A new vision of higher education: An educational technology approach

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"It was the best of times, it was the worst of times." Charles Dickens' opening to the classic novel *A tale of two cities* is possibly the best description of the state of affairs in education at this moment. Designers and developers in technology industries are making gigantic strides in their design, development and dissemination of new technologies and technological applications. Children and adults are making (sometimes) intelligent use of these technologies in the home and at work. Education, in contrast, is moving at a snail's pace (if at all) in the effective and efficient use of these breakthroughs.

Why can my son of nine maneuver through complex worlds with his Sega megadrive®, my daughter of fifteen make sophisticated use of teletext to determine the number one record on MTV® while neither of them can, or had has to, find their way through a database for a report or term paper? Why can faculty members of universities communicate with and do joint research with other scientists halfway around the world, but cannot effectively or efficiently do comparable things with their own students across the classroom or across the campus?

The answer to this question is both simple and complex, but basically comes down to the fact that education, though sincere in its attempts to make use of new technologies and applications, has not made the same step that the rest of society has, namely rethinking and redesigning itself to adapt to these new technologies. It has rather made the mistake of maintaining the status quo and simply trying to adapt these technologies to itself.

This article attempts to lay a new foundation for the design of higher education in general and higher distance education in particular. It attempts to present the important operational elements, from an educational technology and educational design point of view, necessary for a deliberate, well-planned systematic design of institutes for higher education at the macro, meso and micro level. To this end, it unveils a model for education founded upon study processes in which the student and the institution are equal partners, each with their own input into that process as well as their responsibilities for that process.

Case study 1: “You can get a car in any color . . .”

Once upon a time, not that very long ago, there was a pioneer in the automobile industry named Henry Ford. Mr. Ford was a pragmatist, a penny-pincher and a visionary and coined the noteworthy phrase "You can get a car in any color you like as long as it is black". Although the paint industry wasn't that limited in those days, characteristic for such industries was that they had a very limited assortment of colors deliverable. The manufacturer of paints determined the assortment of colors and the types of paint available. The only consumer influence on that process was that they could choose another brand of paint if a certain manufacturer couldn't (or wouldn't) deliver the color or type that they wanted. The manufacturer, on the other hand, could only offer a limited variety of colors and types of paints because the processes involved in the production and distribution of paints was very costly and the reaction of the market to new paints was highly unpredictable. The retailer, the third party in this configuration, was also very limited. In order to offer a wide variety of paints (different colors, types, manufacturers) the retailers needed to have large display areas to present the different paints to the consumers and also large storage areas to store the stocks. Finally, stocking a wide array of colors was also a financial burden and risk because the retailer never knew what would sell and what would not. Still the demands of the consumers grew, the manufacturers offered ever widening assortments of paints and the stores and storage rooms got bigger and bigger.

In the second half of the twentieth century, in a period in which technology began to allow for standardization and stability of chemical processes and for increased accuracy of measurement, someone got a creative brain wave that sounded something like this: "Why should we premix and pre-package everything for the retailer and consumer. Making paint is child's play. You mix pigments, add them to one or more bases and voilà - colored paints." All of a sudden it was possible to widen the variety of colors without the concomitant increases just discussed. The change was dramatic. Paint manufacturers - next to their traditional, predetermined lines of paints - could now offer retailers the combination of pigments, bases, recipes and machinery and allow the retailers to mix the paints themselves. Retailers no longer needed to devote meters of shelf space and cubic meters of warehouse space to the presentation and storage of paints. They also no longer needed to run the risk of stocking too many of the unwanted colors and too little of the wanted ones. Customers had a lot more to

say about the choice of colors, had a wider variety of choices and could even - if they were adventurous - mix their own colors, although woe be those who bought too little and had to try to remix the exact same color! The customer, the retailer and the manufacturer were all more satisfied.

Enter the information technology revolution with computers, color scanners, color analyzers, super accurate measuring and dosage devices, and so forth. Now, in 1995, you can take a sample of weather-beaten paint or a color that you mixed yourself - it doesn't matter how large - to the store. The salesperson can scan the color sample that you brought, analyze it, have the computer choose the exact combination of pigments and bases necessary to create an exact match, have the dosages of the pigments automatically added to the mixture of bases, shake it and deliver it. Supply driven production has changed to demand driven consumption.

I will return to this concept of the revolution from supply driven to demand driven production as it relates to education later in this article.

Case study 2: From 'Radio Gaga' to 'I want my MTV'

Once upon a time, and hopefully there are a few people who can remember this, there was no television. Radio was the mass media used for information and entertainment. The semiotics of radio (the signs and symbols that it employs) were auditory and were highly developed. The people who produced and performed on radio were masters of the use of this semiotic system. They were capable of conveying information and feelings through words, sounds and music in such a way that the listeners were not only able to understand what they heard, but were also able to visualize and even feel things. Listeners, young and old, spent hours sitting in front of the radio and could transform what they heard into something very real and tangible.

Enter television with the magic of pictures. The networks which so successfully produced and distributed radio entered this new field and made use of their master producers and performers. There was only one slight problem. Those who had become masters of the, at that time, prevailing semiotic system were novices at using the signs and symbols of new medium. The results were highly predictable. The first television programs were little more than radio

programs with pictures. You could actually turn the picture off with very little, if any, loss of function. What the producers didn't, and couldn't, do was to make optimal use of the expanded functionalities offered by television. It was a question of the same old wine in a brand new bottle.

Historians and communication scientists can probably give a whole list of reasons why television did not go the way of other short-lived fads. In my opinion three of the major reasons are that:

1) the novelty of this medium was so great and the early availability of it was so low that the networks had the time to innovate and adapt their trusted art to the new functionalities being offered,
2) to their credit the networks actually made the effort to do this and
3) ultimately, creativity won out over conservatism.

The makers and distributors of computer games in the 1980's and 1990's picked up on this way of working and, as soon as the technology allowed, entered the main stream. They made the necessary leap from board games to computer games not, for example, by adding electronic dice to already available games (substitution), but rather by innovating and transforming, by taking the analogy of the board game into parallel games, both horizontally and vertically (different rooms, worlds, . . .), and basing the way one proceeded in those games on either skill, speed, intelligence/logic or a combination thereof.

