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Chapter 1 : Center for Restructuring Education in Science and Technology

Restructuring Education Through Technology was originally published by the Phi Delta Kappa Educational Foundation (). When I wrote this in , the World Wide Web did not exist. When I wrote this in , the World Wide Web did not exist.

The survey covered secondary school teachers in Anambra State. Three research questions guided the study. This is to ensure that the system prepares leaners for effective life in an ICT dominated world. Some suggestions were given for the effective implementation of an ICT-driven curriculum. To achieve this aim, every school system makes use of curriculum. Since the school is established to serve the society, the objectives of the school must be tailored toward meeting the needs and aspirations of the society. The needs of the individual are subsumed within those of the society since a society is made up of individuals. Consequently, education is of functional value to the extent that it enables individuals perform desired activities in a given society. Education that is not functional is characterized as deficient Okafor, The wake of this millennium has witnessed a mismatch between the education children receive in Nigerian schools and the life activities they are expected to engage in. It is a problem of putting a square peg in a round hole. This is the era of technology revolution, the information age. Yet, it appears that the Nigerian education system has been overtaken by events. Since education lags behind technology advancement and it is education that prepares man for life, a change is urgently required. Perelman is advocating restructuring of education to make it appropriate for Information Age. Education restructuring for Information Age is the process of exploiting technology to redesign and improve the total process of education. There is urgent need for education restructuring to ensure that education continues to produce effective citizens. In this regard, Vaille In fact Mecklenburger had earlier called for a technology revolution in education. For education restructuring to be effective, the education system must address what Winslow This means that having computers in the classroom is not enough to support the on going learning revolution. Pearlman in Bruder To achieve this, Simpson, Payne, Munro and Hughes Learning in Information Age requires new teacher role. Teachers cannot depend only on the traditional tools such as chalk, textbooks, overhead video projectors and other types of traditional instructional materials to teach students the skills required for survival in the Information Age. They have to use technologies of the day such as computers, interactive video, CD-ROM, Satellite communications and develop new teacher roles. The development and use of these Information and Communications Technology ICT devices and ideas to promote human learning is the hall-mark of an ICT-driven curriculum. Effective implementation of this type of curriculum requires new teacher roles regarding the what and how of instruction. The new roles of teachers include managers and leaders of instruction. Simpson et al also mention that appropriate targets for the development of skills in both serving and trainee teachers in Scotland were set and published by the Scottish Office Education and Industry Department in while in the same year, the teacher Training Agency in England set out guidelines and Teacher ICT literacy requirements. As regards the training of teachers, McFarlane remarks that by the Department for Education DFE proudly indicated that 90 percent of teachers were computer literate. According to Parmentier after the OECD conference in Sevres, France in participating countries saw the need to introduce computer science in the school curriculum. Also a circular was published in March for the teaching of computer science in elementary schools. This scheme introduced a computer literacy programme in schools. However, technology is used in different ways in the schools. For instance while some schools have computer labs others have computers on carts and when needed, these computers are moved from one room to the other. This review on how different countries embraced education restructuring through ICT was presented to enable us critically evaluate how far we have gone and the direction we are expected to follow if the Nigerian education system is to continue to produce individuals who are effective citizens in this era of Information Technology. In this regard Bruder and Hawkins share the same view as Hawkins However for learners to be technologically literate, a policy statement on computer literacy is just a tip of the iceberg. In this regard,

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Loveless Are the teachers making effective use of IT in the classroom? Therefore, to identify the extent to which the Nigerian teacher has been empowered through ICT â€” driven curriculum to prepare learners for life in this Information Technology Age is the problem of this study. To what extent are ICT facilities available in secondary schools? How frequently do secondary school teachers employ ICT facilities in teaching? Scope, Design and Population: The study was a survey which covered teachers in all state owned secondary schools in Anambra State. Two teachers were sampled from each school and that gave a total sample size of The stratified random sampling method was used. Consequently, one teacher was sampled in the Junior Secondary School section while the other teacher was in the Senior Secondary School section. Data was collected through the use of a questionnaire, which contained ten items, three of which have twenty-four sub-items. The items were structured on a two point scale of yes and no as well as a four point scale ranging from very often to not al all. These lecturers did both the face and content validity of the instrument. The split-half method was used to ascertain reliability by administering the instrument once on 40 secondary school teachers in Enugu State. A reliability coefficient of internal consistency of 0. The Spearman â€” brown formula was applied and this yielded a score of 0. Collected data were analyzed using frequencies and percentages.

