

**21ST CENTURY TEACHING & LEARNING
KOLB CYCLE & REFLECTIVE THINKING AS PART OF TEACHING,
CREATIVITY, INNOVATION, ENTERPRISE AND ETHICS TO ENGINEERS**

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ABSTRACT

In teaching we deal with people, diverse and ever changing. Not everyone learns the same way or equally readily about all types of material. Both the discipline and level have influence on learning.

There are no easy answers to such questions as ‘How do we learn?’ and ‘How we as teachers can bring about learning?’ Our knowledge about teaching and learning is still incomplete, but we know enough as to what types of action may be helpful in enabling learning. It is recognized that both *motivation* and *assessment* play a major part in student learning in H.E.

The use of ‘*Kolb’s learning cycle*’ as a model required for complete learning and the principle of continuous ‘*Reflection in Action*’ are two approaches that can help us deal with the difficult task of teaching and learning in the 21st century.

Marco Polo describes a bridge, stone by stone.

“But which is the stone that supports the bridge?” Kublai Khan asks.

“The bridge is not supported by one stone or another,” Marco answers, “but by the line of the arch that they form.”

Kublai Khan remains silent, reflecting. Then he adds: “Why do you speak to me of the stones? It is only the arch that matters to me.”

Polo answers: “Without the stones there is no arch.”

Invisible Cities – Italo Calvino

INTRODUCTION

We live in a fast moving world. The quotation of the Ionian philosopher Heraclitus “Τα πάντα ρει καὶ οὐδεν μένει” – everything changes and nothing remains – could aptly applied to describe our modern life experiences. The fact that we live in a world of continuous flux is nothing new, irrespective to which Creation theory we espouse, things have been moving forward ever since the beginning. What has drastically changed within our lifetimes is the rate of change which at times can assume quite frightening pace. Of course change can be viewed from different perspectives and on the one hand it can be viewed as a positive driver of continuous improvement, with all the accompanying benefits, whilst on the other it can have devastating and debilitating effects on those who cannot keep abreast of it.

In the last decade of the 20th century, especially after the demise of the communist system of the Soviet Union, we have experienced the inexorable growth of capitalism in the form of globalization and in the current state of affairs it looks that either nations sign up to it or are left behind.

On present evidence, there can be little doubt that education is being affected by the assault of globalization. With the continual increase of global markets and more and more powerful global multinational companies, more and more nations try to adopt their educational systems to cater for the needs of these global multinational economic giants. The result is the creation of educational systems that are geared more towards economic and technical requirements,

neglecting the contribution to the creation of a better social order. *Nation states are in danger of becoming the servants of global markets with their educational systems providing the human resources to feed them [1].*

In this time of enormous and rapid changes not only the average voter, but the average nation appears to have less and less control over their destinies. Nevertheless, in my opinion there is need to keep in front of us a richer vision of education, the vision of the common social good and the development of human potential to its full capabilities.

Teaching and Learning

It seems sensible that before one attempts to teach, one should make an effort to understand how people learn. Teaching and learning are hard to pin down elusive concepts but for sure different people learn in different ways. In addition, there is no doubt for the need of the learner to be actively engaged in the learning process in order that they benefit from it. Everyday experiences in our lives confirm it. For the older persons such as myself, there are no better examples than trying to use new technologies such as programming a video player, using a computer or trying to get to grips with a mobile phone; I find all much easier by *doing* things myself rather than trying to follow vague instructions, either from my daughters or the various manuals. Unless I get actively engaged I do not really '*learn*'.

As humans we tend to enjoy a task better when we have control over it, i.e. it is of our own choosing rather than one that is imposed upon us, even if it results in some extrinsic reward. In fact research suggests that extrinsic rewards not only undermine intrinsic ones, they seem to promote poor learning. In contrast, tasks that are intrinsically rewarding are associated with higher levels of motivation and active engagement. The more responsibility the learners have for their learning, the greater their intrinsic reward is likely to be [2].