This is, and unfortunately you in the educational business with more than a short experience with so called educational innovations can verify this, not the way it has gone in the business of education. Almost all of the new media and technologies intended to revolutionize and even transform education and the roles and functions of its participants have gone the way of most fads. The were hot and heavy at the beginning and short lived in the end. Three of the reasons for this, and again here there is probably a list as long as my arm to explain this phenomenon, are that:

1) the availability and the will to implement these novelties was so great that there was little time to adapt them in a meaningful way

2) to their discredit educators, educational designers and commercial producers did not really make the effort to do this and
3) unfortunately, the conservatism of educators appears to continue to win from creativity.

Intermezzo - Historical developments

The shape and substance of higher education have always been determined by teachers (Boyd & King, 1975; Lawler, 1987). Individual teachers enjoyed great autonomy with respect to content and didactic techniques. This was determined, on the one hand, by the teachers' implicit beliefs on teaching and the student-teacher relationship, formed during their own experiences as students. On the other hand, this power was granted by general societal preconceptions of the nature and function of (higher) education. To put it bluntly, the student was often little more than a vessel which needed to be filled. To pass exams - and obtain their degrees - students were obliged to adopt their teachers' views and approach and to submit to their teachers' orders (and whims). Systematic organization of education based on explicit objectives and educational principles were largely, if not entirely, lacking.

Times have changed. Society has begun, and continues, to change its view on the roles and functions of its members. This development requires individuals to continue to develop personally if they are to keep pace with societal change. Knowledge, understanding, skills and attitudes need to be kept as well tuned and up-to-date as possible, and people need to learn how to apply their knowledge and abilities in new, unique and constantly evolving situations. This process, largely automatic and almost unnoticed in our day-to-day lives, is more deliberate and purposeful in education. The fundamental principle underlying this process of change is that in a democratic society, responsibility and the right to self-determination are absolute prerequisites, influencing the way individuals make choices, how they (wish to) develop personally, how they organize their lives and how they function within society.

If we look critically at the way educational institutions function, we must conclude that they still function in an authoritarian manner. They function within an established cultural framework shaped by implicit assumptions and habits (Boyd & King, 1975) rather than as rationally structured organizations designed according to modern social and educational (educational technology[1]) views and principles. Such a *modus operandus* is often unintentional. Though some institutions have certainly tried to 'break the mold', old habits die hard.

Education has taken many forms in the course of history, primarily determined by the values and standards dictated by religious, political and socio-economic relationships, the nature and breadth of scientific understanding, the availability of technical resources and knowledge and, finally, the conviction that 'a student is only a student if and insofar as there is a teacher'. This belief had two bases of origin. First, the various social structures which have existed tended to be characterized by authoritarian relationships (Boyd & King, 1975; Vervoort, 1975). Those in possession of knowledge or occupational skills had power over those who did not. Second, education was typically something which was provided by adults to children (Idenburg, 1964; Kemenade, 1981). The young had to be prepared for adult life which meant that they needed to be instructed and guided and, most of all, taught to accept the values and standards of the society in which they live (socialization).

Evolution or revolution

Education has known only two real revolutions in the past thousand years (De Wolf, Van der Linden & Kirschner, 1994). Both were based upon the introduction of new delivery technologies, both have lead to an increase in scale in education and democratization of the opportunities to follow education and both have lead to massification and depersonalization of education. At this very moment we stand on the threshold of what could be a third revolution in education which is also the result of the introduction of a new delivery technology and which is also capable of increasing the scale of education to almost astronomical proportions.

1 Educational technology encompasses the knowledge and skills needed for the systematic solution of educational

The major difference is that this new technology also makes it possible to rehumanize and personalize education and make it more effective, efficient and satisfactory for both the student and the teacher. All that needs to happen to achieve this is that the technology be applied in a well thought-out manner according to a well thought out educational and didactic design.

The introduction of *movable and reusable type* in the fifteenth century paved the way for the mass production of books and sparked the first educational revolution. For the first time, there was a source of knowledge - other than the teacher - which could be consulted anywhere and at any time and which could be obtained for a 'reasonable price'. For the first time a part of the role of the teacher - that of information disseminator - could be entrusted to another medium. The technology of bookmaking and more recently of electronic text production, storage, retrieval and dissemination (data bases, query languages, hypertext, printing on demand, encyclopedias and books on CD-ROM, electronic libraries, etc.) have made quantum leaps making more resources available to more people for lower costs. Nevertheless, the educational possibilities made possible by Gütenberg's invention, were limited by the fact that this new 'learning material' was always prescribed by teachers. For centuries after this revolution, books and slates remained very much the only educational resources available. The technical resources and understanding at an educator's disposal were limited. His/her will to change even more so.

The invention/introduction of the *blackboard* around 1800 transformed education from a personal, individual endeavor into a group process which is now the dominant form of education today. Through the 'magic' of the blackboard, teachers could stand in front of increasingly larger classes, limited by the strength of their voice and the size of their board and handwriting. Further technological developments such as the microphone and amplifier, slide and film projectors, opaque and overhead projectors, computer with transviewer and finally audio and video transmission (closed circuit, broadcast and cable television along with video teleconferencing) in the twentieth century further expanded this reach with better teachers making use of each new resource as it became available. Now, at the end of the twentieth century, computers and computer networks are being used in the same way as the other

problems and for the implementation of these solutions.

advances in technology emphasizing, rather than breaking down, this tendency towards massality and depersonalization and fine tuning education to the needs of individual students. In other words, this technological and information revolution did not lead to, or even go hand-in-hand, with a concomitant development or evolution in education and educational thought where media are optimally applied according to well thought out didactic designs.

Since the nineteenth century, regardless of the technological changes made by society, the structure of education has remained constant. There is a teacher who is considered to be an 'expert' in a certain subject. The teacher teaches this subject to the person requiring tuition (often called the student), prescribes the teaching materials, directs the student to read, listen, take notes and memorize; and tests the student to see if he or she has learnt that which has been taught. The teacher gives orders and sets tasks; the student takes the orders and carries them out. The teacher supervises the student's execution and finally assesses the results.

Since the invention of the blackboard and the microphone, there has been little didactic change or development in education. Lessons, tutorials, lectures, or other forms of group instruction still account for most of the education carried out, up to and including the highest levels (De Corte et al, 1981). At universities, colleges and polytechnics seminars, practicals and the preparation and discussion of essays often can bring students and teachers together in a creative exchange, but this still makes up only a small part of the total higher education experience. In the final analysis, teachers are still arbiters of the fields and methods of study, and assessors of the results. Since the teacher's assessment is crucial to the student's success in obtaining a socially and/or financially significant qualification, students submit to this assessment just as they submit to the teacher's instructions during study (Robins, 1988).