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Chapter 2 : What is Plagiarism? Item 1

After a brief historical overview of the uses of technology in education, the paper discusses the nature of systems in education and examines the process of restructuring through systems change in the seven pairs of relationships as they exist today and as they might change in a restructured educational system.

Why is this a good idea? The same reasons above apply to this proposed setup. Out of necessity, students will need to take courses across colleges leading to lateral linkages and synergies. I suggest that the academic units be based on a departmental structure. It will be difficult to prevent the formation of silos within such a structure. Additionally, it creates an additional management layer whose value is questionable. A departmental structure will be flatter and more effective. It is important that the reorganization process factor in mission critical activities such as those related to fulfillment of our land grant mission. Implementing Bottom Up Evaluations To ensure a comprehensive analysis of the restructuring process please consider the following suggestion: For FAMU to position itself for growth and strive to achieve a impeccable reputation in the world, a comprehensive assessment should be done of both employees and their supervisors; not only top down, but also bottom up. The disadvantage of top down analysis is the fact that some supervisors tend to deny involvement to their employees in various projects; this process of denial is not visible to the above-the-supervisor leader, and many employees tend to be qualified as mediocre. In order to have a motivated workforce that would continue to strive towards excellence the bottom up evaluation system should be devised and implemented. By implementing the bottom up evaluations, the leadreship team will have a better picture of which leaders are better position to help lead the university reach its long term goals. Please consider implementing bottom up evaluations give employees a chance to evaluate their supervisors. Environmental Science institute - This is a program that places a lot of focus on an emerging field that covers various sciences and issues that our physical environment which thereby affects all else is currently facing. As such, it holds a lot of prestige to have this institute as it draws attention to the field, thereby luring the interest of many individuals to be participative in such a field. Such goals include the formation of a combined College of Environmental Science and Policy, thereby increasing the number of minority, highly qualified environmental scientists and decision makers, and potentially creating new programs that fall under the bracket of much of the environmental issues at the forefront of our society environmental health, marine science, sustainability, etc. Though there may be opportunity for collaborative research between the two programs, more value is held in allowing the Environmental Sciences Institute to bring these goals to fruition as a distinctive institute. The great majority of the faculty members in this department share this view. Moreover, several laboratories are shared with the BASE program which allows for optimal utilization of limited resources. And finally, these programs share the same accreditation agency. With the recommended addition of the Environmental Sciences Program to CESTA, the future looks much brighter for the Engineering Technology Programs, in terms of possible synergistic arrangements, to develop new programs that are in demand such as the Biomedical Engineering and the Environmental Engineering Technology Programs. The engineering technology programs proudly lay a big partial claim to the historical "M" in the name FAMU. The programs are fully accredited and provide a link to the current STEM efforts in research, training and education being offered by the federal and state government. By eliminating any program duplications, a fruitful pairing of the engineering technology programs civil and electronics would lead to outstanding increased research and graduate education opportunities. The Proposed College of Science and Technology seems the most logical pairing. Technology should be within its own entity and reportable directly to the President directly. That way technology needs and its importance can be directly communicated to the leader over the entire entity for the benefit of all. Technology and the resources money, people, training, licensing, maintenance, and warranties required to implement, maintain and develop is a huge process, cost and need that cannot be ignored which is has in the past. As examples, looking at all State departments,

