomedicine would encourage the possibility. It might make it as easy as winking to improve human intelligence and memory.	It might bring human fatalness that human brain would be controlled.
The progresses in brain chemistry and pharmacies would encourage the possibility. It might raise people's IQ and physical functions through drug.	Using safe drugs to enhance human intelligence and functions is a wonderful thing, but its efficacy and safety are always questionable.

14. Web 17.0

encouraging and positive	inhibiting and negative
In 2030 we will be in Web 4.0 at least!	This trend is very obvious and strong, and only major geopolitical problems and negative wild card scenarios might prevent civilization from advancing.
Massive research is well underway today to make this inevitable in 23 years.	New kinds of viruses and methods of manipulating information delivery could distort knowledge on the semantic web by those who don't like the new knowledge. In the past, cigarette companies distorted cancer research, today an oil company is distorting global warming research, and in the future, ideologues might want to distort research that counters their ideology. As ideological wars were fought by industrial means in Korea and Vietnam, future ideological wars could be fought by information warfare means yet to be invited making the semantic web a battle zone and hence, less trusted.
Information is so cheap and relatively easy to manipulate. What's happened in the past 10 years is just the beginning of how to leverage a global information web. Governments will continue to invest heavily and private capital will continue as well since the cost-benefit ratios are so favorable.	
Break down economic and other barriers to knowledge cooperation. The Internet is simply knowledge shared. The degree of oneness is the same as the degree of its effectiveness, because knowledge is one. When it is economically and otherwise beneficial to maintain personal intellectual property and not to work knowledge cooperatively, knowledge itself is compartmentalized and the Internet becomes a place of increasing undo complexity, confusion, chaos, and error. The next step above the current intellectual property paradigm is to reward the 'act' of knowledge working itself, and not to grant ownership to the product, which is knowledge. This requires clear identification of knowledge interactions, especially knowledge creation with strong identity management. For example, I would be rewarded for creating a new concept and the overarching system would recognize and reward when I do. I am granted certain privilege/status for having created the concept, but I do not personally own it, society as a whole does.	I'd submit that currently, we are not experiencing a "trend toward data integration on the Web" and that this is actually the opposite. We are currently working knowledge in a very, very individualistic way and only "individualistic group solutions" are emerging. Continuing on the present course without a radical shift may render the bulk of the Internet useless in 20 years and people will gravitate toward a few of these group solutions as they learn to work knowledge as one. It will require a realization that knowledge must be worked cooperatively to reach Web 17.0. I believe the open source arguments will become open source warfare before we get there.
If technological development continues unhampered in its acceleration, the layering of breakthroughs across the sciences will likely put us far beyond where we stand today. Human consciousness will arrive at its highest state if this comes to pass, as networked intelligence is always on and instantly accessible and ways of knowing are no longer a struggle.	Biological and/or natural catastrophes or manmade cataclysms (due to terror and/or error) could slow or stop progress. At any point in time progress can be stopped by these or a wildcard the origins of which we are now unaware.
This too seems to have 2 parts.....one part is total access to "all" information...This will happen .Part 2 is open to more interpretation... on the one hand , as Bill Gates says in your article,"Your business and personal information will be safely stored on the Internet, automatically synchronised and instantly available to you - no matter where you are. Everything that can think will link - transparently and automatically", but, on the other hand, that is different from an "integrated logic" to bring it to me. I would prefer my own logic. Just give me the information and I will analyze and interpret it. That is the greatest advantage of the net. Now we can have 6 billion people interpreters...to create the best results.	
Ways of incorporating reflection, inner thinking, and responsible use of these media.	The already present misuse of the net, illegal, and other unethical activities will be likely to increase if more ethical ways of use are not implemented.

encouraging and positive	inhibiting and negative
A very plain extrapolation from current strong trends in technology and society, especially in this area that is in the hands of all of us: co-creation will lead to massive co-development, and we are likely to leapfrog to Web 17.0 much sooner than solving much more radical problems or meeting much more crucial challenges...	
((If by 'integrated' you mean 'interoperable', one can argue that this possibility is closer to 2007 than 2030.))	
Douglas Englebart's Open Hypertextdocument System (OHS) and Pierre Levy's Information Economy Meta Language (IEML) could combine with XML Geo and other open innovations to make it possible for any individual to immerse themselves in the diversity of information inclusive of historical information, multi-cultural and alternative perspectives, real-time serious games/games for change, and practical rigorous dialog and consensus building.	Industries will fight open source software initiatives; they must be beaten into submission. The good of the group requires that industries focus on "services science" and on natural capital--all goods and services must reflect their "true cost" and all goods must be leased rather than sold, to make the vendor responsible for recycling and disposal of their products.
As we have progressed from pedagogy (the teaching of children), to andragogy (the teaching of adults), through to heutagogy (self-directed learning), it is this latter approach, of people learning on their own volition, which will require many sectors of the information-provision part of society to make Web.17, that place where people will go to learn when and how they choose to do so, a reality.	
	It might be achievement of research, but cannot be realize and popularize worldwide.
1) It's proved that the internet will be more and more important through the swift development of IT and its pertinent technologies and applications during several years. It's possible absolutely to do shopping, study, go along entertainment, and communicate but not to depart from home. Stimulated by requirement and marketing, Web 3.0 would be used probably. 2) Developments of communication technologies such as integration of mobile & wireless technology and ADSL, NGM, etc. let speed and distance be no longer problem.	1) The problem of connection, for example, inconsonance of frequency, restriction of policy in each country, would postpone urging the possibility. It needs to make coincident standard and have open attitude. 2) The fogyism in its contents. What interests the people is not technology itself and logical rules, but the evolution of contents brought by technology. No other than rich and colorful contents can stimulate the possibility.
Developments of computer and network technology would improve efficiency and quality to obtain knowledge.	The technologies are not advanced enough to realize the possibility.
Developments of research in computer technologies.	
Development and popularization of network technology. Web 3.0 might transform deeply internet, each terminal is not only the user of internet, but also a part of network. And this kind of semantic network would make query and analysis more exact.	
The progress of technology of Semantic analysis would stimulate the emergence of the possibility. It might actualize intelligent network, and enhance the efficiency and effectiveness of information dissemination with network.	The bottleneck would be the semantic analysis ability. I don't think there is detrimental result following the realization of the possibility.