One could argue that in educational circles there is a growing conviction, especially in higher education, that it is important for students to *participate* in the decision-making process. In its structure and didactic organization, however, the teacher-still controls the character of education. The traditional manifestation of educational processes has prevailed and continues

to prevail. Even the so-called 'innovations' of the last few decades have brought little change. One medium has simply been *substituted* for another. Thus, the culture of education is in some respects out of step with the culture of society in general. Harmonization of the two would be promoted by basing the structure and operation of the educational system on explicit objectives and stated, rational perceptions of the effective and efficient operation of *study processes*.

Supply and demand in education

The predominance of supply driven education

Education in pre-industrialized society was primarily a one-way relationship controlled by those who had 'acquired' education during youth. They were, more often than not, members of the ruling class. One who wished to learn a science (pupil) or vocation (apprentice) was chosen by a master who would teach or train him[2]. "At best there was an invitation to follow in the steps of those who knew best" (Boyd & King, 1975). The pupil/apprentice entered a learning situation with the master and learned, often via dialogue and modeling what the master required. In such a pre-industrialized situation, a situation not only applicable to the past but also prevalent in many modern societies in Africa, Asia and South America, one speaks of *education* for the ruling class and *instruction* or *training* for others. This phase in the development of education is almost completely supply driven. Only the 'better off' could chose to learn, but with almost no control over what they learned. The less 'better off' did what they were told and were encouraged to be happy or even thankful for this 'good fortune'.

Supply driven education can, thus, be characterized as a teaching or instructional process in which a *teacher* - both as expert in a domain as well as representative of societal norms and values - defines the goals to be pursued, selects the contents to pursue these goals, selects the methods and paths to achieve these goals, and defines the standards to determine attainment of the goals. To a certain extent the teacher (as organization or institution) still can even choose/define who gets educated or trained and to what level. The central actor is the teacher. The knowledge base is restricted to declarative knowledge or craft-like procedural knowledge. The view on learning is restricted to passive 're-learning' and reproductive processing.

Technology in these educational settings did not liberate the learner, but simply sustained the teacher. The use of technology:

- was limited to that of a delivery device,
- reinforced the preselected and final nature of the content selection, and
- hardly supported a didactic elaboration of the content.

A need to adapt content or didactic elaboration of the content to individual needs was considered irrelevant.

The further historical development of Western education can be described as the gradual creation of, and more and more generally acceptance of, an *institution* where learners were expected to be receptive so as to attain specific predefined educational goals. Learning technology followed this paradigm. It supported the presentation and transfer of knowledge that was selected, structured, interpreted and embedded in a context by a teacher; the expert. Education has thus become, instead of a living and evolving entity, institutionalized and dead. In this respect it:

- is formalistic and intentional,
- exists in isolation from the society that it should be a part of,
- has become estranged from that society with respect to its content, structure and processes,
- is rigid, almost petrified, through a loss of spontaneity, serendipity, adventure and vivacity,
- is bound by rules and procedures instead of guided by ideas and ideals,
- stifles creativity, independence, authenticity and inventivity of all its members,
- encourages uniformity instead of variety, and
- enforces segmentation instead of interdisciplinarity and integration.

Supply driven education under pressure

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[2] Unfortunately formal learners were almost always men and is the nonsexist him/her not relevant here.

With the industrial revolution and with it the need for skilled technicians and laborers education entered a new phase where the supply driven character of education began to come under pressure. This period, characterized as industrial-entrepreneurial, tends to be progressive in the sense of demanding freedom of action for its characteristic activities, but at the same time calculating and contriving in limiting its employees and their children. Education is characterized by *convergence*. "Its school systems, though enlarging opportunity, tend to be assimilative in function, with built-in guarantees against change . . . 'learning' is a useful tool, an aid to competition, and perhaps a personal possession; but like any other artifact it is usually fixed, is capable of being examined and docketed, and can be distributed in a uniform supply" (Boyd & King, 1975).

In the beginning of the twentieth century, the paradigm of supply driven education was put under even more pressure. At the theoretical level, the restricted view on the actors in the teaching/learning process, the educational goals and the type of learning were questioned. Educational reformers from 1920 on (with some early predecessors in earlier centuries such as Pestalozzi) presented new educational conceptions on how teaching/learning could be set up or induced. These conceptions included a new vision on the actors, the goals and content of education and the learning/teaching process that is considered to be of relevance. 'Learning by doing' (Dewey), 'Activity based learning' (Montessori), 'Discovery learning' (Bruner), 'Learner-centered teaching' (Rogers) and so forth introduce the student as a central actor, introduce the idea that the student actively acquires, builds or constructs knowledge and stretches the type of educational goals from declarative to procedural ones.

Despite the strong potential of the emerging technologies in the late nineteen forties up to the sixties when sound, animation, and moving pictures entered the school, the initial paradigm of supply driven education remained audio-visual. School television was usually nothing more than a 'lecture-in-a-box' and resulted neither in active nor interactive study. Even when the first computing machines came available the paradigm was sustained. This culminated for instance in the first teaching machines of the sixties based on the behaviorist paradigm of programmed

instruction[3]. All technologies were used to replicate the view of the central educational actor (teacher) as well as the central educational goals and standards:

- the technology still 'delivers' education,
- the content is still predefined, and
- the technology also delivers/supports a certain level of didactic elaboration but this remains inflexible and can not be manipulated to answer differential needs.

The emergence of demand driven education

As indicated earlier, the complex of changing variables in the socio-economic, political and cultural context are important catalysts or reinforcers for changes in education. From 1950 on, these changes became more and more apparent as the context variables changed dramatically. De Wolf (1990), for example, outlines a set of changing variables, namely altering population structure, new social interrelations, changing labor market structure, predominance of technology, and so forth.

From a sociological point of view, the 1950's and 1960's introduced a consumer society, also called by some a permissive society. It implied the repudiation of the authority system with its aims of a controlled, socially convergent and technologically standardized planning society and placed emphasis on sharing, judgment, diversity and concern.