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Universities and any business each has a IT department and structure that is its own entity and reports directly to the top person for the purposes mentioned above. Environmental Issues and Their Impact Environmental issues i. Accordingly, federal agencies are reorganizing, creating new offices, and allocating significant research dollars to address these issues. Even within the state of Florida many academic institutions are now scrambling to develop and promote highly visible and autonomous environmental programs to capitalize on these trends and to position themselves to be leaders in this arena. This has allowed ESI to establish itself nationally, as well as with several federal funding agencies i. Because of these national trends, and so that our students receive the best training to ensure they are highly competitive for the future job market, the vision for FAMU should be to further grow the Environmental Sciences Institute into a fully fledged, highly visible, and autonomous college. If it is not possible for ESI to be a stand alone college, one other viable option would be to create a College of Environmental Science and Policy. As I started thinking about my future plans, I realized my options for a doctoral program were limited if I wanted to continue my education at FAMU. D programs are heavily focused in the sciences. UCF offers a unique Ph. Tallahassee being the state capital provides a great pool of candidates for such a program. In the current restructuring process, this type of program may be a perfect fit for FAMU. While I do not know all the ins and outs of establishing a new degree program, this program may be able to take advantage of resources already in place at the University. If you have time, I ask that you visit http: Good Luck in your restructuring process. Restructuring of STEM units in three colleges listed below: Most critically however, is the question of whether the arrangement brings value efficiency and growth to FAMU and I briefly discuss this in context of one of the suggested new colleges below. Putting institutional interest ahead of personal interest 1. It is high time we put institutional interest ahead of personal interest. Formation of College of Agriculture and Environmental Sciences: Department of Biological Sciences within the College of Agriculture and Life Sciences will provide training in biology for i Agriculture students, ii Pre-med students, iii Environmental students and Pre-vet students. Having worked in patent and intellectual property searching during my time at Dialog 6 years , searching for prior art in the creation of patent applications is an important part of the technology transfer process. The customer base can include the legal community. FAMU has trained searchers, the databases are available, the community is available. There are few independent information professionals http: This one budget would take into consideration and pay for all departmental technology needs and implementations such as software, hardware, infrastructure and networking needs on the main campus and its affiliates. I have the following recommendations for the new College of Agriculture and Environmental Sciences: School of Environmental Sciences is OK. The Engineering Technology programs are listed under the College of Agriculture and Environmental Sciences as part of the School of Agricultural Sciences no direct association. The conversational presentation of students matriculating towards an Engineering Technology degree would have to say I am in the School of Agricultural Sciences or The College of Agriculture and Environmental Sciences which would not be a great selling point. Since there is a College of Science and Technology, the Engineering Technology programs would academically and strategically fit with the College of Science and Technology. Since all of the academic areas listed under the College of Science and Technology are Departmental in structure, the Engineering Technology should be structured accordingly. If the Engineering Programs are restructured to fit under the College of Science and Technology, it would have an opportunity to request funding for new visions to grow. Also, allow each individual program to request funding from Title III, so if one program fails to comply with Title III regulations, all programs will not suffer a loss.

Chapter 3 : Restructuring Education for the 21st Century

Education restructuring for Information Age is the process of exploiting technology to redesign and improve the total process of education. There is urgent need for education restructuring to ensure that education continues to produce effective citizens.