We should, and good teachers have always been doing it, not only try to actively engage our students in the learning process and make the learning process intrinsically rewarding, but we must also ensure that the students are provided with the appropriate working models to understand the meaning of what we try to teach them. In other words it is quite important, especially in today's modularization and interdisciplinary nature of courses, to ensure that our students are given the appropriate background information on which to associate the new information we try to impart. Unless they have a working model in their heads or are exposed to situations through which they can build such a model through their experiences, learning will not take place or it will be incomplete if it does. Of course it is important for the students to know the facts, however, unless these facts can be put together in meaningful patterns they will not be of great use. Facts get their meaning from the way they fit into a particular context. When we speak to them of a good theory, we should be able to demonstrate to them how the various seemingly disparate facts of a topic are put together and make sense. The fitting of various facts into a coherent whole supports the active engagement we seek to impart on our students as well as being conducive to '*deep*' forms of learning (holistic approach).

If we think of the various facts that the learner has to absorb as building blocks, then in order to make these blocks fit together in the right pattern, the learners should be given the outline of the complete topic, i.e. how the various bits in the topic hang together. Given the complete outline at the beginning of a series of lectures they will be able to fill in the pattern that emerges as they go along. The emergence of this pattern is the emergence of meaning and when students see it, they will begin to understand the facts; they will have achieved insight.

The student's perspective to learning is highly colored by the way they perceive the value of the process to themselves. It is therefore very important that we know or at least try to understand

the way the students perceive what we try to achieve through our particular way of teaching rather than just rely on how effective or appropriate we judge our teaching method to be.

Kublai asks Marco, “When you return to the West, will you repeat to your people the same tales you tell me?”

“I speak and speak,” Marco says, “but the listener retains only the words he is expecting. The description of the world to which you lend a benevolent ear is one thing; the description that will go the rounds of the groups of stevedores and gondoliers on the street outside my house the day of my return is another; and yet another, that which I might dictate late in life, if I were taken prisoner by Genoese pirates and put in irons in the same cell with a writer of adventure stories. It is not the voice that commands the story: it is the ear.”

Invisible Cities – Italo Calvino

Education should train one's powers of '*reflective thinking*'. Genuine freedom, according to Dewey, is intellectual; it rests in the trained power of thought, in the ability to '*turn things over*', to examine problems in depth.

Reflective thinking is based on five steps between recognition of a problem and its solution [3, 4, 5, and 6]:

1. Suggestions of a solution
2. Clarification of the essence of the problem
3. The use of hypotheses
4. Reasoning about the results of utilizing one of the hypotheses
5. Testing the selected hypothesis by imaginative or overt action.

Mere imitation, dictation of steps to be taken and mechanical drill may give quick results, but they may have the adverse effect of strengthening traits likely to be fatal to reflective power. True learning of skills necessitates their acquisition as the result of the use of the intelligent powers of the mind.

There is a beautiful description by Michael Polanyi of the learning experience of medical students attending a course in the X-ray diagnosis of pulmonary diseases [7] and a number of factors emerge from it have been summarized [8]:

- The discovery that we need to know something that we do not know,
- Immersion in the problem,
- Puzzlement,
- Active engagement; obtaining information and testing of hunches,
- Repeated exposure to the learning situation,
- The presence of an expert who sets up the situation, acts as a model of competence and answers questions,
- The inherent capacity of the human mind to understand,
- Periodic insights,
- Pleasure in gaining insights,
- Doubt that one will ever really understand, and
- Faith that one will eventually understand.

Looking through the above list one can see that there is an absence of a teacher '*teaching*' and also that quite a number of items refer to the way the students feel. Polanyi goes further in fact and suggests that especially in practical lessons one cannot convey a lot of the information learned by '*telling*', simply because such knowledge cannot be specified in words. He calls this

'*tacit*' knowledge. I believe that the major problem of teachers in the conventional classroom situation is not one of language but one of attitude. If the teachers have a sense of empathy and put themselves in the positions of their students, i.e. take on the perspective of their intended learners they will communicate in a way that their learners can understand.

Explaining to students is a challenging task. They may not see the connections that seem so obvious to us. It is an easy assumption to make that facts, which seem so obvious to us that are not worth mentioning, are not equally obvious or could be totally out of the experience of our students. Communicating ideas involves much more than just knowing about them. Meaningful learning and retention are influenced by the substantive content of a learner's structure of knowledge and the organization of that structure [9]. Having '*appropriate background knowledge*' of concepts and principles is essential in problem solving. '*Meaningful learning*' involves the acquisition of '*new meanings*' that will allow the learner to relate the new material to their cognitive structure and to integrate the essence of the new experiences to existing patterns.

