

## **Facilitation of Critical Learning Theory in Design Engineering and International Manager Development Using Web-based Training Course**

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### **Abstract**

As the world is getting smaller due to the impact of global technology, the process of education is getting more effective due to the internet. But the question is, 'is it serving the customers—the managers of the international community in their professional development to be up to date in knowledge and skills required of them at present to be globally competitive?' Are they getting state of the art education, by their own volition and choice, which is truly learner centered? Is the system of acquiring the knowledge and skills defensible by the paradigms of andragogy (the art and science of facilitating adult learning)? Which view does this form of education subscribe to in regard to educational program evaluation and effectiveness-- **(1) The Natural Scientific View (2) The Interpretive View or (3) The Critical View?** What is the application of one recommended view for the practice of education? What is the defensibility of such a promise? One course that has been exclusively designed for international manager development is put to test and its value and effectiveness is evaluated from different measurable outcomes of the internet-based course.

### **Introduction**

The word "Andragogy" means "learner centered education". But it is not found in the dictionary yet, although it was coined and set forth by the adult learning expert Knowles in 1968. As opposed to pedagogy, the andragogical aspect of learning treatment is effective because it is learner centered and because the learner is self-motivated and driven to learn.

The system of Andragogy as improved by Knowles (1980, 1984) represents a well-developed conceptual link between adult development and learner centered education. We can try to connect all the links through important learning processes and experiences virtually by linking important learner centered lesson plans as a simulation of the actual learning milestones.

### **Learner Centered Education and Personal Growth**

Thinkers associated with personal growth share the belief that tends to focus on the individual more than curriculum per se. An orientation to personal growth is closely associated with what Elias and Merriam (1980) call 'humanism'. Humans have the ability to choose; choice implies that learners are responsible for their own actions. The objective of

reaching out is to assist learners in making choices that maximizes their human potential. Since learners are responsible for their own action, they should control their learning content, process and evaluation. As with the progressive tradition, professional education is highly learner centered, and the educator is more of a facilitator of learning than a conveyor of knowledge. Then, how do we expect professionals to make choices about their education?

This premise compels the educator to make choices on reaching out to those that need education. With this premise in mind, a set of actions were taken by five professors to design a course on the internet for the web-based delivery. Care was taken to make the lesson plans more effectively learner centered. Lab-like activities were added that could be accomplished using the world wide web. Some of the premises held by the three views below may be conflicting to the objective assessment of distance education by using the web, but the analysis will justify the soundness of such an endeavor.

Educational theorists and researches have long debated on "educational theory and practice" and have expounded upon the objective and outcome, and finally, exhaustively concluded on three main views. They are **(1) Natural Scientific View (2) The Interpretive View and (3) Critical View of education.**

### **Natural Scientific View**

To quote O'Connor (1973), "Education like medicine or engineering, is a set of practical activities and we understand better how to carry them out if we understand the natural laws that apply to the material with which we have to work..." Here is the important question of "a set of practical activities" that has been instrumental in deciding the fate of any method (or even the internet based education). Proponents and opponents have disagreed on these sets of practical activities at the very early stage of education via the internet, although it is a growing field that has not attained its full potential yet.

The impact of science on the choice of educational aims and values should not be minimized. Indeed, it is partly because of the spread of scientific knowledge that there is now a more realistic vision of the limited range of ends that it is feasible for education to pursue. The sort of educational questions now dominating educational discussion are no longer about educational ends, but about the most *appropriate means of achieving those educational ends*. And it is just these questions that an applied science of education can tackle and resolve. To quote O'Connor again, "Educational policy ... is usually a matter of establishing the most efficient use to be made of scarce resources – time, (technology) building, intelligence, teaching skills and so on. The important point to remember in all such cases is that where something proposed as an educational advance or reform is recommended, as it usually is, on the ground that it is a means to some socially accepted end, the proposal is an empirical matter which stands or falls by the evidence that can be adduced in its favor."

The question, of course, about delivery via the internet and its eventual effectiveness and efficacy can also be judged by the above remarks. This "proposal is an empirical matter which stands or falls by the evidence that can be adduced in its favor."