Teachers present information orally and visually to groups of students. Teachers assign the same readings and exercises to an entire group of students. Teachers supervise student seatwork when not directing group activities in the classroom. Teachers seldom individualize instruction because it is impractical under current conditions. Teachers discipline students who misbehave. Students ask teachers questions when they do not understand some learning task. Students listen to teacher lectures and watch demonstrations. Teachers usually select the content to be learned and decide how long students should take to learn it. Most communication between students and teachers is face-to-face and to a lesser extent by writing. Teachers and students typically spend a limited amount of time together in a teaching-leaming relationship, usually an academic year 9 to 10 months. What If How might the relationship between teachers and students change in a restructured educational system? If electronic information technologies were used to deliver instruction to students computer-based tutorials, simulations, guided-practice exercises, interactive video, hypermedia , then several basic changes could take place. First, a student would have a multitude of teachers, not just one or a few at some point in time. Each of those teachers would be communicating with students via the technology as authors of computer-based learning materials in which information is presented, appropriate interactive tasks with feedback are provided, and achievement is assessed. Thus, much of the interaction between teachers and students would be indirect, not face-to-face. By being freed from the role of information provider to groups of students, the executive teacher would then have more time to establish an individual plan of instruction with each student. The executive teacher might also have more time to get to know students personally and listen to what is on their minds. Student-Content Relationships Students too often find subject matter to be meaningless, disconnected from real life. Student interaction with content is mostly passive listening, reading, or watching. Students encounter content that typically is static, not changing as knowledge or events change. Students seldom choose what content to learn, when to learn it, how long to spend on it, or how deeply to delve into it. Many students fail to master learning objectives since the rate of learning is externally paced much of the time. Many students are bored with, or alienated from, the subject matter they are expected to learn. What If How might the relationship between students and content change in a restructured educational system? Compared to reading a textbook, students would become more actively engaged in learning by interacting with technology-mediated learning materials. Such materials, if well designed, would give students numerous opportunities to respond and would provide immediate feedback in the form of corrections or additional information. During computer-based simulations, feedback would occur when a student experiences the consequences of his or her actions. Students would have more control over the pace of their learning and spend as much time as needed to master particular learning objectives. Students actively engaged with content and experiencing success with it would be more enthusiastic about the subject matter they are studying. Finally, when the content is technology mediated, it becomes possible to present it more dynamically in aural and visual modalities using interactive video. Teacher-Content Relationships Now Teachers have learned most of the content they teach during their formal education in college but are mostly on their own with regard to further learning once they are in the classroom. Teachers have little control over what content is to be covered and when. Such control rests primarily with textbook publishers and with state and local curriculum guidelines. Teachers most often are required to use externally produced learning materials, such as textbooks, workbooks, films, videotapes, and computer courseware. What If Teachers would be able to further their own learning by using the same kinds of technology-mediated materials as students use. Teachers would be able to design and produce instructional materials themselves using computer-based authoring systems, desk-top publishing, video technology, and so forth. Teachers would be developing some of the content for their classes rather than relying almost exclusively on externally produced materials. Student-Context Relationships Now Students attend class in separate rooms, usually in a large building with hundreds of other students. Students spend most of their time in school with a group of other students who are in the same grade and are about the same age. Schedules, bells, and the school calendar dictate the teaching-learning process. Students attend to minute classes, five days a week for days a year. Little organized learning goes on in the late afternoon, evenings, on weekends, or during the summer. Students spend a considerable amount of their time reading printed material and writing about what they have read. Students typically sit at desks oriented toward the front of the room. Secondary students have little private storage space for personal effects except for a locker in the hall. Students tend to be isolated from the rest of the world while in school -from the community , from telephones, and from computer networks. What If Since information technology can bring many more teachers to a student, there would be no need to continue the large, consolidated schools that have become prevalent in the U. The original argument for consolidation, particularly at the secondary level, was