It is interesting to note that a large similarity can be perceived between these changes in context variables and the newly emerging psychological, learning and educational theories. Illustrative are the new conceptions on knowledge and knowledge acquisition. Knowledge and understanding as co-operative enterprises.

The changes in context variables and the theoretical conceptions about knowledge and knowledge acquisition imply changes in education. These transformations are perceivable at a quantitative and qualitative level. We can see an international acceptance of the need for a

[3] Note that the terminology 'teaching' and 'instruction' both refer to the supply side and not the demand side which would use the terms 'learning' and 'study'.

longer educational career. Ages for compulsory education tend to begin earlier (4 or 5 year old children now are often required to attend schools) and go on longer, in many western countries sometimes until the age of 18. Also, increasing proportions of students now participate in higher education. In 1950 the United States had approximately 500,000 university graduates (87% BA's, 12% MA's and 1% PhD's). In 1960 the total was approximately the same, but the percentages showed a shift to longer educational careers (82%, 16% and 2%). By 1970 there were more than one million graduates (77%, 20% and 3%) and by 1976 this was 1.3 million (73%, 24% and 3% respectively) (Bachelller, 1977). On top of this, more and more people participate in programs of adult education, lifelong learning, continuing education, non-formal education, independent study, and job-related formal and experiential learning far beyond initial, compulsory education. At the institutional level, we perceive the emergence and proliferation of completely new types of educational institutions such as open universities, institutes for distance education, open study centers. Although examples of these new types of institutions can be found in the beginning of the twentieth century, the real boom only appeared in the post-fifties period. Since 1969 more than 22 new single mode open/distance universities have been founded throughout the world.

Qualitative changes can also be observed in the provision of educational arrangements. It is in this perspective that 'demand-driven' education becomes a central issue. The central role of education is no longer the provision of basic standard arrangements, but rather allowing a divergence of thought and actions necessary for participatory (of both the 'teacher' and the 'learner') lifelong education. In educational literature book titles such as *Learning more and teaching less* (Brewer, 1985), *Choosing to learn* (Woodley et al, 1987), *Beyond distance teaching, towards open learning (*Hodgson, Mann & Snell, 1987), *Self-directed learning: A guide for learners and teachers* (Knowles, 1975), and *Developing student autonomy in learning* (Boud, 1988) clearly illustrate this shift of focus.

Parallel with this change in attitude towards the role of education in society came a change and growth in the technologies available to the actors in education. As is often the case, however, it took some time before the real potential of these technologies were finally recognized,

accepted and adopted. Kressel (1986), for example, describes the impact of telecommunications, computers and multi-media on education. She indicates that despite the large potential of these technologies, its uses remains fairly traditional. To account for this, she points to the overemphasis attached to technology, often at the expense of the attention that needs to be paid to the educational quality and academic caliber. Bork (1988) blames education for having been obsessed with hardware and of focusing on insignificant and trivial uses of technology in education.

Both Bork and Kressel put forward visions and examples of what the new technology's real potential is, namely to provide active learning environments for students. This need for a switch in education paradigms is widely recognized and acknowledged in literature, during conferences and in research activities. Van den Brande (1993) identified a major trend in technology-based education in Europe where the "supply-driven approach is being replaced by a supply and demand view of the technology-based learning market". The latter is certainly noticeable in the new large scale DELTA research program where one of the main objectives was that "the results will potentially benefit the users of learning technology, at both supplier and learner levels, in terms of flexibility to meet the needs of the user . . ." (ibid., 1993, p. XIII).

De Wolf (1993), in discussing the role that IT plays in making education more effective, efficient and most of all more satisfactory for both students and educators, foresees a three stage approach to the implementation of IT - from substitution through innovation to transformation in and of education[4].

- In the first stage IT is primarily used as a *substitute*. IT replaces something that the educator uses or the student does. This can lead to an easing of the workload for the educator or an increase in effectivity and efficiency for students in that certain functions carried out by the actors are replaced by a 'better' medium. Substitution, although probably a necessary first

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4 *Substitution* in education is the replacement of one medium or technique by another without changing the substance or structure of the primary process.

Innovation in education is the use of new media or techniques in such a way that the process of education itself is significantly changed.

Transformation is the redesign of education in such a way that it no longer bears a principal likeness, either in form or in function to what it is now.

step on the road to demand driven education, is not, and does not in itself lead to innovation.

- *Innovation* requires changes in both the vision regarding and execution of the educational process. It is the use of new media and techniques in such a way that the process of education itself is significantly changed. This is, for example, how the Open University of the Netherlands (OUN) uses its practicals in Science education. They neither use nor see IT as a replacement for practicals, but have rather given a new meaning and new place to practicals of all types, including IT-practicals (Kirschner, 1992).
- *Transformation* goes a step further. If education is transformed, it means that education ceases to exist in its present form. Its concepts, paradigms, theories, and laws cease to be valid and are replaced by new concepts, paradigms, theories and laws. It is only in this setting where the possibilities which IT can offer can be completely utilized.

These ideas are fully realized when educational applications begin to exploit the 'interactivity' possibilities of the new media. The educational metaphor supported by interactivity is "I teach something to myself" rather than "Someone teaches me something". Chacón (1992) identifies in this respect three major characteristics of the technology supporting the notion of interactivity, namely dialogue, alterability and richness of stimuli. Interactive video, hypermedia, intelligent interactive multimedia are technology applications that seem to be able to realize this potential. They build upon a varied set of hardware components that can be rather simple (i.e. low-speed computer with low resolution monitor) or based on complex and advanced components such as high speed computers, high-resolution color monitors, CD-ROM, high-quality video image and sound, laser video/discs, and so forth.

The nature of demand driven education

Thus far, demand driven education has been contrasted with to supply driven education. A better understanding of this term is needed before we proceed any further. In demand driven education "the student is the principal arbiter in making judgments as to what, when and how learning will occur. Typically, students not only select and sequence educational activities, but identify, create, cultivate, pursue, and satisfy their individual learning needs" (Hannafin, 1992,

p.54). Students make decisions in relation to two different fields, namely on the content of the study and the didactic elaborations used.

