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# Investigations into the Application of Internet-Based Learning for the Delivery of Continuing Professional Development for Marine Engineers

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Recent advances in communication technology enable easy access to the Internet from anywhere in the world. This has fuelled interest, demand and research into methods of using and enhancing this technology to deliver Continuing Professional Development (CPD) as personnel who wish to undertake programmes of education and training often experience a lack of time and resources. These factors have led to a number of research initiatives being instigated at the University of Plymouth to investigate effective methods of delivering material to remote learners. Research is described that examines and addresses the issues necessary to deliver professional updating electronically to remote learners and targeted industrial groups in a pro-active manner utilising available technology. The relevance of andragogy, experiential learning and constructivism are investigated and the importance of learning styles in the design of CPD material based on user needs is presented. The authors present the rationale behind the development of an Internet-Based Learning approach for CPD and introduce what they believe to be a valid approach for the delivery of CPD and training into the next millennium.

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## INTRODUCTION

The availability, increased use and acceptance of the Internet, combined with increasing pressures on staff and resources and the demand for multi-mode delivery have necessitated a detailed investigation into new learning strategies for electronically supported distance learning [1-3].

Previous experiences of Computer-Based Learning (CBL) and Computer-Aided Learning (CAL) have resulted in a fragmented approach at both Faculty and Institutional levels at the University of Plymouth. These experiences have been replicated across a large number of Higher Education establishments in the UK [4][5]. These unsatisfying experiences for both students and staff have resulted in negative attitudes that have to be overcome before electronically supported learning can be fully integrated into a modern curriculum [6]. A vital requirement for this learning strategy

has been the development of an Institutional approach to electronically supported distance learning, however there was no mechanism in place to achieve debate on this scale and complexity. This has resulted in a bottom up approach, led by Witt and Stone, which has culminated in the Plymouth Internet Learning Lab (PILL). The PILL system is currently being used for a number of research applications, one of the foremost being a collaborative project between the University of Plymouth and the Institute of Marine Engineers to investigate Internet-Based Learning (IBL) and CPD [7].

## THE EVOLUTION OF PILL

Potential users need to see what lies behind a module or short course, to see and understand a logical and complete process at work. Information and guidance need to do more than answer questions and allay fears,

they should be organised in such a way that they provide for and anticipate the needs of users. These processes should be transparent and integrated with the complete delivery system. The name PILL was adopted to indicate the scale of what the developers were trying to achieve. Research found initiatives either claiming to be or aspiring to be a *virtual university* or *campus*. The words *Learning Lab* were felt to be a pertinent metaphor that conveyed:

- a human scale of operation that learners of all levels of experience would feel comfortable with;
- a space equipped with tools for learning rather than being a collection of technology which could be used for learning; and
- an organised and normal environment in which tutors can manage the learning of their students.

The aims of PILL are to:

- be a shop window for electronically supported distance learning;
- encourage the development of distance learning by providing supporting systems for staff;
- reassure potential learners by providing, explaining and demonstrating the support mechanisms built into Internet delivered modules or short courses;
- be a system that can be used for both academic and vocational programmes;
- use technology to link the related functions of the University to provide a quality system without over taxing staff or adding further to bureaucracy; and
- respond to the needs and demand of learners and tutors.

## EDUCATIONAL THEORY AND IBL

A consistent theme is the call for designers and developers of training and education to take account of learners' characteristics, particularly their learning style [8-11]. In the UK, despite significant amounts of Government funding aimed at introducing electronic courseware in to education, progress has been poor [5]. Assistance in identifying learning styles, information about them and opportunities to experiment with less preferred styles should be offered with any course material.

The constructivist approach is particularly suitable for IBL because:

- the act of going online and undertaking a course is a demonstration of activity and self-motivation;
- the requirement for learning to be context and situation oriented can be accommodated by placing

learning in a suitable framework; and

- the use of email, video and online conferencing furnishes a social aspect to learning [12].

Constructivism takes the view that learning is not the same as acquiring unrelated facts. New knowledge must be incorporated into existing knowledge and this is achieved by providing learning which reflects problems in the real world and inducing learners to interact with it.