to support a broader curriculum offering more specialized courses, such as advanced mathematics, science, and foreign languages. Returning to the small neighborhood school would be possible and practical. Teachers of specialized subjects can "travel" electronically to the neighborhood schools. Modern educational technologies make individualization of instruction truly possible for the first time. There would be no need to continue the lock-step system of grade levels -- nor ability grouping -- since a teacher would not need to teach to the middle of the group. If a mastery learning approach is adopted, then different students would learn at different paces; mixed-age groups would become possible. The goal would not be promotion to the next grade but rather the mastery of educational objectives by each student. The drudgery of record keeping as well as some forms of achievement assessment could be handled by computers. There is no reason why these interactive workstations need to be located in conventional classrooms. It might make more sense to cluster workstations in terms of function interactive video, word processing, information searching , where the hardware needs will vary. Currently schools have few secure places for students to put their things -- textbooks, notebooks, and personal effects. How can students feel like they belong if the facility has no designated places for them to put their own stuff? In most homes, parents and children have some space that is their own. It is certainly feasible for each student to have his or her own computer system at school, accessible at all reasonable hours, year round. Furthermore, students could take portable computer systems home. For years they have taken textbooks home to study. Why not their portable computers? Or why not computer terminals at home for access to school computers? Certainly some specialized computer systems will need to be shared by numerous students. However, private storage space can be made available on these systems so each student has a place to put his or her projects, "papers," notes, electronic mail messages, etc. Finally, one further change that could occur, particularly with older students, is that they would not have to be in school in order to get an education. Their learning could occur at home if they had access to computer technology and appropriate learning modules. Lord Walter Perry, former vice-chancellor and one of the founders of the Open University in Great Britain, predicts that in the 21st century we will be forced into this kind of home learning, because it will become too expensive to transport students to school on a regular basis. Teacher-Context Relationships Now Teachers work in a classroom, typically one teacher to a room with from 20 to 30 students at any given time. Teachers, by and large, are isolated from the rest of the world while at work in the classroom. Teachers have limited opportunities to discuss their work with colleagues. Teachers usually present information by using chalkboards and overhead projectors. Teachers often spend time at home -- outside of regular school hours -- preparing lessons and grading student homework and tests. Teachers seldom work with students outside the school setting -- at home or in the community. Teachers typically have little private storage space, beyond a desk in a classroom, for keeping learning materials and other professional materials. What If One significant change is that teachers could become technologically linked to the rest of the world. They could access information electronically. They could communicate with each other as well as with students and parents using E-Mail. Audio-graphic technology would allow live interaction between teachers and students. And most important, each teacher would have his or her own computer system, plus a telephone for sending and receiving voice mail. Content-Context Relationships Much content is embodied in print format in texts, workbooks, dictionaries, encyclopedias, and periodicals. Much content is static and is slow to change, even after knowledge changes. Much content is presented in a verbal, abstract form -- less often in iconic or concrete formats. What If Content could be presented in a variety of formats via multimedia. Dynamic processes could be illustrated. Content in the form of text, still pictures, video, sound, graphics, or animations could be digitally or analogically encoded and stored in electronic, magnetic, and optical technologies. This encoded information could be transmitted literally around the world in a matter of seconds. Educational System-Environment Relationships Now Parents or other community members have little communication with or participation in teaching-learning experiences in school. Students and teachers have to go to school in order to engage in learning experiences. Students attend school for only a limited period not in evenings, on weekends, during summers ; many are bused; and all come and go at basically the same times. Most formal educational activities occur in schools, not out in the community. Public schools serve students between the ages of 5 and 18, but most of the rest of the community is excluded from participation in formal education. Teachers are certified and licensed by state agencies. School boards, elected by the local community, monitor the administration and operation of the educational system. Curriculum materials are selected primarily from those produced by commercial publishers. Educational systems have few communication links with the outside world, such as computer networks and TV cable or satellite access. Educational systems are highly centralized, making it difficult for community members to have much direct influence on what happens in the system.