15. Integrated life-long learning systems

encouraging and positive	inhibiting and negative
Elderhostel is a contemporary example	
LLL (lifelong learning) is already a reality. People continue learning throughout their lives, and every day more and more, in many countries around the world. Furthermore, learning is now combined with leisure and entertainment, and it is growing so fast as to become the largest industry in the world. More people are devoted to education (teaching and learning) and for more years than in any time in history before. Life has become learning, with a lot of leisure added.	The growing generation gap might be a problem since, according to current trends, there will be more and more older people every day.
To some degree the Internet is providing the life long learning now, although few see it that way yet.	
Life Long Learning is already a trend reinforced by longevity as well as development of knowledge and learning society. But more and more there will be an increase awareness of prenatal care as a necessary condition for better overall performance.	Increasing poor-rich, south-north gaps, may delay worldwide developments.
Better understanding of HOW we learn from elementary school on up. Teachers should help their students understand the process of learning from knowing, understanding, comprehending and applying for a life full of joy through grasping the universe around us.	Too much dependency from the computers trying to substitute the epistemological process of learning. We must not forget that computers and IT are but instruments for us to use to our benefit in learning.
Individual curiosity unconstrained by 2007's realities of time, cost, priorities. Work and leisure both are richer, longer, for more of humanity.	Can't think of anything except apocalypse.
It has been realized nowadays.	
1) The approaches on psychology study and statistic classification of competences required by different occupations for all ages groups. 2) Developing the characteristics of knowledge, such as its divertingness, simpleness and understandability, etc.	The widening gap between rich and poor and imbalance in development of different countries would result in breaking out conflicts and interrupt the course of education.
There is no distinct change between integrated life-long learning system and current education system.	
In knowledge-based society, the spiritual needs of people, as well as more humanistic educational idea would promote the emergence of such possibility. It might make learning a part of life and people will live more substantially.	Economic and cultural retrogression would hinder this possibility.
To call for the mission of life-long learning, makes everyone improve themselves through keeping study.	Learning system might suffocate due to be complacent and conservative.
Evolution of our society more and more rapid and people live longer than ever, we need learn new knowledge continuously, so an integrated life-long learning system would emerge in these circumstances.	
a. Reformation of educational ideas. b. Every one study and cultivate own interests on one's own initiative.	
Reformation of educational system and development of computer and network technology. It might make learning easier, more optional, and more important.	
Nowadays there is already the curriculum across all age groups, but its content would be much richer in 2030 and practical for the various stages of life to learn the necessary knowledge and skills.	Almost nothing can hinder the occurrence of such possibility.

16. Programs aimed at eliminating prejudice and hate

encouraging and positive	inhibiting and negative
There have been programs of this kind (for example, to promote tolerance) for years, and there will be in 2030. The fundamental question is whether these programs in 2030 can be significantly more effective than existing ones.	If this is successful, the fact that you can reduce/eliminate hates and prejudice means that you can control human mind (and the reverse can be done too). Somebody will try to control people for his or her own benefits. For example, cult leaders might use these methods or technologies to have people behave in a way he desires.
This ought to happen but will be very difficult to implement effectively in any meaningful way.	
Some governments will always want to intervene and control people's behavior.	For both the better and the worse, some programs might want to interfere too much with people's knowledge, believes, feelings and emotions. Totalitarian States might want to control people like "Big Brother."
Move the concept of diversity toward a concept of individual 'giftedness' and away from strictly a concept of race/creed. Positioning diversity as a race/creed concept simply creates new, though perhaps more equitable divisions, while it fails to solve the core issue of division in the first place. Engagement with cooperation is the exact opposite of division. A focus on personal giftedness with clarity for how one contributes in industry and/or society encourages engagement and cooperation at all levels without creating 'new social divisions.'	Not understanding how all values and belief systems can cooperate. If, e.g., 'psychologists' don't know how it should look, they can't possibly lead one to the place it should be.
Make them universal curricula units created by some internationally accepted body (UNESCO, Wikipedia, etc) that parties to an educational treaty agree to use. There has to be the sense that it is taught in Chicago as well as Jeddah.	If it is created within an atmosphere of - I will tell you how to teach your children
We can only hope...John Lennon was CORRECT about religion	
The programs of such kind are essential for survival of mankind. But it must be something more than rule of superficial political correctness. Such programs should support the diversity of human beings in any respect, but must present it as blessing, enrichment of human society. I.e. the exceptionality, diversity is not handicap, that should be "understood" or "tolerated," but unique advantage of this man/woman, that with his/her unique experience could make our society and our collective experience and wisdom richer and broader.	There is one danger-that such programs would become part of routine political correctness and its institutionalized hypocrisy. I.e., they won't become efficient, but only ridiculous.
Learning from parents, peers, religions, etc is a much different process that from data bases. It carries all the emotional content ..and meaning. .that most people build their lives and behaviors around.. So changing this learning requires recognition, unlearning, commitment to a new belief and then emotional change. Whereas learning educational material simply means adopting a new idea that you recognize as better than the first. Changing emotionally learned material requires emotion.. either pain or some positive feeling ..."for the good of others, my self , my children, the planet ",,I am not certain this can easily be taught in schools and may require generational growth. That is one of the reasons long term thinking should be built into an educational system so that we accept a pace of life that allows ideas to grow and mature into new generational beliefs. This also raises the question of "Who decides?"	
The development of generic capabilities and its assessment incorporated in schools K to 12 and beyond, will greatly improve the present situation. Left brain use and so called "intelligence" alone will not do it; emotional learning capacities must be tapped for success in this area.	Entrenched values, extremists view and age old hatred will continue to endanger this development.

