PEDAGOGICAL ASPECTS OF SIMULATOR TRAINING

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ABSTRACT
The use of simulator training means that teachers enter a new environment. *The Virtual Classroom* opens up new possibilities and challenges for educators. As well as having to legitimate the use of simulator training as an aspect of the use of information and communications technology (ICT) in education, we are forced to question our basic understanding of the nature of knowledge. In this article, I attempt to shed light on these questions by suggesting that a phenomenological perspective of knowledge can provide the theoretical basis for the development of meaningful simulator pedagogy.

THEORIES OF LEARNING

Knowledge and learning have in our times been viewed from the perspectives of three different traditions - the behaviourist, the cognitive and the relational.

The behaviourist perspective:
In the first part of the century, theories of association and conditioning had a strong position. The major influence was that of *behaviourism*, which established itself at an early date as a prominent school of psychological thought. For learning to occur, this perspective presupposed that the learner should always receive an immediate response. Learning was linked to habit, it was the result of processes of trial and error (Frøyen 1998). Knowledge is acquired within a system of stimuli and responses, a system in which reinforcement plays a central role. All knowledge originates in the context of the social and cultural reinforcements which surround the individual. For example, the behaviourist perspective will understand agression as a learnt response (Atkinson et al.).

The cognitive perspective
The cognitive perspective was something of a reaction to the positivistic and behaviourist perspectives that dominated research into learning until the nineteen-sixties. The behaviourists were criticised for having given too mechanistic an explanation of the learning process (Ibid).

Unlike behaviourism, this perspective focuses on human information processes (such as perception processes, memory processes, thought processes and language processes). Learning involves concepts, structures and knowledge. It involves insight and is in a state of constant change.

The relational learning perspective.
The most recent addition to learning theory is the 'relational perspective'. This criticises both behaviourism and cognitivism because they fundamentally view learning as an individual activity. The relational perspective states that "intelligent acts cannot be understood by analysing isolated individual behaviour. We must look at the relations between the learner and the environment in which learning occurs" (Ludvigsen 1996). Learning is 'situated' - this means that it takes place in concrete situations, or contexts. In other words, this perspective focuses on the contextual and social aspects of learning and thinking. Knowledge is gained through interaction with others and must therefore be understood as a socio-cultural phenomenon. This means that knowledge and competence are viewed as situationally determined. Thus, it can be extremely difficult to teach students about skills in classroom settings that are very different from the environments where these skills are actually practised. Researchers working within the relational perspective have been more interested in analysing the cognitive activity that takes place in specific environments, rather than attempting to make statements about general knowledge structures. Knowledge is seen as a product of individuals, environment and situation.

All cultures are maintained by basic ways of conveying information. Cultural tools are those tools that every culture is dependent on in order to maintain forms of communication. These can take various forms - language, books, IT, etc. The relational learning perspective sees the contents of knowledge structures as being inextricably linked to the situation they have been learnt in. Unlike perspectives that have a positivististic or biological background, the relational learning perspective is a phenomenological understanding of knowledge and learning.

One of the central questions in the learning research of the '80s and '90s has concerned itself with the very nature of the learning process. Is learning a universal, general process or is learning situationally determined? This is a controversial area. The relational perspective

challenges an understanding that is central to the formal education system - the view that knowledge is a commodity that resides in individuals, a commodity that we take with us from one situation to another. The relational perspective would argue that is probably more correct to say that it is the individual-in-context that is the bearer of knowledge. "As long as the nature of the shaping of thought by context is not seen, the organization of mental functions that must be attributed to individual minds to account for observed performance will not be of the right sort" (Hutchins 1996:62). This implies that knowledge is not only tied to a person, but also to the individual's surrounding situations, in the activities, actions and community of practice that the individual is a part of.

> A relational perspective stresses the importance of the fact that learning is a social process. When learning occurs it is the result of an individual acquiring skills within definite social, cultural and material contexts. (Langås 1998)

Knowledge is socially and materially *situated*, or anchored in social practices which, in their turn, belong to social systems.