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Chapter 4 : Restructuring- Florida Agricultural and Mechanical University

At the same time, however, there are some differences between the internet and the classic classroom setting, which could be the source of differences in both affective and cognitive learning.

Department of Education recently released Transforming American Education: Learning Powered by Technology. Here, Karen Cator, director of the Office of Educational Technology, talks with Educational Leadership about the highlights of that plan and the national vision for schools. Can you tell me about a school you have visited that exemplifies good use of technology? It has spirited teachers, exemplary leadership, and a commitment to figuring out how to teach each student. When I visited that school district see "Focus on Mooresville," p. As I did so, I watched for engagement. All the students from 4th grade through high school had their own laptops, and they were using them to do their work. If they were practicing math, they had bookmarked practice sets and tutorials. If they were preparing a report, they were researching and creating the media to accompany the text. It struck me as very straightforward. The whole space was a learning environment, and the technology was just part of the infrastructure. In a high school class, students had chosen books and were presenting to classmates their digital visual representation of the theme of the book. Is engagement in learning the most important characteristic you look for in a technology-rich school, then? I do like to picture an engagement meter in the classroom. When you look across the room, every person is leaning forward, interacting with the teacher, with other students, or with the content. Another thing I look at is the nature of the assignment. Is it compelling, does it have some semblance of relevance, and does it allow for a variety of depths? Does it consider whether answers can be searched, calculated, or copied; and does it ask students to do something with the basic information and calculations? The third quality is the level of personalization. We talked a lot about personalized learning in the National Education Technology Plan. Do you think that learning that occurs online is different from learning that happens in traditional classrooms? I think today it is. In the past, online learning has tended to be isolating and less participatory and has been distinct from using technology in the classroom. But going forward, interactions will be key. Just as people engage in online interactionsâ€"around virtual sports teams, cooking, or whateverâ€"students will be able to engage in participatory learning experiences online in and out of the classroom. And today, the available technology is often a shared resource. As we transition to a digital learning environment and each learner has his or her own device, we will be able to facilitate personalization, participation, interaction, and collaborationâ€"with people who might be right there in the classroom or people who might be across the world. And we need to make sure the environments are fully accessible to all students. Concerning the question of access, does the Department of Education know how many schools have broadband at this time? Does the technology plan recognize that many schools, especially in rural areas, may not have access? The broadband plan focuses on access but also discusses national purposes of broadband technology, one of which is education. Access is a basic necessity for learners of all ages, everywhere. We have been working with the Departments of Commerce and Agriculture because they had a significant amount of American Reinvestment and Recovery Act money to aggressively tackle the broadband provisioning across the country. There is another project underway to create a visual map of the country showing broadband access. They will be able to have higher expectations about what they can ask for, what they can hope for, and what they can replicate. How can schools address the inequities in terms of student access? I say that for three reasons. First, digital and mobile devices are proliferating and are available at lower costs; second, the amount and quality of digital content for learning is exploding; and third, interactive environments online are becoming easier to use and more useful. Students must have a digital device with them in class, just as they have had their binder, their textbook, and their pencil box. They can use this digital device to maintain their portfolio, access news and information when they need it, get their grades, and manage their learning life. Many schools and districts are now trying to figure out how they can leverage, rather than disallow, student-owned devices. Forsythe County, Georgia, for example, is developing a new policy that allows student-owned devices. This particular strategy does require careful policy development and planning. That is an interesting concept, but devices are so unequal. A really good iPad and a cell phone, for example, have different capabilities. We need to talk about the features, what you can accomplish with them. We might say, for example, that all students need a device that will allow them to access the Internet and create documents. And different devices might provide different capabilities. The small mobile device can be used for information access, calculations, and communication. Other devices, maybe shared, will need more processing power so students can create more complex videos or animations. That totally depends on the community and its cultureâ€”the local context. In most places it would have to be a shared responsibility. Obviously, we cannot have policies that exacerbate the digital divide. We want to improve access for all students. The school will likely continue to purchase devices and have them available for some or all students. Colleges used to have many more computer labs and public access spaces, but those have decreased as students have begun coming to school with their own devices. Some communities have access in centers. Libraries are incredibly important. It is an evolving strategy. In some classrooms, kids are using online learning to learn higher-order skills, and in others, kids are taught basic skills. How do we address that inequity? In addition to addressing the digital divide, we need to address the pedagogical divide. We can use technology and the opportunity for learning online to provide more balanced learning opportunities for students. This digital learning environment can augment the capacity of the teacher. And we can improve the opportunity for teachers to learn from one another. In rural and underserved areas, we can provide full courses that would otherwise not be available. How does the typical veteran teacher become more facile with technology? Are you seeing any good professional development out there? To improve the abilities of teachers, I would focus first on their personal use. Now, most teachers are quite facile with technology in their personal livesâ€”for shopping, finding old college and high school friends, videoconferencing with children or grandchildren, or playing interactive games online. A key demographic for these games, like teaching, is actually middle-aged women. So I think we need to get beyond calling teachers digital immigrants, as if technology holds a certain code only young people can decipher. We can let that go. Now we can focus on using technology to support learning goals. If a product requires a chunk of time for professional development just to know how to use it, then it may not be well-designed. What kinds of collaborations are needed among classroom teachers, online teachers, and media specialists? In the technology plan, we talk about the highly connected teacher. Getting better at developing meaningful connections is really important. We are working on a new project on the design of online connected communities of practice where people can grapple with a problem together, share what they have learned, develop a solution together, and connect with experts who can provide research, information, and strategies. Communities of practice are not new, and there is evidence that they are incredibly helpful, so we are focusing on the best ways to leverage online environments and technologies to connect professional educators. Because our theme is called "Teaching Screenagers," I want to talk more about students. When we interviewed some of our college-age interns who worked for us this past summer see p. What is your take on that practice? I certainly understand their frustration. It is really important that we do everything we can to make sure children are safe online. This requires strong policies and rules; better information and education for teachers, leaders, and students; and much improved technologies to sort the appropriate from the inappropriate. Many filtering programs today use what I call brute force. They are not intelligent enough to distinguish one YouTube video from another. We should be able to get our smartest computer scientists to create seriously intelligent filtering systems and search technologies to empower learning, not just blocking. ELauthor Mark Bauerlein p. He also says that it encourages kids to respond to complex content before they understand it. Do you see ways schools can counteract that potential downside of technology use? Part of being literate in the 21st century or probably any century is being able to make careful decisions about technologies and their uses. Students really need the wisdom of adults, as they always have, to figure out what they need to learn and how they should go about it. The challenge for teachers is to understand the opportunities new technology provides something that is hard because of rapid changes in what is possible and then make decisions about how to manage the learning environment. Teachers have a tremendous opportunity to create compelling assignments that require their students to read a lot and to think deeply. If we value the abilities that Mark suggests we are losing, then we need curriculum to support their development. We have had a tremendous shift in culture with the rise in mobile devices that provide fast and easy answers to the kinds of questions we have always spent a lot of time teaching and testing.