The above discussion suggests that the main ingredient of comprehensive understanding of any topic is that the learner can see all its details as an integrated whole. Details of any topic become coherent only when they '*fall into place*'; they integrate with the whole, making the '*picture*' complete. Does this fact affect the setting of rigid objectives? Does the fact that we recognize the goal only when we get close to it affect the determination of such goals beforehand? Are we able to specify goals before we reach them?

In a fast paced world of conflicting demands we need to evolve a dynamic, flexible curriculum as modelled in Figure 1.

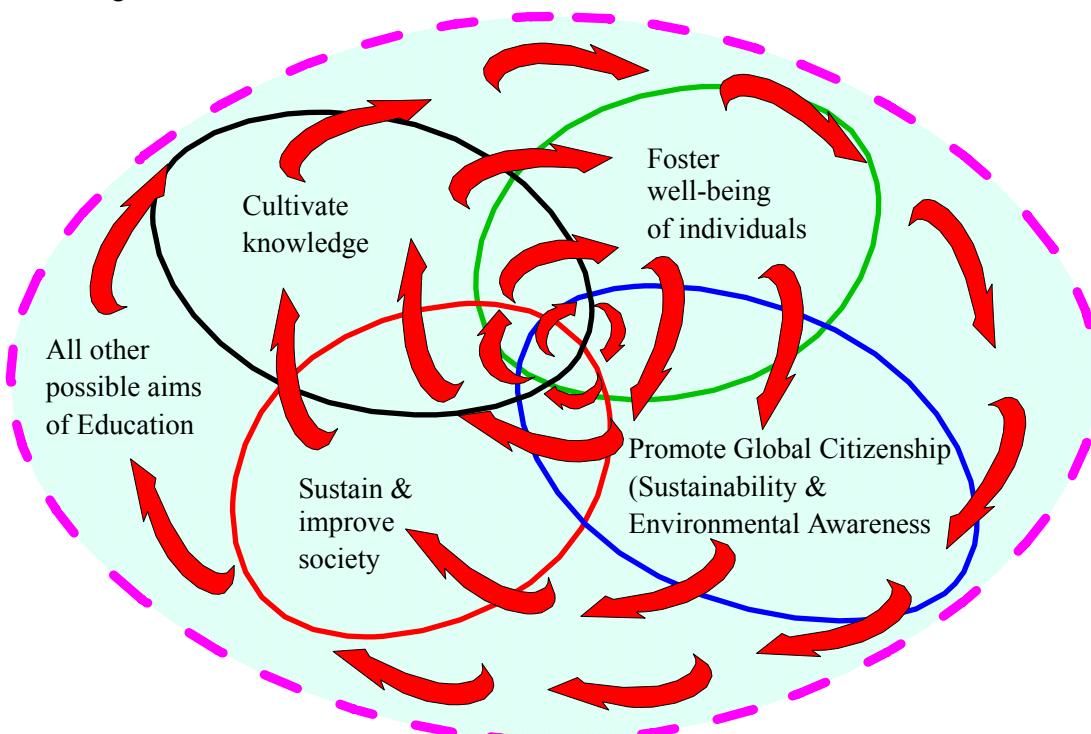


Figure 1 Model showing how a balance can be achieved between contending aims by targeting the common elements in the set of aims. Working from the intersection of the different sets of aims and by continuing to work through common points between the sets we can we can develop a consensus through a democratic process that accommodates the sincere differences and contesting interests. They key to this process is to realise that the purpose of education is not monolithic or static and that the continuous shifts of educational aims provides the potential of dynamism in the real world of continuous flux. Even the most tenuous consensual can act as a focal point from which the process of building a sound educational programme can begin.

The activities we have been discussing above are not of course set in vacuum. They are part of the curriculum and as such they can generate positive or negative effects on the way the students will approach their studies and they will also help to shape their learning strategies. Overcrowded timetables, overloaded syllabus can affect the way we teach. We might be willing to take our students in a trip of exploration but we most probably will end up speeding through prescribed material at a gallop leaving our audience breathless and possibly lost in the process. All these, coupled with an assessment approach that is geared towards examination and the recall of facts and you end up with the classical symptoms of '*surface*' learning. All these adverse effects are consistent with the simple theories of learning we have already touched upon. We need '*plasticity*' in the curriculum that reflects changes either of substance or perspective in technology, metamorphoses in subject content, changes in landscape, i.e. the changing of boundaries.