- Content decisions are related to the specific themes, objectives, and activities that the students want to be involved in when tackling a specific domain. These decisions can also affect the order and the structure of the content of that which is to be studied. In this respect, questions such as: What theme will be studied first? Will parts of the content be omitted? What content parts fit my study intentions or professional ambitions? become highly important.
- Decisions about the didactic elaboration are related to questions dealing with the representation level preferred by students prefer, the desire to make use of embedded support devices such as schemata, illustrations, examples, key concepts, advance organizers, summaries, glossaries, typographical cueing, adjunct questions, (self) test items, and so forth.

The question which now arises is: If demand driven education depends largely on such levels of freedom, does this not make learning trivial and even impossible? Hannafin (1992) states that this kind of education tacitly presumes that students either *possess* the meta-cognitive skills (competencies) needed to make effective judgments, or that they can *be induced* to make appropriate choices through advice, hints, or guided reflection (cf. also Marchionini, 1988). Good education is neither the exclusive prerogative of the student or the teacher/institution, but is the product of the *joint* efforts of the student and the institution. Institute and student work together in the *study process*, each having its own tasks and responsibilities, in pursuit of a common goal. The effectiveness of education is the degree to which an institute is successful in promoting and facilitating integrated educational and study objectives and the degree to which individuals are successful in attaining them.

The promoters of demand driven education take special account of this potential threat to the effectivity and efficiency of the demand driven study environment which they promote. First of all, demand driven education is especially propagated in the context of adult education.

This can already answer some of the criticism about the inability of students to cope with the decisions they are expected to make. But even then, the criticism of Hannafin can remain valid. Are students able to cope at one and the same time with their study process at both the content and the meta-cognitive level? In other words, are adults even able to tackle new domain knowledge and be able to deal with the way they study this domain knowledge? It is in this context that both the role of IT and the way IT is implemented can play a central role.

Before such innovation (on the way to transformation) of education can be achieved, it is necessary to consider the problems that can arise along the way.

Problem 1 - Resistance to change

Innovation, either voluntary or imposed, is never easy. It almost always goes hand-in-hand with feelings of unrest. People enjoy equilibrium and familiarity and tend to resist change. Familiarity breeds not contempt, but rather a feeling of tranquillity. Anything that tends to upset this balance is experienced as risk-taking and seen as a problem and/or a threat.

Change is a serious personal and collective experience characterized by ambivalence and insecurity. Teachers, who individually and collectively play key roles in the innovation of education, are members of a social system - the school - and have common ideas about the meaning of their work and how change can affect this. Fullan (1982) sketches the *subjective reality* of the teacher as follows:

> '. . . teachers are uncertain about how to influence students, especially about non-cognitive goals, and even on whether they are having an influence; they experience students as individuals in specific circumstances who, taken as a classroom of individuals, are being influenced by multiple and different forces for which generalizations are not possible; teaching decisions are often made on pragmatic trial-and-error grounds with little chance for reflection or thinking through the rationale; teachers must deal with constant daily disruptions, within the classroom managing discipline and inter-personal conflicts, and from outside the classroom . . . making announcements, dealing with the principal , parents, central office staff, etc.; they must get through the daily grind; the rewards are

> having a few good days, covering curriculum, getting a lesson across, having an impact on one or two students (success stories); they constantly feel the shortage of time.'

Within this situation, teachers often operate in too full classrooms in which diverse activities must be carried out with respect to instruction and control. They must simultaneously devote individual attention to certain students while monitoring the work of other groups within the same class. They must anticipate and solve both content and didactic problems in 'real time'. In such a situation, the potential for something going wrong is high and it often does.

For just this reason innovation often appears to teachers to be a waste of time. Feelings of solitude, alienation and being trapped are reinforced, stress and time pressure increases, and the number of disturbances encountered does not decrease. Beyond this, many teachers experience the personal costs involved with innovation to be high with no concomitant, objective proof that the investment will be worth the costs. Innovation is often a question of idealism or trust. It requires teachers to either operate from a feeling of 'a higher good' or to have faith that the fruits of their labor will be worth the investment.

Added to these subjective aspects of innovation, there are also a number of *objective aspects* not particularly beneficial to the process of innovation. For teachers, innovation means:

- making use of new or revised materials, media or technologies in an existing situation;
- making use of new didactic techniques or teaching strategies for the attainment of a new situation; and
- changing their ideas about the educational premises and theories upon which they base their actions.

A teacher who introduces new materials or technologies without changing his/her didactic strategies and techniques is only busy with *substitution*. A step further is the teacher who combines the use of new didactic techniques with the implementation of new media or technologies. This teacher is busy with *innovation*. The teacher who also changes the

foundations of his/her actions and is, thus, busy with all three components of the objective reality of change, is busy with *transformation*.

Against this background, it is understandable that there is a very real resistance to innovation. This resistance can be classified into four categories, namely:

- *Maintaining the status quo* - Changes in complex organizations result in risk, insecurity and stress. People do not appreciate these feelings and strive to avoid and/or reduce them. The teacher's only security are traditional notions on his or her own role and function. Toying with those notions irrevocably incurs strong resistance.
- *Incomprehension* - It's hard to develop and present a simple, practically imaginable and makeable design for an innovated educational institution. It is possibly harder to get these plans accepted. This acceptance and the concomitant feelings of involvement are necessary to allow teachers to create the necessary distance between the existing situation and the desired situation in order to determine how to bridge that gap.
- *Investment* - Innovation requires investment. Personnel have to be trained, equipment and software needs to be purchased, for a period of time old systems will have to be maintained along with the new, there is a need for communication with clients (students, parents, . . .) and negative developments will have to be corrected. Enthusiasm and ideals are a good begin, but not much more than that!
- *Delay of gratification* - It often takes quite a while before teachers begin to reap what they have sown. In the beginning it appears as if (and often is also the case) that the situation gets worse instead of better. Teachers have more work and more uncertainty and the possibility always exists that at the moment that they are just about ready to reap the profits that they are 'punished' by new ideas, plans and tasks.

Problem 2 - Absence of vision

Education is burdened by its history, culture and poignant lack of vision. Its policies are often reactionary in the literal sense of the word and often resembles a pendulum or a yo-yo. Its

administration is seldom based upon considerations of effectiveness, efficiency or increasing the satisfaction of its students or faculty. The roles of the various actors within the organization are often shaped by non-academic factors such as habit, seniority, acquired rights, expectations, and political and strategic preferences - the existing culture - and by academic criteria such as research, publication, Ph.D. supervision and so forth. Institutions for higher education are complicated, impenetrable organizations subject to complex explicit and implicit rules, regulations, policies and agreements, all of which do not always enhance efficiency, effectiveness or satisfaction and almost never can be accused of being based on any kind of educational vision. When it comes to the implementation of new media, it appears as if this characterization increases exponentially.