Chapter 5 : Transforming Education with Technology - Educational Leadership

Note: Citations are based on reference standards. However, formatting rules can vary widely between applications and fields of interest or study. The specific requirements or preferences of your reviewing publisher, classroom teacher, institution or organization should be applied.

A shift is occurring in the sociotechnological paradigm that underlies our current sophisticated industrial structure. This old paradigm consists of the mass production of essentially standardized goods in ever-larger units; an emphasis on quantitative goals for production, requiring ever higher inputs of capital, energy, and raw materials to produce more and more; and little attention to environmental impact, resource use, and conservation issues. In contrast, the new paradigm taking shape is identified with an emphasis on quality and diversification of products and processes, diffusion of small but highly productive units that rely on new technologies and are linked to a process of decentralization of production, adoption of process and product choices requiring far less energy and materials input per unit of output, and a greater awareness of the need to preserve the quality of local and global environments. Thus, we are in a period of transition between two epochs, a time comparable to the industrial revolution, when the steam engine was introduced and coal was the emerging energy source. Then, as now, there was widespread fear of the future, a fear derived from the difficulty of even imagining the range of opportunities that an ongoing revolution brings in terms of new activities and related jobs. During a transition of this magnitude, past equilibria are disrupted and conditions of mismatch occur in labor markets. The demand for new jobs and skills increases, and old activities disappear or lose their importance in the marketplace. These changes are visible; their impact is almost immediate. It is now clear that the paper-free office is going to be widespread in a few Page 24 Share Cite Suggested Citation: The National Academies Press. The human-free factory is also in sight. With increasing automation and robotization, it is not only blue-collar jobs that will be eliminated. The change is more profound. We are witnessing the sharpened decline of the factory as the primary function and chief labor-absorber in industry. Now manufacturing itself becomes ancillary and often even a candidate for contracting out. This does not mean, however, that manufacturing technologies are becoming secondary in importance. The contrary is true, and here, too, history offers a parallel. All through the history of industrial society, agriculture improved its output and productivity enormously, although it no longer dominated the economy and was not the main source of jobs as it once had been. Industry will repeat this pattern, as the transition to a postindustrial, service-oriented society is completed. The present era of change is being brought about by a whole cluster of technologies, some of which have an exceptional capacity for horizontal diffusion in all sectors of the economy and society and an equally exceptional capacity for cross-fertilization. Key technologies in this category include the microelectronics-information technologies complex, the biotechnologies, and the new materials science. This process of technological change spurs structural changes in the economy and society. Mature sectors such as machine tools and textiles can be rejuvenated by grafting new technologies onto their processes and products. When this rejuvenation occurs in industrialized countries, these traditional sectors take the lead in international competition. Italy is a case in point, since Italian prosperity is in no small measure due to the restored competitiveness of such sectors. These sectors demonstrate a highly flexible approach to production, making possible less standardized products specifically designed to satisfy the tastes and needs of customers. They also demonstrate considerable creativity through attention to design factors and closer links to the market and its fluctuations, attentiveness to moods and fashions with highly imaginative marketing, and a capacity to absorb new technology and indeed to interact with it to generate improvements and adaptations. The fact that in Italy these sectors tend to consist of dynamic, small- to medium-size firms organized in industrial districts is extremely important. Such districts operate as coalitions of competitors, interdependent yet united by a common goal. This pattern encourages the diffusion of technology through all firms in the district. This is in marked contrast to experience elsewhere when competing firms tend to keep technological advances closely Page 25 Share Cite Suggested Citation: Mature sectors that undergo such technological renewal and then strive continually to keep abreast of technological developments and market trends can retain competitiveness even in the face of increasing international competition. This pattern is one of the elements suggesting that long-established concepts of comparative advantage and ensuing international division of labor must be challenged. But the emerging technologies are not the exclusive domain of advanced countries, and their intelligent application in developing countries may speed up their economic growth and open possibilities for decentralized patterns of development. Until recently in the advanced countries, the main technological innovations in production have involved mass production and standardization. The emerging technologies make it possible to give an effective answer to the demand for diversification, product customization, and personalization. Thus, the structure of supply is becoming more flexible and innovative. In other words, it is now possible to combine small-scale production units with high productivity and high quality efficiently at increasingly accessible prices. We may therefore say that small becomes beautiful again, although not in the sense that E. Schumacher used this phrase in the early s. The pace of innovation is extremely rapid. No individual firm or country can hope to gain or retain technological and market superiority in any given area for long. The pressure of competition and the rapid spread of production capabilities, innovative ideas, and new patterns of demand compel companies to measure themselves against rival firms at home and abroad early in the production cycle, and then rapidly exploit, in the widest possible market, any competitive advantages that arise from a lead in innovation. We are witnessing a compression of the time scale by which new technology is introduced, with ever-shorter intervals between discovery and application. This compression is especially apparent in microelectronics and the information technologies, sectors in which international competition and academic and industrial research activities are intense. This phenomenon is widely visible though not universal. In some sectors specifically, though not exclusively, those involving the life sciences longer periods are imposed