### **The notion of "interpretive social science" of education**

Interpretive social science is a generic term. Perhaps the clearest expression of the

interpretive standpoint is from Max Weber (1964), " (Educational) action is social in so far as, by virtue of the subjective meaning attached to it by acting individual (or individuals), it takes account of the behavior of others and is thereby oriented in its course." Weber says that underneath the 'interpretive understanding' of educational endeavor is the most significant aspect of 'subjective meaning' attached to it by individuals who benefit from it.

As Hirst, an educational philosopher argues, present day education can be seen as:

" Where ... a practical activity like education is concerned, ... theory is constructed to determine and guide the activity ... The distinction ... between scientific theory and educational theory is the traditional distinction between knowledge that is organized for the pursuit of knowledge ... and knowledge that is organized for determining some practical activity. To try and understand the nature and pattern of some practical discourse in terms of the nature and pattern of some purely theoretical discourse can only result in its being radically misconceived."

From this assertion of a great thinker we must say that the internet as a medium of effective education has been radically misconceived. Its potential has not been tapped yet for effective educational goal attainment.

### **The Critical Approach to Theory and Practice of Education**

This concept can best be defined and summarized by a quote from Fay (1979). This theory and practice of education "...is clearly rooted in concrete social experience, for it is ... explicitly conceived with the principal intention of overcoming felt dissatisfaction. Consequently, it names the people for whom it is directed; it analyzes their suffering; it offers enlightenment to them about what their real needs and wants are; it demonstrates to them in what ways their ideas about themselves are false and at the same time extracts from these false ideas implicit truths about them; it points to those inherently contradictory social conditions which both engendered specific needs and make it impossible for them to be satisfied; it reveals the mechanisms in terms of which this process of repression operates and, in light of changing social conditions which it describes, it offers a mode of activity by which they can intervene in and change the social processes which are thwarting to them. A critical social theory arises out of the problems of everyday life and is constructed with an eye towards solving them."

Evidently, recent trends in distance education has capitalized on the socio-critical theory of education for the emancipatory function it presents for on the job training and workplace improvement. The principle of reaching out to those who demonstrate the felt need of education has been the hallmark of web-based education whose curricular design is need based and its benefit lies in the immediacy of the learner's skill improvement, use and consequent job satisfaction. It is the premise of distance educators/experts that such emancipatory education can be delivered via the net to bridge the gap in education.

### **The Application of "Theory in Practice" of Education**

A course called "MANF3500: Manufacturing Automation / The CAD Module" was designed with specific objective of tapping on to the best available CAD practices in the industries around the world to bring their designing technology to the class room. Following lesson plans were

developed and deployed over the internet.

**First Lesson:** Here, learning emphasizes the importance of Computer Aided Design (CAD) for Manufacturing Automation. CAD is considered as the building block of automation. It plays a pivotal role in manufacturing. In fact, CAD is first in line of automation initiatives for paper less manufacturing practices. The complete cycle of automation CAD-->CAM--> CAE--> and Rapid Prototyping was enunciated for “Concurrent Engineering concept to implementation”. Applications of Concurrent Engineering concept in design engineering was emphasized via the web.

Students are connected to CAD world through the world of internet. After some simple information on CAD systems high-end graphic systems are explored, and these are: Pro-Engineer, SDRC-I-DEAS, Unigraphics, and Solidworks. They offer training sessions on their web sites that introduces students to their individualized design capability. Some low-end systems like Cadkey and Autocad, which offer training lessons in the web, also were introduced. The objective was to first acquaint students with what is in the CAD industry today and what a student can do with them. This ability of demonstrating the industrial strength CAD software capability in the class room is like feeling the power of a real world cad-education by just being there.

Students were asked to take interactive web-based audio/video training from these following companies. This decision was predicated by their world prominence as global engineering/CAD solution software which has impacted engineering managers worldwide.