At present there are many aspects of learning which have yet to be fully understood and, inevitably, further work will be necessary before a universally accepted paradigm is able to emerge. Self-actualisation [13] and Behaviourism [14], for example, share the assumption that the rules and processes of learning are universal. In contrast, Experiential Learning [15] and Constructivism [16] focus on the roles played by individual differences and personal experience.

Kolb's theory of Experiential Learning, utilising the Learning Cycle and the Learning Styles Inventory, was the basis for the work of Honey and Mumford [15][17][18]. They revised the Learning Cycle, developed new learning styles, and constructed the Learning Styles Questionnaire. The Questionnaire is widely used and benefits from being relatively easy to administer and interpret. It has the disadvantages of being lengthy and of only allowing an agree or disagree answer and it is not without its critics, eg [19]. It can, however, give valuable insight into learning styles and underline that learners are not a homogenous group and that different methods of tuition should be considered when designing any kind of learning situation.

IBL requires an educational framework which is able to recognise and accommodate the needs of the individual by taking advantage of the new and unique flexibility which this style of delivery can provide. To do anything less is to ignore the potential benefits of electronic media and would only serve to perpetuate the structure of a classroom or paper-based course by merely swapping one delivery mechanism for another.

In the context of this research it will be necessary to investigate the learning style(s) of marine engineers in order to find out whether, as a group, they favour a particular learning style. This information will enable the provision of suitably presented learning material.

## LIFE-LONG LEARNING

At no time in the past has the development of science and technology been so rapid or so global. It is suggested that the sum total of human knowledge increases two-fold every four years [20]. Consequently, to stay up to date, acquired knowledge must be con-

tinually updated and learning can no longer be seen as a finite requirement [21].

The nature of knowledge has also changed. Employers require individuals to be more productive and adaptable. Increasing competition and rapidly changing technology require employees to have a complex knowledge of underlying principles rather than just the skills to carry out particular tasks. The resultant benefits are transferable skills which can be applied to new tasks and situations. Thus it is necessary that knowledge is increased in both level (upskilling) and breadth (cross skilling) [22]. To enable individuals to participate in life-long learning it is necessary for traditional patterns of learning to be supplemented by more flexible, non-traditional approaches such as IBL.

### PROFESSIONAL DEVELOPMENT

When considering the formation of a professional it is necessary to distinguish between initial training which allows entry into a profession and further training to increase professional knowledge and expertise. During the 1970s a number of terms were in use to describe the learning that qualified professionals undertook [23]. The term Continuing Professional Development (CPD) was used as an attempt to emphasise the link between education and practice, and to underline the fact that learning should be regarded as continuous and integral to the practice of any profession [24].

For an increasing number of professions the concept of CPD is integral to being allowed to continue with practice. For example, nurses are required to undertake 35 hours of study over a period of three years [25]. However, Paechter questions the usefulness of the element of compulsion when it comes to developing the individual [26]. She also regrets the recent *hijacking* of CPD by institutions and feels that often the aim is to produce a safe practitioner or fulfil a corporate need rather than address the requirements of the individual professional.

It has been suggested that the relevance of learning is equally as important as its *voluntariness* [27]. Therefore involvement in CPD must have significance and meaning to the individual. CPD must not require a constant struggle to balance demands on time.

### RESPONSIBILITY FOR CPD

In parallel with a growing need for increased learning there has been a perceptible shift in responsibility away from the state and towards employers and individuals [27][28], although it has been argued that there is little or no role for the employer and that responsibility

lies with the individual alone [29]. However, successful CPD is most often viewed as a partnership between parties, for example the Engineering Council sees roles for the engineer, employers, professional institutions and CPD providers [30]. Hughes looks to Government to provide national policies and incentives [31]. This is supported by the Dearing Report, which calls for a fair and stable proportion of public spending to be directed toward higher education [4]. Higher education is essential to this process as there is a growing interdependence between students, institutions, the economy, employers and the state.