However, there is one more point I would like to stress, it is not only how well intentioned we are in our approach and how well we articulate our aims and objectives but how well and what the students understand those objectives to be. It is not how well we design assessments to test understanding rather than reproduction, but what our students believe the assessment to be about. Any mismatch between these perceptions and the effectiveness of what we are trying to achieve will be severely reduced. Different students, as all of us, perceive the same context in different ways. If we are lucky enough to establish a rapport with our students and both are on the same '*wavelength*' then we can both reap the benefits of the developed theories of learning. However, if any mismatch occurs in the perception of the learning process from either side, there will be frustration and disillusionment all around.

Engineering is a subject heavily loaded with explicit knowledge. Engineering suffers from too much emphasis on knowledge and teaching and not enough on technology and learning. The teacher's role is to structure knowledge, to make knowledge accessible, to facilitate learning (not to impart information), and to manage the learner's interaction with knowledge, whilst the learner's role is to assimilate, organize and apply knowledge.

What are the employers looking from our graduates and what are the career expectations that our graduates have? Employers take as granted that the graduates should have appropriate technical skills. Graduates are also expected to possess good communication, decision-making, problem solving, team building, and negotiating skills. A report by the Association of Graduate Recruiters has shown that although graduates may have top qualifications they do lack important working skills. Large companies perceive that graduates leave universities lacking initiative and without the ability of effective communication. Nearly half of the firms surveyed in the same report expressed the belief that graduates are not good in decision making, whilst a third are not impressed with their problem solving or team-building abilities. Nearly 80% said that employees with such soft skills would find it easier to move up the corporate ladder. The majority of graduates think that they have completed the learning process when they graduate and they do not want to take on job functions that they perceive to be beneath them. Their salary expectations appear to be ~£10,000 higher than the prevailing rates! What can the professional teachers do to assist in bridging this perception gap that exists between the two camps?

Now Kublai Khan no longer had to send Marco Polo on distant expeditions: he kept him playing endless games of chess. Knowledge of the empire was hidden in the pattern drawn by the angular shifts of the knight, by the diagonal passages opened by the bishop's incursions, by the lumbering, cautious tread of the king and the humble pawn, by the inexorable ups and downs of every game.

The Great Khan tried to concentrate on the game: but it was the game's purpose that eluded him. Each game ends in a gain or a loss: but of what? What were the true stakes? A checkmate, beneath the foot of the king, knocked aside by the winner's hand, a black or a white square remains. By disembodying his conquests to reduce them to the essential, Kublai had arrived at

the extreme operation: the definitive conquest, of which the empire's multiform treasures were only illusory envelopes. It was reduced to a square of planed wood: nothingness....

Then Marco Polo spoke: "Your chessboard, Sire, is inlaid with two woods: ebony and maple. The square on which your enlightened gaze is fixed was cut from the ring of a trunk that grew in a year of draught: you see how its fibres are arranged? Here a barely hinted knot can be made out: a bud tried to burgeon on a premature spring day, but the night's frost forced it to desist."

Until then the Great Khan had not realised that the foreigner knew how to express himself fluently in his language, but it was not his fluency that amazed him.

"Here is a thicker pore: perhaps it was a larvum's nest; not a woodworm, because, once born, it would have begun to dig, but a caterpillar that gnawed the leaves and was the cause of the tree's being chosen for chopping down..."

This edge was scored by the wood carver with his gouge so that it would adhere to the next square, more protruding..."

The quantity of things that could be read in a little piece of smooth and empty wood overwhelmed Kublai; Polo was already talking about ebony forests, about rafts laden with logs that come down the rivers, of docks, of women at the windows....

Invisible Cities – Italo Calvino

THE 21ST CENTURY TEACHER

“Which mask shall I wear today?” asked the teacher looking in the mirror.

“It all depends what day it is!” the mirror replied....