A PHENOMENOLOGICAL MODEL OF THE LEARNING PROCESS

Different phenomenological studies of learning suggest that the learning of skills proceeds through a number of different phases. In *Mind Over Machine* Hubert L. and Stuart E. Dreyfus put forward a five-stage phenomenological model of knowledge and learning (Dreyfus & Dreyfus 1986).

1. Novice.
2. Advanced Beginner
3. Competence
4. Proficiency
5. Expertise

The Novice

Learning at this stage is characterised by the fact that skills are separated from the contexts within which they occur. The novice meets context-free features which he can recognize without actually having experienced them in their real settings. The novice learns rules which make action possible. Since the novice lacks an understanding of the overall situation in

which skills are performed, he will tend to judge his performance in terms of how well he follows learned rules. After he acquires more rules, more and more concentration is demanded if he is to carry out tasks. The learning situation will thus often be characterised by the student's limited capacity to talk or listen to advice (Dreyfus & Dreyfus 1986). Dreyfus & Dreyfus give an example of the novice stage in driver education. The novice driver learns a number of situation-independent skills, e.g. at what speed he should change gears, safe following distances at given speeds. Such rules and procedures are isolated from any authentic context.

> The beginning student wants to do a good job, but lacking any coherent sense of the overall task he judges his performance mainly by how well he follows learned rules. After he acquires more than just a few rules, he exercise of his skill requires so much concentration that his capacity to talk or listen to advice is severely limited. Like the training wheels on a child's first bicycle, these rules allow the accumulation of experience, but soon they must be put aside to proceed (Dreyfus & Dreyfus 1986: 22)

For the teacher, these rules and procedures will serve an instructional purpose, while, for the student they will function as basic guidelines in the first phase of his instruction. However, it is important that the learner progresses beyond mere knowledge of abstracted rules and procedures.

Advanced Beginner

The advanced beginner will have acquired new experiences as a result of having mastered authentic situations. He will have faced situations where the skills that characterise the activity are not possible to recognise as objective signs.

> Through practical experience in concrete situations with meaningful elements, which neither an instructor nor the learner can define in terms of objectively recognizable context-free features, the advanced beginner starts to recognize those elements when they are present. How? Thanks to perceived similarity with prior examples. We call the new elements "situational" to distinguish them from context-free elements. Rules for behaviour may now refer to booth the new situational and the context-free components (Dreyfus & Dreyfus 1986:22).

The advanced beginner will make both situation-dependent and situation-independent interpretations. The learner driver will use motor sound (situation-dependent) and speedometer readings (situation-independent) when changing gear. He will also be able to predict other drivers' movements by observing their behaviour, position and speed. He learns to distinguish between the ways in which different road users behave. The ability to

distinguish between an impatient professional driver and a drunken driver is not best acquired through the teacher's words and explanations, but through meeting authentic examples.

> Motor sounds have no satisfactory verbal description. Pedestrian behaviour can be described, but no amount of description is as educative as the experience of having to observe and react to innumerable cases of pedestrians crossing different roads in different circumstances. (Flyvbjerg 1993).

The advanced beginner learns through practical experience rather than through rules. Participation in authentic practice activity is much more valuable and educative than any amount of exposure to verbal explanation and description. As more and more experience is gained, the amount of recognizable features found in real-life, concrete situations becomes overwhelming.

Competence

In order to manage this explosion of information, the learner learns to make use of hierarchical decision-making procedures. Firstly, he chooses a goal, plan or perspective so as to organize the situation. Thereafter, specific characteristics and factors are focused on. An experienced nurse educator comments on the problems her students meet when moving from the beginner's mastery of rules to the competent performer's ability to prioritize and see overall situations.

> I give instructions to the new graduate, very detailed and explicit instructions: When you come in and first see the baby, you take the baby's vital signs and make the physical examination, and you check the I.V. sites, and the ventilator and make sure that it works, and you check the monitors and the alarms. When I would say this to them, they would do exactly what I told them to do, no matter what else was going on....They couldn't choose which one was the most important.....They couldn't do for one baby the things that was most important and then go to the other baby and do the things that were the most important, and leave the things that weren't as important until later on..... If I said, you have to do these eight things...they did those things, and they didn't care if their other kid was screaming its head of. When they did realize, they would be like a mule between two piles of hay (Dreyfus & Dreyfus 1986:23,24).