### THE MARINE ENGINEER

The rapid developments which necessitate life-long learning require that professional education must be completely renewed at times during a person's career and it is argued that this is particularly applicable to engineering and technology professionals [32]. There are considerable benefits which flow from continuing education, including:

- increased range and depth of skills;
- improved employment prospects;
- can lead to more qualifications;
- higher self-esteem;
- greater adaptability;
- enhanced mental and physical energy [32]; and
- increased job satisfaction [33].

Encouraging involvement requires the crucial ingredients of motivation and confidence [31][34]. However, it has been suggested that there are four obstacles which prevent participation, namely lack of time, arrogance, fear and laziness [35]. Lack of time needs no explanation. Arrogance can lead to a denial of the need for CPD. Fear is a problem because it can feel dangerous to move into new areas of learning, safety lies in what is familiar and the attempt to acquire new skills, perhaps a language, can lead to a fear of failure. Finally, laziness may be encouraged because overly directed CPD can result in passivity and lack of initiative. However, lack of awareness may also be an obstacle, for example, what is required, where to find it, how to access it.

Successful CPD also needs to be driven by the individual's own needs rather than those of an employer, professional institution, government or CPD provider. Furthermore it must be sufficiently flexible for different people to get different things from the same situation [36]. This is endorsed by Cockett and Geale who stress that individuals may have quite dif-

ferent learning requirements that need to be satisfied [35]. It has been found that teachers were positive towards CPD when it was well planned, relevant to their needs and built upon existing expertise [37]. CPD which did not fulfil these criteria resulted in a *powerful antipathy* to any type of training.

Knowles and Associates have investigated *andragogy*, which they describe as the art and science of teaching adults and have contrasted it with *pedagogy*, the art and science of teaching children [38]. Pedagogy assumes the following about the learning situation:

- the teacher will decide how, when and what will be learned;
- the experience of teachers, experts etc is valued, not the experience of the learner;
- learning is a matter of progression through stages;
- learning is based on acquiring  $x$  amount of knowledge about specified subjects; and
- the learner is responding to external pressures, eg parents, teachers, peers.

In contrast, andragogy assumes the following:

- the learner is self-directed, therefore decides how, when and what will be learned;
- the experience of the learner is valued as a rich resource, eg in group discussions;
- learners will be motivated by a need to improve an area of their life. This may occur naturally through a life event such as unemployment or bereavement, or may be *induced* by encouraging career planning or exposure to role models;
- adults enter education to enable themselves to carry out a task, solve a problem or for their own satisfaction; and
- external motivators such as salary, promotion (and maintenance of professional registration) may motivate learning, but internal needs like increasing self-esteem, self-confidence, quality of life and self-actualisation are likely to be more potent.

Knowles views these as parallel models, not as competing paradigms. It is envisaged that, on occasion, adults may benefit from the pedagogic framework, for example when confronted with a totally new piece of equipment where learning can only be based on a plan formulated by a teacher. More frequently, however, it is appropriate for a facilitator to involve the learner in diagnosing their own learning needs, planning their learning, setting objectives and evaluating the outcome of learning.

One of the difficulties a learner may experience is

that s/he is likely to be accustomed to learning via the pedagogic model, whereas CPD requires an andragogical approach, ie self-directed, motivated, etc. The marine engineer is made responsible for his or her own learning in that they must choose to keep updated, must choose how and what to study and do not have to achieve specified goals. There is a contradiction here as the marine engineer is expected to make these decisions, yet the requirement to undertake CPD is imposed from outside.

## CURRENT PROVISION FOR MARINE ENGINEERS

Marine Engineers who wish to undertake formal education as part of their CPD can elect to attend a college or university. Events appropriate for CPD may also be offered by professional institutions, a supplier or customer, employer or specialist training provider. Choice will be constrained by geographical considerations unless a distance learning course is chosen.

There is concern that CPD may focus attention on formal courses and overlook the role of informal learning such as discussions with colleagues and reading books and journals. It has been found that such informal learning is widespread amongst professionals, though often it is not recognised as CPD by the individual concerned [39].