“Is it Short Courses-day, Committee-day, Lecture-day, Examiners meeting day, TQA-day, COST-day, Paper submission deadline-day, External funding bodies meeting-day”? P. Kapranos

Every year I spent a lot of time on improvements to the various undergraduate modules I teach. This is done through reflection of what I do and on the feedback from students and colleagues. That means that I have to spend more TIME on updating and changing notes, sometimes even drastic changes such as the possible introduction of interactive case studies. However, I feel that teaching is all about creating the appropriate ‘environment’ for learning to take place. If we are given the serious task of educating or influencing minds (young or old), the least they deserve is the commitment from us that we will do our best to facilitate the process of learning.

Effective teachers are by definition reflective practitioners. Continuous progress in their practice, the search for novel and better ways of engaging and challenging their students as well as themselves are second nature. They have been trained to analyse their performance as communicators and to objectively look for ways to make the difference, i.e. reflective practice is an established part of the teaching/learning culture or is it?

I fear that not many teachers in academia are ‘qualified’ as teachers. Depending on the nature of the establishment many see teaching as something of secondary importance to research if not as a direct hindrance to it. Reflecting practice is a time consuming process and TIME is a commodity that academics do not have in abundance.

Nevertheless, if teaching is to be a meaningful activity, every teacher must be allowed the luxury of TIME and TOOLS to step back and assess their individual part within the educational context. This clearly will be a struggle and every struggle embodies a dilemma to which a balanced but optimised solution **must** be sought. It is only by reflecting on our own experiences that we can make the necessary changes; clarifying the vague, breaking through barriers, changing through positive experiences, gaining insight, learning, engaging our creativity, allowing our potential to flourish.

I subscribe to the notion that ideas are not fixed or unchanging elements of thought but are formed and re-formed through our ‘experiences’. I therefore decided that since my approach to

teaching and learning revolves around the Kolb learning cycle it would be appropriate to report on my experiences through teaching my undergraduate students in an action research set-up (Figure 2).

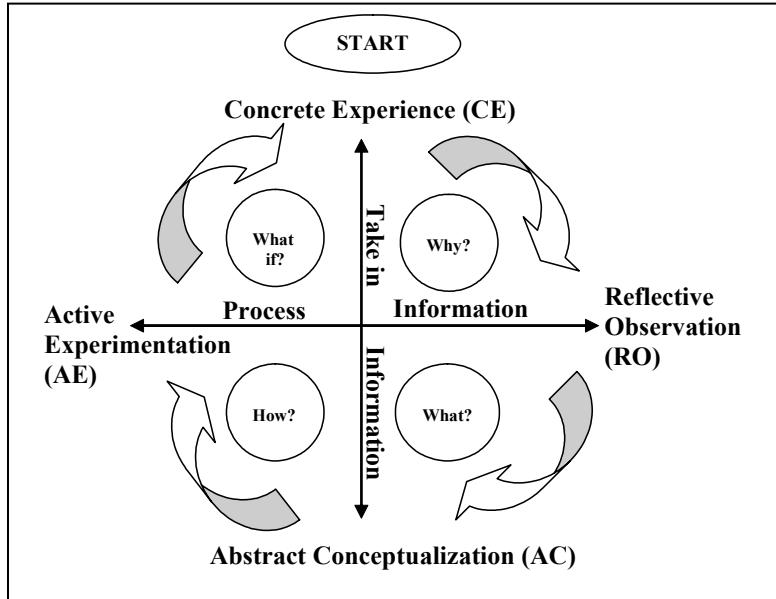


Figure 2: Kolb learning model [10]

Motivation is highly dependent on personal involvement in the successful completion of various tasks. If one has a personal stake in something, as well as being interested in it, chances are that they will be much more motivated in getting on with it rather than if it were imposed on them from outside (intrinsic as opposed to extrinsic rewards). I give my students ‘a stake’ into what I am doing and the result is that I almost get full cooperation with responses to my questionnaires, contrary to the expectations of many of my colleagues.

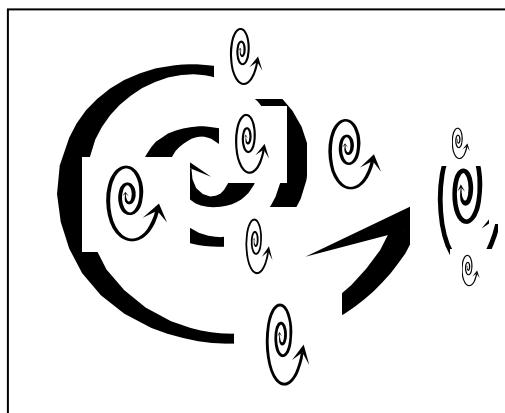


Figure 3: The unlimited cycles in the ‘reflection in action spiral’ after [11].

