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The provision of continuing professional development in the natural sciences at the University of Stellenbosch

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Continuing professional development (CPD) gains relevance and prominence in a global society characterised by constant change and a consumer-driven market economy. Competence, accountability, professionalism and lifelong learning are concepts currently requiring professionals to improve their expertise continuously. This article reports on the providers and the provision of CPD within a particular professional field, namely the natural sciences in higher education. The findings are based on the literature and a qualitative study conducted in the Faculty of Science at the University of Stellenbosch, South Africa. This mapping of the provision of CPD will provide an insight into current practice within the field, which could assist in determining future initiatives.

Kartering van die verskaffing van voortgesette professionele ontwikkeling in die natuurwetenskappe by die Universiteit van Stellenbosch

Voortgesette professionele ontwikkeling (VPO) verkry relevansie en prominensie in 'n wêreldgemeenskap wat gekenmerk word deur konstante verandering en 'n verbruikersgedrewe markgerigte ekonomie. Bevoegdheid, toerekenbaarheid, professionalisme en lewenslange leer is konsepte wat tans professionele persone lei tot die voortdurende verbetering van hul kundigheid. Die navorsing binne hierdie artikel rapporteer oor die verskaffers en die verskaffing van VPO binne 'n spesifieke professionele veld, naamlik die natuurwetenskappe in hoëronderwys. Die bevindinge is gebaseer op literatuur en 'n kwalitatiewe studie wat in die Fakulteit Natuurwetenskappe aan die Universiteit van Stellenbosch, Suid-Afrika onderneem is. Kartering van die verskaffing van VPO sal insig bied in die huidige praktyk daarvan binne hierdie veld en sal sodoende help om inisiatiewe vir die toekoms te bepaal.

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Continuing professional development (CPD) is gaining increasing relevance and prominence in our global society, characterised by constant change and a consumer-driven market economy. Competence, accountability, professionalism and lifelong learning are concepts that continuously inspire professionals to improve their expertise. Increasing academic requirements in the higher education workplace require academic staff to be highly qualified (cf McDonald 2001, Kachingwe 2000, Cobb 1999).

Professional development does not take place in a vacuum (Kutner & Tibbetts 1997) but requires the support and involvement of the state, providers, organisations and individual professionals. Novikov (1999) deems a unified educational domain necessary for continuity in CPD. This can only be achieved by means of organised co-operation among the various stakeholders. Providers of CPD play a decisive role in its success and therefore form an integral component of any investigation into its practice. An integrated model of academic professional practice in higher education is implied, involving the lecturer's roles: teaching, research, community service and administration. This is in contrast to a one-dimensional model, in which the academic practitioner would focus on only one of these roles and develop linearly within it. McDonald (2001), Kachingwe (2000) and Cobb (1999) point out the difficulty involved in developing, integrating and balancing these roles and responsibilities in practice. Does the provision of CPD influence lecturers' professional development in this context?

The research investigated the role of providers of CPD within a particular professional field — that of lecturers in the natural sciences in higher education. The article considers providers in terms of the formal, informal and commercial sectors and discusses the provision of CPD in terms of the four main paradigm shifts that currently guide its provision. The findings are based on the literature, relevant documentation and a qualitative study conducted in the Faculty of Science at the University of Stellenbosch (US). The purpose of the article is to investigate the CPD offered to lecturers in the natural sciences at the US in order to conceptualise CPD provision. Mapping the provision of CPD will provide insight into current practice, which could help to determine future initiatives.

1. The literature

Costley (2001: 58) refers to professional intellectual capital as the most important factor affecting an organisation's success. Most resources are invested in the first three to six years of a professional's education but little systematic thought is given to what happens in the following 40 years of professional practice (Cervero 2001, 2000). CPD addresses this problem, but several critical issues remain if CPD is to fulfil its potential as an agent for change and improvement. It still lacks a unified, well-developed system of delivery. It is commonly characterised by programmes that merely aim to update professionals on the latest developments, and transmit knowledge in an ineffective manner. Such programmes are offered by a pluralistic group of providers who do not work together in a co-ordinated fashion. Furthermore, individuals' learning patterns vary considerably — depending on their profession, the location of their workplace and their opportunities for participation in CPD (Cervero 2001). It is thus prudent to consider the "who and how" of CPD provision as a background to the specific study.