## THE PROFESSIONAL INSTITUTIONS

The history and development of professional institutions has always been centred on the promotion of learning and professionalism [30][31]. However, until recently professional development has been in response to the need of the moment rather than following any cohesive framework [39]. According to Todd such an *ad hoc* approach results in:

- selecting CPD almost on impulse without considering needs;
- not keeping records; and
- time and money spent on potentially valueless CPD which may not even be remembered [23].

During the last decade there has been a burgeoning of CPD policies amongst the institutions, which tend to follow either the Sanctions Model or the Benefits Model [40]:

- The Sanctions Model places emphasis on mandatory CPD monitored by an institution, which will apply sanctions for non-compliance. CPD is about achieving targets and maintaining technical knowledge and skills.

- In the Benefits Model, participation is ensured by the achievement of rewards rather than the threat of punishment. CPD is a voluntary activity and is about learning, self-development and increasing expertise.

The Engineering Council is very much in favour of CPD but has chosen not to lay down specific requirements perhaps because of an awareness of the tension between compulsion and voluntariness. The Council is conscious of the need not to be seen as policing CPD, though a monitoring role is regarded as legitimate. It also aims to stress the importance of the process rather than the actual amount. In accordance with this philosophy the Engineering Council has chosen a third approach and made CPD an *obligation* rather than voluntary or compulsory. This places responsibility on the individual and compliance is necessary for those applying for or changing registration.

Some institutions are more explicit in their requirements and ask for a specific number of hours to be undertaken; for example the Institute of Marine Engineers makes a general recommendation of at least 35 hours CPD per year. This may be contrasted with the British Computer Society, for example, which requires its members to undertake 20 CPD units per year [29]. Guidance is given on what constitutes a unit, for example:

- examined or assessed courses of study = 1 CPD unit per hour;
- attendance at a lecture or seminar = ½ CPD unit per hour; and
- production of a professional paper = 5 CPD units.

A record of CPD must be submitted annually and, provided it is adequate, a Certificate of Achievement will be issued.

Some institutions have yet to decide which route to follow; for example, the Chartered Institute of Public Finance and Accounting is currently seeking feedback from members to help them choose between models [41].

Cockett and Geale question whose CPD needs are being met [35]. Is it those of the employer whose commercially led approach is primarily aimed at anticipating future workplace needs? Is it the professional body who, by stating precisely the amount and form of CPD, emphasise the process rather than the outcome? In some cases it might appear that development of the professional is of secondary importance, a mere by-product of the activities of employer and institution. They propose a *career development model* concerned with balancing the needs of employer and professional institution but giving a central role to the individual's

own requirements. It takes account of both process and outcome. Motivation, awareness and support are seen as critical elements in shaping patterns of CPD. Very prescriptive CPD is felt to encourage a passive attitude. Self-assessment and personal goal setting is used to encourage *ownership* of CPD. Tools for self-assessment include learning styles, portfolios, career planning, learning logs, mentoring and networking. This model is currently being used to promote CPD amongst a group of young professionals and appears to be having a beneficial outcome.

## A EUROPEAN PERSPECTIVE

The Fédération Européenne d'Associations Nationales d'Ingénieurs (FEANI) was formed in 1951 to promote the interests and educational standards of European engineers. Those who are appropriately qualified and experienced may apply to be registered as European engineer (EurIng) to facilitate working in other countries. The EurIng initiative should be complemented by the work of the European Society for Engineering Education Working Group on Continuing Engineering Education, which is developing a European Professional Record of Achievement (EuroRecord). This is a pilot project examining methods of standardising the language and structure of career planning, learning achievement and professional development of engineers [42].

## THE ENGINEERING COUNCIL

The Engineering Council is the national organisation of the 290,000 engineers and forty professional institutions in the United Kingdom. It is responsible for setting the standards required for registration as a Chartered Engineer (CEng), Incorporated Engineer (IEng) and Engineering Technician (EngTech).