Of course this process is a spiral one, the iterations continue every time the cycle is repeated resulting to what I hope is an improvement to my practice. This ‘recursively improving practice’ is well described as a cycle of cycles by McNiff [11] and shown in Figure 3, where each individual cycle consists of: identification of problem – imagination of solution – implementation of the solution – evaluation of the solution – modification of practice. Each such cycle may be

taken as the germ of a system that generates an unlimited number of cycles that operate in a similar fashion. Of course that takes us back to the issues of ‘What constitutes education/learning?’ [12]. Should education be about the development of the individual or should it focus in meeting the requirements of society? Should education manifest itself as the development of the individual or as a set of skills and knowledge that will get the individual employment? There is clearly a dichotomy of purpose and this dichotomy manifests itself through the various curricula. However, although the social and individual needs are not the same, they do clearly overlap.

There is need to see the commonalities of purpose as the base of an education that fulfils both tasks at the same time. It must be understood that education is multifaceted and it must serve a number of purposes. In addition, rather than viewing the educational purposes as neat little linearly connected boxes, they could be envisaged as part of a 3-dimensional continuum all interconnected, each having an influence on the others and vice versa (see Figure 1). In our search for a meaning, we might be forced to step back and reflect before jumping onto whatever bandwagon is fashionable in educational circles (that does happen).

If we perceive, and democratically convince others, that there is underlying unity, then there is scope for a potential working consensus however tenuous, imbalanced or adversarial that may be. We must first establish values that are commonly agreed upon across society and not whether there are any values that should be agreed upon across society. Agreement on such values can be compatible with different interpretations and applications of them. If we perceive the differences in educational aims (the strains in the model) as a potentially healthy source of dynamism in a continuously changing real world that might allow us to focus on the need for adaptability to our perpetually changing needs, purposes and values. When things get out of balance because of change, we can expect that by adapting our views accordingly the imbalance in the system can be corrected (alleviation of the strains in the atomic model).

Of course the real problem in the curriculum is how to proceed when there is a continuous state of flux in our aims and priorities. How can effective educational programmes be built on unstable and shifting ground. This is more a practical and political problem rather than a philosophical one.

The grand aims of education are clear: *‘We should aim at the transmission of knowledge, the good of society and a good life for the individual’*. The key question is how do we proceed when these aims are or appear to be in conflict?

One way forward, without the risk of aimlessness and further elaborate procedural rituals, is that we must strive in building a consensual basis on the aims of education upon which in a spirit of tolerance and through critical examination and open debate can hope to arrive to a convergence of conclusions. Hope lies in the perpetual process of understanding and reaching reasonable accommodations rather than the attainment of any final solutions.

Nothing is simple, linear or predictable in human affairs. Teaching, is above all, an intensely human and interactive activity, if not, it is not done correctly. There are different learning styles, a plethora of educational aims, a variety of curricula, a profusion of communication techniques, different skills to be taught and learnt, negotiations, administrative duties, philosophical aspects, professional aspects, psychological aspects, practical aspects, institutions, funding bodies, and a myriad of other factors to be considered by the teachers in their daily duties. Above all, there are the human interactions, with students, colleagues and outside agencies. Therefore, first of all the teacher must be able to juggle; keep all these balls up in the air; a tough act to follow!

It is all too easy for the conscientious teacher to shoulder the total responsibility of learning on their shoulders, after all teachers often speak of their work as a vocation. Teaching often becomes synonymous with a calling distinguished by selfless service to students and educational institutions. To imagine that the performance of their students is directly related to theirs and their failings are their failings, we move into the teacher-martyr-wreck syndrome. Ensuring that the students realise their responsibilities in the learning process does not translate to the shedding of responsibility but the sharing of responsibility. It is a partnership that has to be negotiated and nurtured in order to bear fruit and it certainly proves much more productive than the one-sided martyr syndrome.

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