encouraging and positive	inhibiting and negative
	I do not believe that by 2030 the process of transforming tensions into opportunities for improvements will be mature enough to have this kind of development.
Until we are at least a generation beyond the Westphalian, state-above-all, era the 'balance' of impression will be back in time or at the present. Thereafter, there may be 'space' to begin "significant efforts" to design and offer education ways and means with less emphasis on extremes in society. But 'the media' will not go quietly. More awareness of the value of 'soft' knowledge, and of accurate history.	Conflict, crisis, contagion and the fact that humans are attracted to the sensational. It will take longer for more people to have better education, and learning opportunities.
	Wars and extremist activities have social causations.
1) Peaceful development in the world, harmonious & friendly relationship among the worldwide people. 2) Correct orientation of the public opinion and press. 3) The education during high school, which is the period to sharp individual philosophy and world view, is very important.	1) The facts what exist violence like war or racial conflict would influence the young people to form good philosophy and world view. 2) Bad familial education.
Maybe psychologists would be incapable to resolve ideological differences.	
Emergence of equality, democracy, and freedom in more and more countries, respecting each culture and keeping the relative harmony.	Extremist would hinder this possibility.
To emphasize positive education and make them a clear distinction between right and wrong.	Exacerbating of educational environment and lacking of moral sense would discourage the possibility.
The widening gap between rich and poor, unjust situations, stress and etc. would be easy to arouse the extreme emotion, psychotherapy will be a good solution, especially for young people who are susceptible, dupable and act excursively by impulsion.	
a. Integrating well the psychology and education. b. The society becomes more auspicious and stable.	Unfair distribution of society and departmental selfishness.
To avoid the war and extremist in dealing with the conflicts among various countries or regions with might and main and reduce violence in media and entertainment programs, it would conduce to build a harmonious world.	Governmental actions in certain countries, such as current American foreign policy would discourage the possibility actually.
Globalization of politics and economy, faith, and elimination of the gap between rich and poor would encourage the possibility. It might make it possible to actualize the ideal of peaceful & harmonious world.	The diversity among nations, difference in faith, and the gap between rich and poor.
As long as the gap between rich and poor and limited resources, there is usually prejudice and hate, and there would be no exception in 2030. Its realization might promote social harmony a certain extent.	Just with education, it would not be enough to eliminate prejudice and hate. The programs must include specific means to achieve social justice.

17. e-Teaching

encouraging and positive	inhibiting and negative
This seems inevitable; many others things get out sourced, why not education. Outsource the e-teaching to those who are the best teachers, and then they get enough "business" to hire computer programmers, cognitive scientists, and others to make really brilliant programs to teach many.	
Individualized, virtual, continuous, improving, cheap education will be a reality. E-teaching will be global and globalized.	One size does not fit all, so personal differences have to be taken into consideration.
With continuing development of advanced interfaces, it is likely that educational opportunities in virtual or synthetic worlds (such as what we see today in rough form embodied in Second Life) will be perfected as tools for teaching. Avatars or 3D holographic recordings will allow top teachers to send their lessons to the underprivileged. Appropriate levels of funding and an R&D emphasis on education (and not just "gaming") could advance this. It's possible that by 2030 accelerating technologies could even advance humans to the point at which the elite will be educated through direct brain downloads or nanotechnology and the people in poorer areas will have to "settle" for 3D VR teachers and learn the "old-fashioned" way, by listening and trying to remember.	Of course evil regimes and entrenched institutions are likely to either: a) stifle the proliferation of educational technologies, which they generally (and rightfully) perceive to be a threat to their power; or b) utilize the technologies in a limited fashion only to further inculcate belief systems tied to their own narrow ideologies. There will be no problem with removing the "human" element from education, as mentioned by earlier respondents. The learning systems in democratic nation-states will be empathetic and they will be geared to fit human learning needs at the time in which they are being used.
Regard to development of internet this trend will be world-wide and suitable both for busy people in affluent regions as well as for people living in poor countries or remote areas. This trend could bring democratization into education. In my opinion, it will be useful and beneficial also from environmental point of view.	The education could loose the human dimension. The personality of teacher and experience of interpersonal communication is important part of educational process. The education is something more than exchange of information only. But the e-learning has no human dimension.
Useful tool for distant publics. but, not substitutes for the presencial education	
Agree with e-teachers as opposed to e-learning (self teaching) alone, but why not use humans..? It seems the great advantage of the net is that we could bring the best teachers to all people.	
Further research on teleconferencing, videoconference, and the like will increase the positive results of this development because "modeling" is an important part of teaching. Contact with the human element enhances learning from an adequate teacher.	The danger of eliminating the human element from education is actually very present.
In developed countries with lot of population could be an effective tool to the extent of increasing democracy. It's a wonderful alternative to encourage the acquisition of knowledge.	I don't think that the poorest areas could have e teachers if it is considered the poor level of education on those areas especially because of the heterogeneity related to the process of acquisition of knowledge and the possibility of develop it. This model could be a failure
Education is becoming a commodity. As such, basic economics will force providers toward methods that are more effective and/or more efficient. The live teacher is one of the least efficient, and perhaps least effective way of teaching. The artificial constructs will become more and more the norm.	Existing groups and systems providing learning today will oppose the change. Self interest controls much of what we have in education. Overall, I foresee a huge political battle, with the learner being the eventual winner. But this is not a certainty.
Increasing awareness of both the diversity in knowledge levels and the unevenness of access to knowledge. More teachers and more students everywhere, and more who are life-long.	? Slower spread of learners and learning.
Homework Help from India charges $18 an hour to tutoring on any subject, as opposed to $100 an hour in the USA. Knowledge can be shared and built upon at no cost. It is inevitable that the cost of communications will go to zero and the cost of e-teaching will be within the reach of all, especially if the government subsidizes e-learning.	Entrenched monopolies and special interests must be defeated by firm wise government policies.