A policy statement of pathways to professional registration, known as Standards and Routes to Registration (SARTOR) Third Edition, was published in 1997 and updated in 1998. The process comprises of:

- Stage 1 - Educational Base
- Stage 2 - Initial Professional Development
- Stage 3 - Professional Review

The Educational Base involves the completion of a course of accredited academic study. It is followed by Initial Professional Development (IPD), a period of education, training and personal development which takes place whilst in employment. After IPD, a Professional Review will assess competence and commitment to the profession. Commitment to maintaining professional competence will be based on evidence

drawn from the quality of Initial Professional Development records and Action Plans for post-registration professional development. Though no specific number of hours are required, Rule 3.1 of the Code of Conduct places an obligation on the registrant to be competent and have the time and authority to undertake work, and Rule 8.1 requires the maintenance and development of competence and knowledge [33].

The Engineering Council requires professional institutions to operate within a framework of requirements for CPD [43]. The main points being:

- CPD must be part of the institute's mission;
- a CPD policy must be established, resourced and reviewed;
- aims, importance and benefits of CPD must be promoted to members; and
- guidance, support and recognition should be provided.

The Engineering Council also provides a Code of Professional Practice which requires registrants to take responsibility for, and self-manage, their own CPD and to support others with their CPD.

## THE INSTITUTE OF MARINE ENGINEERS

The Institute of Marine Engineers (IMarE) is a professional institution and learned society for those working in all fields of marine related engineering. It has 16,362 members in both the United Kingdom and overseas. As an authorised and nominated body of The Engineering Council it is licensed to assess candidates for registration as CEng, IEng or EngTech, as appropriate.

IMarE requires a Professional Review for those who wish to become a Fellow, Member or Associate Member of the Institute whether or not Engineering Council registration is also required. In line with the Engineering Council's directives, the applicant must show, amongst other things, a commitment to CPD. IMarE produce their own guidelines for this, offering advice on identifying needs, appropriate activities, quantity and recording [44]. The exception to this is for marine engineers appearing on Register A of the Small Ships Group, who are required to participate in monitored CPD [45]. A minimum of 35 hours per year is suggested, the content of which should be decided by the marine engineer in consultation with any employer. However, it is not clear whether or how this will be monitored and, if necessary, enforced as commitment to CPD is assessed at *professional review* when professional registra-

tion takes place. If the institutions are successful in creating a *culture of CPD*, this should be sufficient. However, it is not apparent that this has been achieved, thus a continuing commitment can not be assumed.

It is recognised that specifying a number of hours is input-oriented and it is anticipated that the objectivity of employers or mentors will be means of focusing on outcomes [46]. Activities do not have to be examined courses but can include non-assessed activities such as attendance at conferences, seminars, short courses, meetings or undertaking reading, coaching, mentoring, and writing papers. Suggested subject areas are technical/scientific, commercial/business and personal effectiveness/communication skills.

CPD may be accessed via open learning (eg the Open University), distance learning (videos, workbooks), *on-the-job* training and attendance at another location. Courses may be provided by in-house training, specialist training providers, professional institution, academic establishment, suppliers and customers. A programme of workshops and seminars is also run by IMarE.

## EMPLOYERS' PERSPECTIVE

Whether they are aware of it or not, employers are primarily motivated to develop CPD in accordance with business needs [35]. This is supported by James who believes they are driven by the desire for improved performance and cost effectiveness [36].

The Dearing Report would like to see an increase in employers' involvement and argues for greater financial support for training of employees [4]. However, it is suggested that employers are now distancing themselves from involvement in CPD.

A number of British ship owners and managers are represented by the Chamber of Shipping, which has sponsored several investigations into the current offshore maritime skills base. It found that British seafarers, including engineers, are an ageing workforce with over 70% retiring during the next 20 years [48], and demand for them to work ashore will deplete the population still further [49]. Therefore, the UK's highly qualified, highly skilled maritime workforce will become a dwindling resource unless replaced.

## GOVERNMENT PERSPECTIVE

Since the early 1980s, it has been increasingly recognised by government that the need for a skilled and flexible workforce could not be satisfied by new workers entering employment for the first time [50]. As a consequence, there has been increasing interest in

promoting the concept of life-long learning.