by the need for testing to satisfy regulatory criteria. Examples here come from the pharmaceutical and agrochemical industries. Simultaneously, firms acquire more strategic space in which to operate. In the past, the smaller the firm, the narrower its natural geographic horizon. Page 26 Share Cite Suggested Citation: This new perspective implies the need for all interests, large and small, to seek arrangements such as transnational mergers, joint venture agreements, consortia, and shared production and licensing agreements with other companies. The partners often bring complementary assets: In this way returns in different countries can be maximized rapidly. This worldwide change is being spearheaded by the industrial democraciesâ€"the countries that possess major resources in science and technology, innovative capability, and investment capital. Not only is it created and developed on scientific bases, but it also generates fundamental scientific knowledge. The discovery of new superconducting materials, for example, is simultaneously a great scientific achievement that implies fundamental advances in our understanding of the behavior of matter in the solid state and a technological invention that is immediately open to extraordinary applications in many fields, from energy transmission to computers and from high-field magnets to nuclear fusion. The development of artificial intelligence is another example of the increasingly scientific nature of technology; this effort requires the cooperation of the most disparate disciplines and in turn holds the potential for application in a wide variety of fields. These examples illustrate how the narrow, specialized, compartmentalized ways in which problems typically were approached in the past are giving way to a more global approach that breaks down the barriers of single disciplines to obtain a unified, cross-disciplinary vision. Another unique aspect of the present technological revolution is that it brings about a dematerialization of society. In a sense, dematerialization is the logical outcome of an advanced economy in which material needs are substantially saturated. Throughout history there has been a direct correlation between increases in gross domestic product and consumption of raw materials and energy. This is no longer automatically the case. According to estimates by the International Monetary Fund, the amount of industrial raw materials needed for one unit of industrial production is now no more than two-fifths of what it was in , and this decline is accelerating. Thus, Japan, for example, in consumed only 60 percent of the raw materials required for the same volume of industrial output in The reason for this phenomenon is basically twofold. Increases in consumption tend to be concentrated on goods that have a high degree of value added, goods that contain a great deal of technology and design rather than Page 27 Share Cite Suggested Citation: For example, it is now possible to invent new energy sources that have energy densities far exceeding those of raw materials. One kilogram of uranium can produce the same amount of energy as 13 U. Decoupling of the amount of raw material needed for a given unit of economic output, income generation, and consumption of raw materials and energy is an essential element in the dematerialization process. But present trends go beyond this. World society is becoming more open; interdependence is increasing. This is part of what is increasingly being termed the globalization of business and finance. The comparison between the various forms of trade and transactions is, however, a matter of concern. It might be an indication that conditions for profit increasingly are more favorable in financial speculation than in capital investment in a world that still greatly needs economic growth and opportunities for employment. The alarming indebtedness of developing countries and the massive transfer of resources to advanced economies in interest payments are another facet of this problem. But globalization affects all sectors of the economy. As noted earlier, the present wave of innovation, technological and otherwise, is spearheaded by the industrial democracies: In this context, protectionism and defensive attitudes are losing bets. It is not by chance that even a superpowerâ€”the USSRâ€"that had built barriers around itself and was striving to compete and advance by planning its economy in isolation is now being forced to come to terms with this new reality Page 28 Share Cite Suggested Citation: In considering the triad, it is important to note that each of its three cornerstones faces problems. The United States retains its lead in the creation and development of the more important emergent technologies, and signs are that it will continue to do so for some time. But the size of the federal budget deficit and the size of the trade deficit, as well as the process of deindustrialization in many traditional sectors that were once the powerhouse of the U. Japan is exceptionally good at exploiting the new technologies and creating large-scale applications for diverse markets. Yet the Japanese, too, are seriously worried, as can be deduced from Japanese reports calling for improved economic and scientific strategies. There are several reasons for their apprehension. Their economic success has been built on an excessive dependence on exports. Profits have been reinvested in industry at home, and the resulting overcapacity has spurred in a vicious circle the need for an even better performance abroad. Part of the production capacity devoted to promotion of exports needs to be switched to expansion of social infrastructures and improvement in the quality of life. The housing stock, the environment, and infrastructures in the less favored regions are all in need of upgrading. This is a by-product of a culture and an education system that instill virtues of obedience and teamwork rather than initiative and individualism. The future of Japanese technology must be based on independent effort in fundamental research and not on the import of technology from more advanced countries, as during the century-long process of catching up that began with the Meiji Restoration. Savings and consumption patterns will have to alter. All this is likely to mean major changes in the education system, a new role for the Page 29 Share Cite Suggested Citation: Western Europe, on the other hand, appears less oriented toward the future. On the whole, the economies of Western European countries are less concentrated on advanced sectors and are more balanced in their strengths. High-tech sectors are not the most aggressive elements in their economies, even though some of these sectors constitute areas of strengthâ€"nuclear energy, aerospace, and robotics. Overall, Europe is too weak in certain critical areas of microelectronics and information technologyâ€"for example, in basic electronic components, very-large-scale integration technology, and supercomputers. The most negative aspects of the situation in Europe are a lack of cohesion in many emergent sectors, inadequate infrastructures, and a dispersed and fragmented market.