encouraging and positive	inhibiting and negative
E-teaching might help to exchange information among educational institutions in a country, and with those in other countries. It also might help to increase access to education for more people around the world. What might encourage this possibility is to focus efforts among the educational institutions, the governments, the companies, the banks, and other organizations, cooperating and collaborating together.	This possibility could be discouraged where people don't even have access to computers, and the basic need of education is not considered a basic need by the institutions in that country. On the other hand, among educational institutions where e-teaching could happen, the lack of will to cooperate and collaborate and exchange information could be an obstacle.
	Generally, e-teachers cannot get ahead of living human even if they use artificial intelligence.
With developments of internet, tele-education, and virtual reality technology, even some special vocational training can be disseminated.	Education is not only teaching the knowledge, but also how to be an upright person.
Development of intelligent robots. Progress of IT.	Human brain is most intelligent for all time, and nothing can cover for it even with the technical progress. Economic depression would cause negative effect.
Progress & popularization of advanced science and technology. It might conduce to eliminating poverty, popularize science and culture, and make everyone enjoy advanced education.	
To develop network technology would make the acquirement of knowledge become more easy and rapid.	
a. Improvement of establishments of network communication and opening of education method. b. Teachers might teach students in accordance of their aptitude and students might choose their teachers who may suit themselves, namely to carry out customization---one to one instruction.	
It would economize the costs and be in favor of dissemination of education.	The teachers' responsibilities are not only initiate knowledge, it's more important to set themselves an example to the students, and let them know how to be an upright person. Computer cannot do that.
Developments of computer and network technology. It might integrate furthest educational resources and make learning inimitable convenience.	
Developments of network technology, virtual reality technology and reformation of educational system would encourage the possibility. It might conduce to individualized education and sharing educational resources.	Rigidity of the educational system and backward of reformation of teaching system would delay the realization of the possibility.

18. Smarter than human computers

encouraging and positive	inhibiting and negative
If Moore's Law continues, then this is clearly possible by 2030, but processing power may yield very different "thinking" than humans and provide an interesting cross-reference to understanding reality	Backlash by people who are threatened the robots and computers will grow in power to control our lives beyond our control
In many respects we are there already	
Moore's Law seems like a good indicator that artificial intelligence will overtake human intelligence by 2029, as forecasted by Ray Kurzweil.	The fear of humanity splitting between the Enhanced and the Naturals (not Enhanced) will be a constant worry in the development of artificial intelligence and its direct application to human beings.
In effect, the Internet is already a 'smarter' than human computer. This depends of course on how one defines 'smartness.' There is a great deal of confusion in our society around the difference between intelligence (smartness) and genius. Intelligence is simply knowledge stored and accessed. For example, a machine that has 'more' knowledge stored and can access this knowledge is more intelligent. The same is true of an individual human being as compared with another. Storage and access are independent factors. For example, one can store a great deal of knowledge and not be able to access it. Or be able to access rapidly and accurately without a small amount stored. Genius, on the other hand, is high-volume knowledge creation. This is totally distinct from storage and retrieval. This is commonly what people mean when they say "artificial intelligence," which is really a misnomer. As an example, today, I'm often asked questions by family members who know I don't know the answer, but can find it for them on the Internet. In this example, I'd be using the Internet as artificial intelligence, but not to create new knowledge. Confusion of these concepts has stagnated AI efforts as a whole. But clearly differentiating these will open up a new social era on many fronts, not just this one.	Confusing intelligence and genius. Continuation of currently frustrated AI efforts.
This scenario as it has been presented has nearly been reached already - we're there on most levels. Advances in the fields of artificial life and nanotechnology have to continue on expected pace in order for machines to pass the Turing test and extend into ways of understanding beyond simple information processing. The fulfillment of this and other scenarios in this vision of 2030 would pretty much eliminate the need for schools and human teachers.	Entrenched institutions are fighting the future, and so far education has been resisting more than many established industrial-age systems. This may continue to delay progress for the next few years, but the cascading power of expected breakthroughs by 2030 is only likely to be stopped by either a cosmic or natural disaster or the violence brought forth by those who lag behind the knowledge curve and fear its consequences or a demonic despot who somehow wins control. There will be an evolutionary problem similar to the division between the Homo neaderthalensis and Homo sapiens, as the future will continue to be "unevenly distributed" - a select few will benefit before everyone else; a lot will depend upon the benevolence of the people in control of the technology.
If you speak of memory or specific functions, the net has already accomplished that. If you speak of creative and conceptual knowledge that includes all the physical, psyche, social, emotional, and sexual of the human. (and all of humanity), I think it may be mimicked but never accomplished. And who would trust it?	
If superhuman AI emerges, it is going to require learning. So besides AI's being copied, these entities are also going to require some form of education. Most likely that would be extremely different from human learning in terms of pure fact acquisition, but learning social interactions and dealing with the physical world (important skills even for a superhuman entity) they would require something not unlike schooling or childhoods.	We might not recognize superhuman intelligence for what it is, especially since it may be distributed and not a being per se (compare how "the invisible hand of the market" and Google solve problems).