[Pro-Engineer \(www.ptc.com\)](http://www.ptc.com); [SDRC-I-DEAS \(www.sdrc.com\)](http://www.sdrc.com); [Unigraphics \(www.unigraphics.com\)](http://www.unigraphics.com); [Solidworks \(www.solidworks.com\)](http://www.solidworks.com); [Catia \(www.Catia.com\)](http://www.Catia.com); [Autodesk \(Mechanical Desktop\) \(www.autodesk.com\)](http://www.autodesk.com); [Cadkey \(www.cadkey.com\)](http://www.cadkey.com)

### **Second Lesson: Training for CAD-CAM-CAE**

Students were asked to visit these university sites where CAD lessons are comprehensively developed and distributed as programmed learning scheme in a structured tutorial format.

<http://www2.ncsu.edu/ncsu/cep/oed/gc/tutorials.html> and  
[http://www.staffs.ac.uk/schools/engineering\\_and\\_technology/des/design.htm](http://www.staffs.ac.uk/schools/engineering_and_technology/des/design.htm)

### **Third Lesson: Understanding the applications of design models**

This part of the lesson was the application of theory to practice. Students learned to draw effective conclusions on concurrent engineering and CAD-CAM-CAE-CIM applications in real life industries by visiting their web-sites. Some of the sites offered state of the art design methodologies that cannot be converted to a conventional or traditional teaching. Such application scenarios were most gratifying to the curious students as they saw real life cad practices in design and production.

<http://www.sdrc.com/ideas/case/bose/>

<http://www.sdrc.com/ideas/case/ford/>

<http://www.sdrc.com/ideas/case/boeing/>

<http://www.sdrc.com/ideas/case/honeywell/>

<http://www.sdrc.com/ideas/case/western/>

<http://www.sdrc.com/ideas/case/harley-davidson/>

<http://www.sdrc.com/ideas/case/iomega2/>

<http://www.sdrc.com/ideas/case/sony/>

<http://www.sdrc.com/ideas/case/iochpe/>

<http://www.sdrc.com/ideas/case/gilbarco/>

<http://www.sdrc.com/ideas/case/base/>

#### **Fourth Lesson: Modeling Techniques Learned**

Students learned such 3D CAD modeling techniques: Boolean operations, Sweeping, Automated filleting and chamfering, Tweaking, Fleshing out wireframe, and projections, Parametric part modeling, Assembly modeling, Surface and freeform modeling, Feature based modeling, VGX technology, Variational Sweep.

#### **Outcome Statements of Skills learned as CAD-Specialists**

1. Students developed basic appreciation and intuitive familiarity of some high end and some low end graphics programs (Cognitive Skills)
2. Students drew wire-frames, Surface and solid models of mechanical objects and parts (Psychomotor skills)
3. Students showed confidence of understanding broad based modern cad systems (Affective Skills)

#### **Experiential Learning Reports Generated by Students**

Requirements and Formats for Reports:

1. Write, how you used web-based delivery systems effectively. How many total hours you spent in browsing and learning and give a break down of such activities for its effectiveness.
2. Write a detailed report of your modeling experiences after finishing the activities. The report should contain three things as noted in the activity page: Did it help you apply the concepts learned in the experiential training? Do you think it is at least comparable with a class and lab experience? Do you think it lets you learn better because it suits your self-imposed learning needs for workplace professional development and competitiveness.
3. What is CAD-CAM-CAE-CIM and 3D Graphics going to be with your vision of the year 2020. Using the web produce an electronic web-based report with audio, video and graphics to enunciate their capability as you visualize for the year 2020. No bars.

## Conclusions

After reviewing the student electronic reports the following impressions were noted. These comments have been analyzed with respect to the quality criteria associated with web-based learner centered educational focus, referencing primarily to the cognitive, affective and psychomotor aspect of learning outcome. For instance, did a student learn from web based tutorials available from different universities in the world. The responses were very conducive to satisfaction level achieved, confidence level attained, and affective level demonstrated.

1. Visits to the company sites were illuminating
2. Web based training and tutorials were effective learning tools.
3. Open-ended electronic reports encouraged students to browse available information and compelled them to write in a concise manner what is important to this subject. Demands of these reports enhanced their cognitive, affective and psychomotor skills.

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