The incorporation of new media and technologies in education has primarily been based on the media and not on education or didactics. A commercial company first decides which direction it wants to go and then determines the infrastuctural and technological consequences of this change, although here too there are exceptions. General Motors, for example, in seeking to remedy quality and productivity problems in the 1980's invested approximately $50 billion on automated assembly lines and robots for its manufacturing plants. Ten years later, the absolute gains in quality and productivity were marginal and gains in relation to its competitors were actually negative while GM's competitors (American Nissan, Honda and even Ford) had made much smaller investments. Why hadn't the silver bullet worked? The answer is simple. GM poured money into technology, but paid little or no attention to the overall design process. The new technology on the assembly lines could not resolve key design problems in the product (Green & Gilbert, 1995). Sound familiar?!

Education habitually incorporates technologies in the hope that they will solve its problems based upon the technology and not based upon an analysis of the problem and then begins to search for how the chosen technology can best be implemented. This often results in simple substitution where educators and administrators often see a great amount of effort on the part of the staff resulting in minimal gains at best. Instead of first defining the problems that need to be solved in terms of the functional requirements of a system to solve or avoid them

(something every designer learns in Design 101) and consequently choosing the optimal solution in terms of processes and technologies, education shoots first and asks questions later.

What then should education in general, and higher education specifically be and how should it be structured? Simply stated, the structure of an educational institution could and should be such that, taking all the specific characteristics of learning processes, knowledge transfer and culture transfer into consideration, it operates to optimize effectiveness, efficiency and satisfaction. To function well, an educational institution should meet the following criteria.

- It must define a coherent set of educational or didactic premises which form the basis for all further decisions. These premises are basically technology-free with respect to their implementation. They don't prescribe a certain technology and can be implemented independent of specific technologies. In this respect they are living and evolutionary in that new technologies can be easily plugged in without exorbitant expenditures of effort on the part of teachers or students who use them. Teachers and students can continue to do what they were used to doing and the technologies magically FIT.
- It must set objectives for both teachers and students along with providing the criteria and facilities for attaining them.
- It must make the resources and input necessary for increasing the efficiency and effectivity and satisfaction of the process available and accessible.
- Educational planning, therefore, requires educational institutions to be designed so that all three previous criteria are met.

The actual functioning of the institution should subsequently be constantly compared with the design so that any discrepancies or divergence can be identified and so that a strategy can be developed to bring reality as close as possible to the ideal.

Educationally and didactically responsible use of modern technologies - in other words according to a well thought out didactic concept - could open the door to that *third educational revolution* (Kirschner et al, 1993). Through the responsible application of the

possibilities and functionalities of technologies such as networks, on-line data bases, computer modeling and simulation, intelligent search and query systems, student tracking and registration systems, assessment systems, etcetera it becomes possible to deliver education to large groups of students spread over geographically diverse areas in a way which is virtually independent of time, place and pace. Students can work alone, work together in groups or be tutored personally in their own homes or places of work by an expert independent of where they live and when they choose to study. Students can determine which knowledge bases they need or wish to use (experts spread around the world on the Internet are also sources of knowledge), when they wish to use them and in the manner they choose. Teachers - or more applicable study mentors or stimulators - can monitor and support more students and students can now make use of tutors based upon expertise and not geographical proximity. Institutions can have access to large testing systems and item banks and can use them for tailor-made placement, testing and certification. In other words, education can become more effective, efficient and satisfactory for institution, teacher and student and can allow education to make the transformation from a supply driven to a demand driven commodity (Kirschner & Valcke, 1993) such that it:

- integrates study and education into the social context of both the students and the institutions and
- creates, through this integration, optimal conditions for a more functional integration of study and education into society itself.

Case study 3: Brave new world

For a well-designed system, a framework in which the functionalities of the system as well as the actors and their tasks and responsibilities in the system must be defined. In other words, the nature of the process has to be described in such a way that the various phases which have to be passed through are identified and the functionalities and activities of each phase are described. The general framework developed within the Educational Technology Innovation Centre of the Open University of the Netherlands lends itself to such ends (Van der Linden et al, 1993). Through that framework or model it is possible to *systematically* examine the design

and performance of an educational institution and to assess the degree to which its aims are effectively and efficiently realized. At the same time it can facilitate the selection of a technical infrastructure most consistent with the coherent performance of tasks by both students and institution.

[Figure about here]

One of the features of the model is that a number of generally accepted, 'self-evident' misconceptions within education can be corrected. The aim of education is to provide opportunities to study. If one sets aside the stubborn conviction that education must always involve direction by a teacher and starts thinking in terms of efficient didactic arrangements for the student, one is left with the concept of study processes that are facilitated by education - students and institutions participating in the process of study. Thus, the design of an educational institution becomes the design of an *environment* in which all kinds of *study processes* can take place through interaction between the institution and its students. The amount of interaction is in turn characterized and actually determined by the number of degrees of freedom in the needs and choices of the students and the possibilities and limiting conditions of the institution. Thus, what we have is a continuum from open (many degrees of freedom) to closed (few degrees of freedom).

The study process

Study takes place in a number of steps or phases which are not necessarily sequential and which are often, at least partially, repeated. In each phase, the institution provides certain *services* or *facilities* based upon its *mission*. The student performs *tasks* and *activities* and has a study environment guided by a certain *intention*. The division of tasks and responsibilities between institute and student will vary from one situation to another. There is also considerable variation between phases in terms of time and resources expended for and in them. However, no single phase may be passed over, and each phase involves both tasks and responsibilities for institute and student alike. The phases are:

The information phase where students orient themselves to higher education in general, and to a specific subject at a specific institute in particular. This information is necessary to make well reasoned and sensible choices. The institute carries the brunt of the load in supplying information to meet the students' questions. With respect to a specific institution, students may, for instance, want to know what is available or what can be expected concerning:

- the study in general
- courses and/or programs provided;
- available support (guidance/tutoring);
- requirements (entry/time/money/activities) and
- employment prospects upon completion.