encouraging and positive	inhibiting and negative
.Computers may surpass "intelligence" as we define it today, but they will never be able to compete with the other learning areas of individuals such as Emotional and Social where the interests of individuals reside.	Frustration for not been able to achieve it.
A very plain extrapolation from current strong trends in technology and in an area of research where funding from the military-industrial complex and the big corporations will not be missed for sure.	
I can not think of any reason why this can not happen by 2030. Whether 'enough' people have access to capabilities above human limits to make a substantive difference by 2030 is...a question.	What will rich, powerful BAD people do with these capabilities and what will the rest of us have to deal with them?
It's impossible absolutely to make machines which are clearly smarter than humans in any way.	It's impossible absolutely to make machines which are clearly smarter than humans in any way.
High-speed developments of artificial intelligence and IT. Humans would get more powerfully cogent.	Capability of humans themselves.
	The mechanism of human body is stupendous complex, and it's not possible to have machines which are smarter than humans before people decode it. The difficulty of cognition would not be inferior to exploring outer space.
Progress of computer technology, robot technology would encourage this possibility. It might enhance efficiency of learning, and change the previous form of education.	
	I don't think it would be realized in 2030.
These smart machines would play important role in human's life, especially in some extreme or dangerous situations. And maybe they would resolve many enigmatical puzzles.	Isn't there possibility that human world would be controlled by these intelligent machines like in some science fiction?!
a. Making further definitude on standards in the field of IT. b. It might reduce working of manpower.	a. To be encumbered by network ethic. b. Human functions begin to degenerate.
Development of computer science and intelligent robot, as well as large numbers of inputs would promote the possibility. This possibility would not only be propitious to produce, security of traffic and enhancing efficiency of work, but also change fundamentally methods of education and learning, and then advance the social progress.	It may bring on the arguments on ethic and morality.
Developments in technology of computer and simulation. It might impulse hugely human development, and be the best working tool created by human being.	It might conduce to risk to human being: whether "smarter than human computer" can control human being in reverse?
Integration of artificial intelligence and human intelligent in the micro-device would encourage such possibility.	It might cause new social problems such as unemployment due to use this kind of machines.

19. Artificial microbes enhance intelligence

encouraging and positive	inhibiting and negative
It would be wise to dedicate some of the research money for public education as was done for the Genome Project, so that the public understanding evolves with research developments.	If the microbes mutate and cause mental disease, therefore, a series of research trials over years should be conducted. Craig Venter's work on writing genetic code to create unique life forms might develop some life forms by 2010, then maybe another ten years to such microbes to live in and assist the brain, then another ten years to test or other mammals; hence, by 2030 could be possible to have safe microbes assisting the brain keeping neurons healthy, etc. To the comment that it will take more than a generation - that gets it to 2030 the timeframe of the question.
Besides artificial microbes, there might be nanobots that will also help increase overall human performance.	There is a normal "human" fear about the unknown. Many people will be afraid of artificial microbes, new bacteria, and nanobots.
	R&D and testing will likely take more than a generation.
I think this is doable...but it raises great questions of ethics and the definition of "human"..as do many of the concepts in this questionnaire. You do not raise several pertinent questions. Just because many of these things are doable and many are being done or planned in today's sometimes secretive scientific environment, does that mean we should do them? Another question, "Shouldn't there be a global human review board that challenges science that questions our humanness?" (i.e. human genetic engineering.) Another, "Shouldn't all science be required to be transparent so that all humanity can decide on any issue that affects large portions..or all of humanity?" It is not the right of a few to decide the good of humanity challenging concepts without such input.	
Symbiotic organisms have many advantages over gene therapy, but also require ways of circumventing the immune system. Symbiotic gut bacteria producing drugs seem very plausible, and could probably be used for enhancement. Anti-cavity mouth bacteria have already been demonstrated.	High "yuck factor," fear of spread. Harsh anti GMO-regulations in some areas might limit people's movement.
Obviously, further research, however intelligence is more than just performing better. There is little doubt in my mind that physical performance could be enhanced this way.	In summary. Education is obviously far behind other sciences as far as what is needed in the 21st century. Development of generic capabilities seems to be far in the future in spite of vast amount of resources invested. Hope we see more and more initiatives such as this of the UN University. There is much to be done!!!
	I do not believe it is an achievable goal in the next few decades from technological viewpoint.
I think this will occur in other ways -- through psychopharmacology and augmented cognition (through the use of computer brain interfaces) -- we are already seeing this in the military. The good news is that it will eventually become available to everyone.	The bad news is that it will eventually become available to everyone -- including those who wish to harm others or promote violence.
Gates-type Foundations funded by the nouveau-super-riche in countries like India and Russia and China.	The human and material means are not up to the task to levels of confidence that we dare use our 'recipes'.
Researches on gene have expanded in the world, including approaches to enhance human intelligence.	The influences of genetic products to humans need a long time to validate.
Continuous progress in human scientific activities and technical level would make it possible partially, but there is still long way to practice it actually.	In the case of not understanding entirely the mechanism of humans themselves, it exists stupendous risks to use artificial microbes enhance neural performance.
The gene was decoded; medicine and biotechnology make great progresses. It might let human be cleverer.	It might be condemned by ethic.