1.1 Who provides continuing professional development?

Costley (2001), Knox (2000) and Teichler (1999) identify three main types of CPD providers, namely the formal sector (including the state and higher education), the informal sector (for example, professional associations) and the commercial sector (such as private enterprises that provide education for profit). These providers and their programmes differ in their definitions of an educational strategy, their scientific and technological potential, their clientele, their sources of finance, the nature of their training and the type of certification they offer (Teichler 1999).

1.1.1   The formal sector

At the state level key decisions are made that determine the structure and sometimes even the content of CPD activities. Kutner & Tibbetts (1997) describe state support as the allocation of sufficient resources for professional development and monitoring of CPD programmes and providers according to set standards. The central government's strategic control of, or influence upon, higher education has been increased through earmarked or performance-based funding systems, reporting requirements and the establishment of statutory and consultative bodies within the

South African higher education context (US 2000). This state power has far-reaching implications for South African higher education institutions in terms of the provision of CPD initiatives. Various government bodies exert an influence within this power relationship between the state and higher education. The state's influence on CPD should therefore not be underestimated, especially in the South African context. No CPD initiatives within higher education can succeed unless they take national authorities and current legislation into account.

Within the South African context several legislative measures have been passed in the last decade which have had a profound effect on CPD. The SAQA Act of 1995 resulted in the establishment of a National Qualifications Framework (NQF) which regulates all qualifications and accredits programmes and short courses. The White Paper on Higher Education (RSA 1997), the National Plan for Higher Education (RSA 2001), and the Department of Education (DoE) emphasise capacity development in higher education as a strategic goal for the South African higher education system. Strategies for capacity development in higher education include effective postgraduate supervision and support for new researchers and supervisors (Council on Higher Education 2004). Within the broader legislation, the Skills Development Act 97 of 1998 (RSA 1998) ensures the quality of education and training in and for the workplace, including lecturers as a central component of the higher education workforce. Sector Education and Training Authorities (SETAs) encourage partnerships between the public and private sectors of the economy as well as co-operation with the South African Qualifications Authority (SAQA), by establishing an institutional and financial framework (RSA 1998).

These legislative developments have far-reaching implications for institutions such as universities, as employers of a professional workforce, since they force such institutions by law to make provision for the continuous development of their employees. It may be difficult to translate all learning that takes place into measurable output, as much of it is self-directed, self-initiated and informal. Accordingly, not all aspects considered as CPD will be taken into account in the system.

Higher education institutions are not only the workplaces of lecturers and researchers, but also important providers of CPD. Universities are described as democratic institutions that allow their members substan-

tial operating freedom, while providing them with a safety net of quality control. A university should not be merely a provider of knowledge, but rather a facilitator and referee of learning (Costley 2001: 63, Knox 2000: 13). The traditional higher education model provides the bulk of learning in the pre-service period, but the changing landscape in higher education and the limited funding available for new strategic plans. Organisational culture — as a learned and socially constructed pattern of thought — has a determining effect on the provision of CPD in higher education (Grzyb *et al* 1998: 9). Academic support services are often required to create infrastructure and opportunities by means of which staff can enhance their expertise (Council on Higher Education 2004). There is a need for CPD that is work-based, part-time, qualification-seeking and repetitive, with learning consisting of a range of deliberate, purposeful and systematic events (Liu & Wan 1999).

Higher education has made significant contributions to the field of CPD, even though it did not previously have a clear strategic or proactive role in the continuing professional development of its employees (Mott 2000, Teichler, 1999). The challenge lies in the ability to organise the uncertainties, involve all the role-players and seize opportunities (Liu & Wan 1999: 458). It is therefore important also to consider the informal and commercial CPD provision sectors.