The Department for Education and Employment (DfEE) has recently produced a Green Paper, *The Learning Age: a Renaissance for Britain*, which is a consultation document on all matters relating to life-long learning [51]. It recognises the need to create a *culture of life-long learning* and acknowledges that the CPD schemes of professional bodies are already contributing to this. The Green Paper proposes that individuals should invest in their own learning to improve their employability, professional competence, and earning potential. It also states that Employers will continue to have responsibility for investing in the job and career-related training of their employees, although some public funding of employee training may be justified to promote broader learning and portable qualifications where this benefits the economy.

The Government's commitment to life-long learning is largely endorsed by the Engineering Council. However, it questions the emphasis on formal learning and doubts the efficacy of merely requiring employers to make their contribution rather than using incentives or compulsion [52].

## EDUCATIONAL INSTITUTIONS

The former polytechnics have a long history of involvement in the provision of vocational and professional courses and now many of the *old* universities are responding to the current growth in CPD [53]. It is important that learning providers do not make assumptions about what is required but ascertain the needs of the individual [34].

In doing so the higher education sector should be moving towards the provision of diverse, modular and flexibly delivered forms of continuing education [54]. It must also satisfy the requirements of employers, which include, amongst other things, the use of distance and open learning strategies involving a mixture of presentation methods from local, national and international sources. The DfEE notes that education providers need to research new and flexible methods of delivery which it feels will play a vital role in providing cost effective learning [55].

## INTERNET DELIVERY OF LEARNING

Recent decades have seen an exponential growth of the Internet and this trend, facilitated by the development of the World Wide Web, is expected to continue. It has brought with it a revolution in the transmission of graphical, non-graphical, audio and video communications. Users are able to obtain incredible amounts of information which can be accessed with complete

geographical and temporal flexibility.

The flexibility of the Internet has the potential to fit well with the philosophy and delivery of open and distance learning in that it can provide individualised, cost effective and time effective student-centred learning. These advantages have to be balanced against the frustrations of having access to the necessary hardware and software, delays and breakdowns on the Internet and the potentially frustrating nature of hypermedia.

Learning providers have the opportunity to supply courses to a world wide student body which are quickly and easily updateable and cost efficient. The geographical spread of learners and the availability of Web-based resources will ease pressures on existing campus-based resources and alleviate the need to increase provision of the same.

The challenges to be met to deliver IBL for CPD centre around the need to determine and apply sound theoretical principles to the design of learning packages.

## CONCLUSION

To encourage a culture of CPD, professionals must be made aware of the potential benefits, but it must be recognised that those who wish to participate have obstacles to overcome, for example competing demands on time, fears of taking on something new and taking responsibility for organising CPD. These are problems with which employers, government, professional institutions and CPD providers can help.

Employers need to recognise that their needs do not necessarily coincide with the needs of their employees but a process of negotiation can facilitate support and objective assessment of what is required. The UK Government has stated its conviction that life-long learning is essential to the creation and maintenance of a skilled and flexible workforce. It anticipates that initiatives such as the creation of Individual Learning Accounts will help to achieve this [51]. For the professional institutions the question of compulsory, voluntary or obligatory CPD must be addressed and the implementation of procedures and policies which will both guide and encourage members' participation is required. Finally, as the issues of relevance and accessibility are pertinent, CPD providers should be investigating what CPD is required and how it can be flexibly delivered.

The Internet provides a number of new forms of communication which are increasingly used for commercial and educational purposes. The adaptability offered provides the potential for the development of a valuable vehicle for the transmission of distance and open learning. In this respect, however, there are nu-

merous drawbacks as well as benefits which need to be considered when a learning package is being developed. Educational theory also needs to be taken into account when determining the design of such packages. IBL should bring about changes in the way that learning is constructed and controlled and it is likely that this will have implications for existing and new educational institutions.

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Dr Neil Witt is presently Senior Lecturer in Navigation Systems at the Institute of Marine Studies, University of Plymouth. His main areas of interest are marine communication systems, GMDSS, guidance and tracking systems, marine information systems and marine education

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