encouraging and positive	inhibiting and negative
To develop pertinent research vigorously might make us enjoy the achievement of scientific development.	Backward in science and technology makes the possibility difficult to realize.
We decoded the gene and the connection pattern of the synapses in the human brain, and mastered completely all functions of the brain, maybe it would happen. If genetic codes could be written by human being, it would be a great revolution to life sciences.	But in other hand, if genetic codes could really be written or modified, and this technology controlled by the person who wants to use it in illegal way or follow one's inclinations, it would be a tragedy for the human society.
a. Making further enlargement on genome project. b. It might reduce persons who have amentia.	
The breakthroughs in biology, genetics, and medicine would encourage the possibility. It might conduce to epochal impulse to the development of human intelligence.	Human gene might be attacked by artificial microbes.

Appendix 4: List of Registrants in the Study

	Name	Country
1.	Hokume Abbasova	Azerbaijan
2.	NABA PALIPOUGUINI ABDOULAYE	Africa
3.	Ira Ahokas	Finland
4.	Rosa Alegria	Brazil
5.	Alper Alsan	Turkey
6.	Ali Saleh Ameen	Kuwait
7.	Janna Anderson	USA
8.	Kaare Stamer Andreasen	Denmark
9.	Margarita Arroyo	Mexico
10.	richard aryel	USA
11.	Victor Atanga	Cameroon
12.	Tom Atlee	USA
13.	Guillermina Baena Paz	México
14.	Mohsen Bahrami	Iran
15.	Ying BAI	Beijing
16.	Luc Bastien	Canada
17.	Simon Bégin	USA
18.	Stefan Bergheim	Germany
19.	Daniel Bergmann	United Kingdom
20.	Evelyne BERTIN	Europe
21.	Marco Bevolo	Netherlands
22.	Peter Bishop	USA
23.	Joseph Bloch	USA
24.	Heiner Bneking	Berlin
25.	Claudio Bruzzi Boechat	Brazil
26.	Arlind Boshnjaku	Europe
27.	Dr. Jeanann Boyce	USA
28.	anette braun	Germany
29.	Julio Burdman	Argentina
30.	Deborah Byrd	USA
31.	Susan Cannon, PhD	USA
32.	Jorge Carlos García Carbajo	Mendoza
33.	Jorge Anibal Carcavallo	Cuba
34.	HÉCTOR CASANUEVA	USA
35.	Manuel Moreno Castañeda	México
36.	frank Catanzaro	Canada
37.	Vitória Catarina Dib	USA

	Name	Country
38.	ceratojr	USA
39.	Jacques Chagnon	Canada
40.	Jorge Rodríguez Chavira	México
41.	Hongan CHE	China
42.	Xiaomin CHE	Beijing
43.	Ted J. Christensen	USA
44.	Dr Guenter Clar	Germany
45.	Diane Cohen-Boulakia	Canada
46.	Patrick Colbeck	USA
47.	Wallys Conhaim	USA
48.	Brenda Jean Cooper	USA
49.	Jose Cordeiro	Venezuela
50.	catherine cosgrove	Canada
51.	Edgar Cotte	Venezuela
52.	Karina Cotte Díaz	Venezuela
53.	marina cunningham	USA
54.	Yvonne Curtis	New Zealand
55.	Cornelia Daheim	Germany
56.	Andreas Dally	Germany
57.	Mariela Damoni	Argentina
58.	william daul	USA
59.	Dr Bob Day	Pretoria
60.	Amparo Mantilla de Ardila	USA
61.	arnoldo de hoyos	Brazil
62.	Michael DeBellis	USA
63.	James Dewar	Canada
64.	José C. Duarte	USA
65.	Juan Eibenschutz	México
66.	Ali Salah Abu El-Khair	Dahbi
67.	V. L Elliott	Virginia
68.	Respicio A. Espirito Santo Jr.	Brazil
69.	Hongfu FAN	Beijing
70.	Yunxia FAN	China
71.	Judith Light Feather	USA
72.	Ivan Roberto Ferraz	Brazil
73.	Elizabeth Florescu	Canada
74.	Flávio Henrique dos Santos Foguel	Brazil
75.	P G	Canada
76.	Michaela Gajdosova	Slovak Republic
77.	Marco Vinicio Guzman Gameros	Mexico
78.	Zongming GAN	China