Goals, plans and prioritizing procedures help the performer to focus attention on a limited set of important features, rather than having to deal with all aspects of a particular situation. The competent nurse, unlike the novice, does not go from patient to patient in a fixed, pre-determined sequence, but continually evaluates patients' needs for care and attention and organises her work on this basis. The behaviour of the competent performer becomes more

fluid and better adapted to concrete contexts (Flyvbjerg 1992:27). If we return to the example of the learner driver, the competent motorist no longer looks to procedures and rules in order to drive safely and attentively. He will drive according to clear goals or plans. If he wants to get from A to B in the shortest possible time he will choose the route he thinks is fastest on the basis of his previous experience of roads, traffic, etc. At the same time, he will maybe drive more closely up to the car in front of him and break speed limits or other regulations so as to reduce travel time. The competent driver will be surprised if his chosen strategy for covering the distance does not succeed. His choice of route may not fulfil his expectations because of roadwork, heavy traffic, slow-moving cars, etc.

The competent motorist will choose goals and strategies. No-one can give him rules about how he chooses his driving plans. He will therefore set up different rules which he can follow or abandon in different situations, depending on his continuous evaluation of how these rules function. Competent performers select the organising principles they follow. Such choices have a considerable influence on behaviour (Ibid). While the novice or advanced beginner only experience a limited responsibility for their actions, the competent performer will show a much greater involvement and experience greater personal responsibility. The novice will tend to explain his mistakes by pointing to external factors such as bad rules or procedures. If he has not made any direct mistakes, he will explain any unfortunate outcome as the result of inadequate rules or procedures. For example, marine accident debriefings will often explain accidents as the result of bad rules or procedures, or that these rules and procedures were not followed. However, the competent performer will not be satisfied with such explanations. He will be personally and emotionally involved. He will question his own judgement and interpretation of the critical situation. It is this capacity to judge, independent of rules and procedures, that is central to the advanced stages of the learning process. The ability to make one's own evaluation of individual situations is the very essence of genuine expertise.

Proficiency

On the basis of their vast experience of different situations, performers who have reached the two highest stages are able to make decisions quickly and fluidly. They are not restrained by a more fragmented approach to analysing and solving problems. The proficient performer is deeply involved in his actions and has developed a *perspective.* This perspective enables him to focus on certain elements of a situation, while other features automatically disappear into

the background

> As events modify the salient features, plans expectations, and even the relative salience of features will gradually change. No detached choice or deliberation occurs. It just happens, apparently because the proficient performer has experienced similar situations in the past and memories of them trigger plans similar to those that worked in the past and anticipations of events similar to those that occurred (Dreyfus & Dreyfus 1986:28).

Expertise

An expert's skill and knowledge have become so much part of him that he takes them for granted. Like the person who has learned to cycle or swim, his expertise has become an integral part of him. An expert driver becomes one with his car, and he experiences that he is simply driving, rather than driving a car. While novice pilots feel they are flying a machine, expert pilots simply experience flying. The division between man and machine, subject and object, disappears. At this level of virtuosity, the performer does not solve problems and make decisions, he simply *does the right thing* (Flyvbjerg 1992). When virtuoso footballers dribble or shoot at goal they do not seem to be making conscious decisions based on general rules and data of their own and their opponents' positions and speeds. It would seem that they intuitively dribble or shoot, that their bodies act automatically. The experience that resides in the body cannot be verbalised, intellectualised and tied to any set of rules. With expertise comes fluidity. It is seldom that we choose every word or think about where to place our feet; we just speak and walk.

> An immense library of distinguishable situations is built up on the basis of experience. A chess master, it has been estimated, can recignize roughly 50,000 types of positions, and the same can probably be said of automobile driving. We doubtless store many more typical situations in our memories than words in our vocabularies. Consequently, such situations of reference bear no names and, in fact, seem to defy complete verbal description (Dreyfus & Dreyfus 1986:32)

A central aspect of the 5-stage model of adult learning processes is that there is a qualitative leap from rule-based, context-free novice behaviour to experience-based, context-dependent expert performance.