Information of this kind might be available centrally (from the institution), locally (from departments within the institution) and peripherally (in libraries, shopping centers, at home etc.). Technically, the information made available in this phase can be verbal or printed and may be made available personally or telematically (video-text, on-line via a modem, voice mail, etc.).

A characteristic of this phase is that the student-institute relationship is completely open. The student has simply decided to consider the possibility of study, while the institute merely provides information about what it has to offer. The student is the information gatherer, the institute the information provider. The information exchanged at this point is primarily one-way, from the institution to the student.

Intake phase involving the obtaining of study-related information about the student prior to the start of a given course of study at a particular institution. The process provides student *and* institution with information on a number of variables, making it possible to better determine an appropriate course of study as well as the contours of the study (study arrangements). Ideally, the institute will have at its disposal a number of instruments with which to effectively and efficiently gather the required information. The type of data sought will typically include prior

knowledge, preferred or utilized study strategies, degree of independence, envisaged end terms or expectations (study intention), study skills, available facilities and so on. It is characteristic of this phase that both the institute and the student obtain information. The student is the information provider, the institution and the student are both information gatherers and users.

Course advice and determination phase in which possible courses of study are generated by both the institute and the student to enable the student to make a decision about a study. The information obtained in the *intake phase* is compared to what the institution can offer so as to achieve an 'optimal match' between student and institution. In other words, using the information obtained by means of fully supported dialogue between student and institution, the two parties together look for suitable courses of study.

The result of this process is advice that the student, in view of his or her independent status, self responsibility and right to self-determination, may or may not choose to follow. The (as far as possible customized) advice provided represents a concrete, optimal harmonization of the student's requirements, the student's capabilities and the institution's possibilities. It specifies, for example, the required' or advised entry level, selected goals, subject matter, didactic approach, materials and provisions necessary (i.e., books, computers, networks, internship periods etc.), degree of guidance and independent-study, scheduling, planning and organization of the study, methods of (formal) evaluation and type of certification available upon completion.

In this phase, the information obtained by the student and the institution are compared. The advice from the institution is translated here into a choice by the student[5].

Contract phase: In this phase, the course of study chosen by the student including the agreed upon obligations and responsibilities of both the student and the institution is set down in a contract between the student and the institution. The contract also sets down the financial and other rights *and* obligations of the two participants in the study process. Changes may only be

[5] The choice, of course, may end up to be 'don't begin' or 'begin somewhere else'.

made by mutual consent. Contractual changes can have either content (changes in study aims or end terms), logistic (schedule, supervision) or financial consequences.

Execution phase: This is the central phase of the study process. The other, more preparatory or introductory, phases serve directly or indirectly to support this phase. While executing a course of study, the student carries out the agreed study activities within the agreed period and amount of time. The institution does its part in providing the agreed upon content support and guidance. Student and institution have a system of progress registration and evaluation at their disposal to ascertain whether the student's progress and execution are in accordance with the agreements in the contract. In other words, both participants are provided with information to use as a basis for reviewing the earlier agreements or modifying the study by means of (formative) evaluative discussion.

In addition, while studying, student and institution have the opportunity to exchange information on subject-matter, didactics, progress and execution via both personal contact and information-technology.

Formal examination: The study process is concluded with the formal examination as was agreed upon in the contract if that were actually the case[6]. This examination serves to establish the degree to which the agreed upon aims and goals have been achieved. For the examinations, the:

- content is clearly related to the relevant study aims and goals;
- timing and form are in concordance with the provisions of the study contract; and
- location is chosen with due consideration for the student's circumstances.

Award of qualifications/certification: Qualifications or degrees are awarded when a student has successfully completed a contracted study process.

[6] A student can always choose to audit a course of study without examination or credit.

The roles and input of the participants

As already stated, both the student and the institution have a role to play in and a contribution to make to the study process. The following two sections cover the two participants.

THE STUDENT

A (would-be) student begins a (proposed) study with *intentions* regarding the study itself and the role and function that the study will play in his or her life. With regard to students, the following matters are relevant:

Responsibility and right of self-determination: The degree of responsibility and self-determination ascribed to a student determines the margin of freedom he or she has in the organization and pursuit of the study process. Other factors relating to this freedom include the institution's mission, the limiting conditions in which it must work, and considerations of effectiveness, efficiency and satisfaction (for both students and institution). Formal aspects and consequences of this are clearly seen in the *information* and *intake* phases, are considered in the *advice and determination phase* and are laid down in a *study contract*.

The student is given the opportunity to discuss with the institution the degree to which he or she is willing and able to assume responsibility and exercise the right of self-determination in his or her study. If a student wishes, he or she may share or even delegate all or part of this responsibility and right of determination with or to the establishment.

What this means is that the participants together try to clarify the relationship between the components of study and to specify the consequences of this relationship for the design and content of the study process. In short they try to decide what the participants can and may expect of each other.

Relevant prior knowledge, skills and attitudes: The principal requirement is that students themselves gain insight into their own prior:

- general knowledge and skills,
- domain-specific knowledge and skills,
- subject-specific knowledge and skills,
- knowledge and skills in supporting subject areas, and
- attitudes towards study in general, the domain and the subject itself.

The student should manifestly participate in determining what he or she is about to undertake, what prior knowledge is relevant to the proposed study, and what knowledge or which skills are missing and need be remediated. The institution helps the student to reach the necessary conclusions with guidance and consultation in the *information* and *intake* phases. Prior knowledge that forms a part of the course of study to be undertaken may at this stage be formally examined and, if appropriate, accredited.

General and specific study skills: It is not only important that during the *information* and *intake* phases the student becomes aware of the level of relevant prior knowledge, but that the student also becomes aware of what is expected concerning:

- necessary general study skills,
- necessary (subject)specific study skills, and
- level of mastery of such skills.

Using the results obtained in the aforementioned phases, the student can, in a dialogue with the institution, decide how any apparent shortcomings can be remediated. In the *advice* phase ideas will be generated as to how to hone the student's existing study skills, primarily during the *execution* of the study. If during a student's studies other shortcomings in study skills become apparent, 'provisions' can be made so that the situation can be remedied as smoothly as possible.

Availability of the necessary (private) study facilities: It is essentially up to the student to determine the amount of time he or she is both willing and able to invest in the study process,

when and how this will take place and what resources he or she will use. The student determines this during the *information* and *intake* phases. Conclusions are then drawn in discussions with the institution, and these are laid down in a *study contract*.