	Name	Country
79.	Anibal Jose Cardenas Garcia	Venezuela
80.	giorgio gaviraghi	Italy
81.	Rom Gayoso	USA
82.	Jeremy Gibberd	South Africa
83.	Jerome C. Glenn	USA
84.	Feihong GONG	China
85.	ann gordon	USA
86.	Ted Gordon	USA
87.	Ted Gordon	USA
88.	John J. Gottsman	Canada
89.	Hans G. Graf	Switzerland
90.	michael gravino	USA
91.	Jan Gregersen	Germany
92.	OBOT NSEOBONG GREGORY	Nigeria
93.	Luis Gutierrez	USA
94.	Miguel Angel Gutierrez	Argentina
95.	Jacob McCain Hamilton	USA
96.	Ali Haouchine	Canada
97.	Ali HAOUCHINE	Canada
98.	Vincent Harper	USA
99.	David Harries	Canada
100.	Sinclair Harris	USA
101.	Fumio Hasegawa	Tokyo
102.	Kathryn J. Hatcher	USA
103.	Aharon Hauptman	Israel
104.	Sirkka Heinonen	Finland
105.	Jay Herson	USA
106.	Koji HOASHI	China
107.	rudi richard hoffman	USA
108.	Dr. Feng Hsu	USA
109.	Barry Hughes	USA
110.	Karen Hurley	Canada
111.	Reyhan Huseynova	Azerbaijan
112.	Dennis Brian Hutchison	USA
113.	Benjamin Patrick Hyink	USA
114.	Eric Jackson	Ashville
115.	Klaus Jaffe	Venezuela
116.	Jan	Asia
117.	Dr. Jens Jerndal	Argentina
118.	Cynthia Jimes	Canada
119.	Zhouying JIN	Beijing
120.	teng jingwei	Singapore

	Name	Country
121.	Steven Jones	Canada
122.	Hyo Jung	USA
123.	Ted Kahn	Canada
124.	Istvan Kappeter	Hungary
125.	Naila Karimova	Azerbaijan
126.	Geci Karuri	Johannesburg
127.	Martin Kaščák	Slovak Republic
128.	Juha Kaskinen	Finland
129.	Heretikova Katarina	Slovak republic
130.	Daniel S. Katz	USA
131.	Heloisa Kavinski	Brazil
132.	Mary Keitelman	Pacifica
133.	Ki-Soo Kim	Korea
134.	Susanna Kivelä	Europe
135.	Svetlana Klincova	Slovak Republic
136.	Ivan Klinec	Slovak republic
137.	Hayato Kobayashi	USA
138.	Theodore C Kraver	USA
139.	Xiaoxin KUANG	China
140.	Osmo Kuusi	Finland
141.	Lubor Kysučan	Czech Republic
142.	Bruce LaDuke	USA
143.	FRANCOIS LE BEL	Canada
144.	Eric Leavitt	USA
145.	Okhwa Lee	Korea
146.	Piia Leppänen	Finland
147.	Sary Levy	Venezuela
148.	Sebastian Arvidsson Liem	Sweden
149.	Hannu Linturi	Switzerland
150.	dennis list	Australia
151.	Jason Liszkiewicz	USA
152.	Fredric Michael Litto	Brazil
153.	Bruce Lloyd	United Kingdom
154.	Alejandro López-García	Argentina
155.	Mark Lupisella	USA
156.	Linda MacDonald Glenn	USA
157.	Stephan Magnus	Portugal
158.	makulilo victoria	Africa
159.	Pentti Malaska	Finland
160.	Dr. Karola Maltry	Germany
161.	Mika Mannermaa	Finland

	Name	Country
162.	arezzo mansouri	Iran
163.	Eleonora Barbieri Masini	Italy
164.	Shinji Matsumoto	Tokyo
165.	DAVID TORRES - MEJIA	USA
166.	Bongani Memela	Africa
167.	KATIA MENDONÇA	USA
168.	Ricardo Mercado	Mexico
169.	Marian Mester	Slovak Republic
170.	Metais	USA
171.	Tomás Miklos	Mexico
172.	kazuo Mizuta	Japan
173.	Dr. Nader Montazerin	Middle East
174.	James L. Morrison	USA
175.	Liteboho Mphutlane	South Africa
176.	Guido David Núñez Mujica	Venezuela
177.	Tom Murphy	USA
178.	Elfreedes Sales Navas	Argentina
179.	David Nelson	Belmont
180.	Jean-Francois Noubel	France
181.	Pavel Novacek	Czech Republic
182.	Concepción Olavarrieta	Mexico
183.	Johanna Ollila	Finland
184.	Robert Olsinsky	Slovak Republic
185.	Evandro Vieira Ouriques	Europe
186.	Francisco Palacio	Argentina
187.	Angelo Palmisano	Brazil
188.	Simone Paranhos	USA
189.	Jack Park	Canada
190.	Kyung-Jun Park	Korea
191.	MoonSoo Park	Asia
192.	youngsook park	Korea
193.	dr. nadja parpart	Europe
194.	Tuomo Peltonen	Finland
195.	Nicky Penttila	USA
196.	Veronica Sandra Peredo	Argentina
197.	Christopher Petersen	USA
198.	Amedeo Petrocco	USA
199.	Jay Phelan	Los Angeles
200.	Chris Phoenix	USA
201.	Jaroslav Pokorný, PhD.	Slovak republic