INFORMATION AND COMMUNICATIONS TECHNOLOGY (ICT) IN EDUCATION

The fantastic thing about modern information and communications technology is its potential to revolutionise social and cultural practice. The technology gives us the possibility to establish learning situations we could only previously dream about. In our field of simulator training we will soon witness developments whereby many subject areas will be able to develop simulator systems. Tomorrow's schoolchildren will be able to learn physics, chemistry, biology, etc. through simulations. The pedagogical challenge we face is that of how we can manage to create a pedagogy that unites technological and human considerations. On the one hand, technology must be given a social dimension and be placed in the centre of a field of social relations. On the other hand, pedagogics cannot deny technology its place in the sphere of culture and the humanities.

When simulator training becomes an integrated part of education, we will be able to talk of *The Virtual Classroom*. Pioneers in the use of simulator systems have accumulated valuable knowledge and experience in the exploration of Virtual Reality (VR). Loeffler and Anderson give a definition of VR: *'Virtual reality is a three-dimensional, computer-created, simulated space, existing in real time in relation to the user's movements and perspective (Loeffler og Anderson 1994:13).* From a phenomenological learning perspective, the pedagogical challenge of VR lies in the potential of this interactive technology to provide examples, cases and relevant practice situations. What will legitimate VR technology is the extent to which the complexity and multi-dimensionality of its interface will be able to give the learner a feeling of 'being there'. The degree to which the learner's senses are immersed in the simulation, undisturbed by the outside world, will be of crucial importance in determining the optimal pedagogical benefits. The VR systems that will survive in tomorrow's world will be those that continually strive to produce maximum perceptual and sensory user involvement and attention.

PEDAGOGICAL IMPLICATIONS AND FUTURE CHALLENGES

The classroom of the future will be more and more a virtual classroom. Whereas earlier educational traditions clearly separated body and mind through a strong emphasis on intellectual and cognitive insights and structures, the virtual classroom will be able to integrate the body and its intuitive, sensory knowledge into a more holistic learning perspective, one in which body and mind may interact. Simulator education will make this possible.

> If possible the situations should be realistic and historical in the sense that the particular situation as well as the story behind is presented for the students. The description must include both irrelevant and relevant aspects so that the students learn to distinguish between them in a chaotic situation. In this way simulations– even computer simulations - can be useful. Generally speaking, the universities must move towards simulations and case-studies and other descriptive, narrative, historical ways of approaching things in order to develop expertise (Hubert Dreyfus 1997:206).

For us to succeed in our work, VR scenarios must be created in close co-operation with practising experts. For example, maritime experts should contribute to maritime simulations. Scenarios must contain a variety of examples which will demand contextual interpretation and continuous student practice in acting and making decisions. Students should be helped to move from the novice stage to the higher levels of competence, proficiency and expertise with the help of simulation training programmes that expose them to a variety of situations. Scenarios which practising experts help to create will be of enormous benefit to students, who will be inspired by being able to participate in virtually authentic social interaction at the expert level. Using the simulator to test students' knowledge of rules and procedures is of little value.

The socio-cultural contexts that characterise different situations must be recognized and made part of scenarios, in addition to routine rules and procedures. Hierarchical structures must be analysed and made part of simulations. Power hierarchies can both hinder and promote the acquisition of expertise. Outmoded cultures of power relations may prevent the expertise of those who are in the lower reaches of the chain of command from being expressed and possibly utilised in strategies designed to prevent accidents. On the other hand, unclear command lines may lead to novices acting beyond their competence. In the creation of different scenarios it is important to pay attention to production and dramatization techniques as well as programming and graphic design (Ødegård 1994). There must be a recognition that it is human relations that primarily regulate workplace behaviour. Thus, it is not only physical

structures that must be reproduced, but social structures and relations as well.
It is important that everyone involved in the development and employment of simulator systems, from designers to instructors, is trained to think of learning processes as being relational and contextual.

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