The physical study environment necessary is always available in the institution itself, but is also to a considerable extent available in the student's own immediate environment. Usually this is his or her 'home', but it may also be a place of work or somewhere else. This study environment has to be equipped with the facilities necessary for study, preferably all of which are immediately at hand. The institution must play a role in this (see the following section on the institution). For facilities that cannot realistically be located in the student's own environment, a realistic balance must be found between 'distance' and 'proximity', with the institution's own facilities playing an important role.

Where internships are concerned, special arrangements may need to be made at the workplace.

Capacity to organize one's personal and study situation: The student has a definite contribution to make to the organization and execution of his or her own study. Organizing a study involves making effective and efficient use of available time and resources. During the *course advice and determination phase* adequate support for this is given including organizational suggestions and agreements on the institution's rendering of organizational assistance (e.g., a course on planning one's time or regular telephone/personal contact with a tutor). Instruments that may assist students are made available by the institution wherever possible or necessary (e.g., time-planners, diaries, time management seminars, etc.). If the student should nevertheless encounter problems of an organizational nature during the execution of his or her studies, she or he must be able to fall back upon the institution for help.

THE INSTITUTION

The institution has a mission, a duty both to society in general and to its students in particular. Its purpose is to provide 'primary' higher education plus various forms of updating, upgrading

or retraining at higher and post higher education levels. This takes place in an innovative, effective and efficient manner. What it means for the institution is as follows:

Collecting and providing access to structured knowledge and expertise: The various domains (subject areas, occupational groups and scientific disciplines) are mapped out, separately from existing or as still to be developed courses with respect to:

- knowledge of and insights into the domains
- domain-specific skills
- domain-specific didactic approaches
- aspects of the academic discourse
- priorities inherent to the domain
- developments and expectations within the domain
- regulations covering the domain or parts of it

which makes it possible to examine the subject matter of the various domains from both a scientific or labor market point of view, as well as from a study and educational point of view.

Charting the domains is one of the institution's structural tasks which is necessary to ensure continuous adjustment and topicality of the study. The 'domain maps' thus developed can be recorded (using information-technology) so that the information contained in them can be quickly and easily used by those directly involved (both the institution and the student).

Program development: The domain maps are used in the *information* and *intake* phases. They also function as a reservoir from which components can be drawn in a dialogue between institution and student to provide the content-related and didactic elements of the course of study. In certain cases where, for instance, a course leads to a formal qualification, the course content is planned and provided by using 'pre-programmed' study units developed in line with the prevailing regulations and governing priorities. The pre-programmed course elements are

designed in such a way that they can be quickly and easily adapted in line with new developments or changing views (Wolf & Dochy, 1989).

Giving didactic form to the subject matter: If study units are to be capable of effective and efficient combination into customized study courses, it is essential that program development either includes or is accompanied by the development of *semi-manufactured products*, and/or easily adaptable study units. In other words, there are stocks of study unit components at hand from which individual courses of study can be assembled in a dialogue with the student. This brings the development of study units and their utilization in the study process closer to each other and more relevant for student and institution.

With this approach, course development becomes a somewhat *prefabricated* construction requiring high levels of expertise and adequate tools and organization. It should be noted that the prefabricated sections do not necessarily have to be made by the institution itself. They can just as well be obtained from other institutions (public or private). Where pre-programmed programs of study and courses are required (e.g., where study leads to a predetermined professional qualification), prefabrication can also be used for development or exploitation purposes. The point here is that pre-programming and individual course design are not diametrically opposed to each another. Program choice and design however, are 'less open' when this technique is used.

Providing personal services to students: If student and institution are to participate fully in the study, it is important that there is room for personal contact between them. The student can ask for personal guidance and support in relation to the subject matter presented, the didactic approach used or the progress and execution of the study reached. The gap between 'distance education' and the need for 'personal proximity' can be bridged by information-technology possibilities (study-network facilities, for instance). Students may also be able to make use of readily available communication and information channels to intensify contact with one another (e.g., bulletin boards).

Making material facilities available to students: If the course of study agreed upon between the student and the institution is to progress optimally, it is important that the student has access to the necessary material facilities. Where 'stand alone' resources such as simple audio, video or computer equipment are concerned, the ideal situation is one where the student has direct access to the necessary facilities in his or her own immediate environment. Where this is not possible (for whatever reason), or where more sophisticated (and therefore expensive) equipment such as CD-I or CD-ROM is required, an infrastructure is needed which facilitates the purchase or leasing of such equipment and/or which enables students to use it at their own discretion, for example in specially outfitted study centers.

For institution-wide facilities associated with educational/study functions such as progress monitoring (by the student or institution), dissemination of study material and/or study information, and communication between students and/or between students and the institution, the institution needs to install, maintain and extend an infrastructure to which students have ready access.

Development of an educational organization: It will be clear that the conception of education described here is an unusual one, and that an organization will need to be constructed which is capable of making a contribution to the practical realization of that conception. The design of this organization will depend on the policy decisions made and the prevailing limiting conditions.

A great many decisions will need to be taken before designing such an organization. First, the division of tasks and responsibilities between student and institution must be made. Second, the related question of the level of investment to be made in each area would need to be addressed.

Conclusion

What does all of this mean for higher education?

The education process ceases to exist because it has been transformed into a study process in which both the student and the institution participate as partners. This process is defined as an organic whole consisting of a series of discrete phases or steps which are functionally related to each other. This means that no one step can be isolated or separated from any other. In educational research, development and practice each and every phase must be seen in relation to and in conjunction with all of the other phases in the context of the process as a whole. Following the line of thought in this article implies a new way of thinking about and carrying out educational research, educational design, educational development and educational practice.

Students with their intentions *considerations*	Participate together in the study process (guided self-study)	Institution with its mission *program*
1 Independence and right of self- determination	INFORMATION ↓ INTAKE	1 Structured content, expertise, etc.
2 Prior knowledge	↓ COURSE OF STUDY	2 Program development
3 Study skills - general - specific	↓ STUDY CONTRACT	3 Course content design
4 Accessible study environment	↓ PURSUIT OF COURSE OF STUDY	4 Provision of personal services
5 Organizational capacity	↓ FORMAL TESTING	5 Making material facilities available
	↓ AWARD OF QUALIFICATIONS	6 Providing organization

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