	Name	Country
202.	Markus Pöllänen	Finland
203.	Dr. Andreas Poltermann	Berlin
204.	Jose Prats	Venezuela
205.	Hartmut Prochaska	Germany
206.	Gregory Propf	USA
207.	Arturs Puga	Latvia
208.	Bill Pugsley	Canada
209.	Gianmarco Radice	United Kingdom
210.	Luis Ragno	Argentina
211.	Alex Ramonsky	United Kingdom
212.	Surendra L Rao	South East Asia
213.	Ari Raynsford	Brazil
214.	Kelly Redeker	USA
215.	sylvie rijkers-defrasne	Germany
216.	Marcelo Rinesi	Argentina
217.	Alan RODNEY	France
218.	Fred Rodriguez	Venezuela
219.	Marie-Claude ROLAND	France
220.	Ingo Rollwagen	Germany
221.	Lee Rosenzweig	South Africa
222.	Kamel Rouibah	Middle East
223.	Miroslav Rusko	Slovak Republic
224.	Luciano Paolo Russo	Argentina
225.	Steven Earl Salmony	USA
226.	Dr.Mohinder Kumar Salooja	New Delhi
227.	sam	Private
228.	Hur Sang-soo	Korea
229.	Homero Luís Santos	Brazil
230.	Antonio de Padua Bastos de Araujo Sarmento	Brazil
231.	Eric Nicolas Schneider	Europe
232.	Stephan A. Schwartz	Virginia
233.	Ramin Shafagatov	Europe
234.	Abeer Farouk Shakweer	Egypt
235.	Jason Siko	USA
236.	simonnet	Canada
237.	J Snape	Norfolk
238.	David Pearce Snyder	USA
239.	Sari Söderlund	Finland
240.	Jimena Sol Casal	USA

	Name	Country
241.	Jose R. Solano	USA
242.	Xianfeng SONG	China
243.	Dr.Oscar Soria	USA
244.	Juan Carlos Sosa Azpúrua	Venezuela
245.	Dirk HR Spennemann	Australia
246.	Robert David Steele (Vivas)	Virginia
247.	Martijn van der Steen	Europe
248.	Miroslav Syrovátka	Czech Republic
249.	Charles Elliott Tandy	Canada
250.	joe tankersley	USA
251.	Petri Tapio	Europe
252.	Mohan K. Tikku	India
253.	Tofig	Azerbaijan
254.	terushi tomita	Japan
255.	Ikram Turki	Africa
256.	Anna Tylor	USA
257.	Dr. Gereon Uerz	Europe
258.	Bengt-Arne Vedin	Sweden
259.	Arnost Vesely	Czech Repbulic
260.	Natasha Vita-More	USA
261.	Jaroslav Vokoun	Slovakia
262.	Marian Wasilesky	Europe
263.	Chuck Weir	USA
264.	Matthias Wesseler	Germany
265.	Nancy White	USA
266.	paul wildman	Australia
267.	alyosha witness	USA
268.	Irving Wladawsky-Berger	USA
269.	Gregor Wolbring	Canada
270.	Guangle YAN	China
271.	Edward Yang	Brazil
272.	Peter Yim	USA
273.	John Young	USA

Appendix 5: General Description of the Real Time Delphi Process

Imagine a Delphi-like study involving a set of numerical questions, for example "What is the priority of a proposed research project?" When each respondent joins the on-going study, he or she is presented an on-screen form that contains, for each potential research project:

1. A space for a respondent to provide his or her numerical estimate of the priority of each item on a Linkert-like scale.
2. The average of all of the responses of the group so far
3. The number of responses made so far
4. A window that shows reasons that others have given for their responses.
5. And finally, a window that provides a place for respondents to type in the thinking behind their own answers.

In considering his or her answer to each question the respondent may refer to the reasons others have given (4). Considering this information, the respondent provides a numerical input (1) on the priority and instructs the computer to "save" the answer. The group average or median is updated immediately and presented back to the respondent and anyone else who has signed on.

If the respondent's numerical answer is beyond a pre-specified distance from the average or the median, an attention-getting indicator flags the question for the respondent. When the flag is "up" the respondent is asked to give reasons for their response (item 5 above) which, when saved, become an entry in the "reasons window" and is seen later when anyone opens that window (item 4 above).

There is no explicit second round. When the respondent comes back to the study in a minute or a day, the original input form is presented to him or her. Of course, by then others may have contributed judgments, the averages or medians may have changed and other questions may be flagged since the group response may have changed sufficiently to move the respondent's previous answers outside of the pre-specified distance from the average or the median since the last time the input page was viewed.

In this way the Delphi requirements of anonymity and feedback are met and the process, once underway yields the distribution of the group's responses and reasons for the extreme positions. The process can be synchronous or asynchronous, and if implemented on an Internet site, can involve a world wide panel. The administrator can publish a cut off time (an hour, a day, a week, or a month away) and encourage participants to visit the site often before that time. There will be no "stuffing of the ballot box" since each participant has only one form- their original form- that is always brought back when the participant revisits. [22]

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[22] A complete description of the Real Time Delphi process may be found in Gordon, T and Pease, A. " RT Delphi: An efficient, "roundless" almost real time Delphi method," *Technological Forecasting and Social Change*, 73 (2006) 321-333.