1.1.2   The informal sector

CPD is often the major or primary function of professional associations (Cervero 2000). The educational functions of such associations are complementary to initial education. Professional associations broaden the theoretical knowledge gained in the initial stages of education in order to make it applicable to daily operational problems (O'Rourke 1997: 4). They offer the benefits of affiliation, an extensive support system and opportunities for both networking and professional development (Florez 1997: 4). It is therefore important that institutions of higher education strengthen their bonds with these associations in order to offer preservice learners better preparation for actual practice and to avoid duplication in CPD programmes for professionals seeking help from both parties (O'Rourke 1997: 4).

1.1.3 The commercial sector

The role of the commercial sector in higher education is multi-faceted and has a widespread influence in the provision of CPD (McDonald 2001: 34). The commercial sector includes private organisations either directly involved in providing CPD, or indirectly involved by providing scope and/or funding for collaborative projects between academe and industry, supplying jobs to newly qualified professionals or providing advice on academic practice from the perspective of private practice.

There are various examples of commercial involvement in CPD in the higher education sector. A number of international organisations, in collaboration with government organisations such as the National Research Foundation (NRF), have been involved in education and training. The Technology and Human Resources for Industry Programme (THRIP) is a joint venture between industry, research institutions, educational institutions and government. It supports the development of technology and appropriately skilled people for industry in order to promote South Africa's global competitiveness. The focus is on collaborative research in the areas of science, engineering and technology (SET) (NRF 2004). The NRF also supports CPD through the Thuthuka Programme in order to contribute to and create synergy between various initiatives (NRF 2004).

The challenge to CPD lies in co-ordinating learning programmes and providers effectively and gaining the support of all stakeholders (Knox 2000: 18). This would result in active contributions from all parties concerned and promote meaningful learning for professionals.

1.2 How is continuing professional development provided?

How CPD is provided is determined by both the historical educational legacy and current educational demands (Novikov 1999). The type of CPD offered is determined by the paradigm within which the organisation works. Lee (2001: 4) identifies four major paradigm shifts in CPD that currently have an influence on its provision. These are: a change in emphasis from the transmission of knowledge to experimental learning; a development from reliance on existing research findings to an examination of one's own practice through reflective practices; a move from individually focused learning to collaborative efforts, and a shift from mimicking best practice to problem-based learning and practice. The provision of CPD will now be discussed in terms of these paradigm shifts.

1.2.1 Providing CPD that encourages experimental learning

Florez (2001: 2) states that the field of education experiences difficulties in the provision of CPD as there is such a range of programme types, financial resources are limited, and varied policies and requirements exist for professional accreditation or certification. CPD educators cannot rely simply on the foundations of adult learning theory, but have to seek new, resourceful ways to present programmes effectively and to motivate their learners. There is no standard format for CPD programmes and the context of implementation is crucial (cf Healey & Lawler 2002, Kutner & Tibbetts 1997). Programme designers (and facilitators) need to pay attention to the learners, the facilitators, the physical environment, the policies, the resources, the organisational culture and structures, the history of CPD within the specific context, and the community (Lee 2001: 4).

Experimental learning is one of the ways in which CPD can be contextualised. It can be explained by means of Kolb's Experiential Learning Model (Kolb 1984), where it features as the last of four learning cycles. As part of learning, experimentation is preceded by concrete experience, reflective observation and abstract conceptualisation. This paradigm shift requires not only content knowledge, but also knowledge of how people learn, knowledge of the learners themselves, and the knowledge of the context in which they practise their profession.

1.2.2 Less reliance on existing research findings, more critical self-examination

Critical self-examination requires professionals to reflect on questions in a systematic and deliberate manner over time (Florez 2001). Ferraro (2000) and Steinert (2000: 46) advocate reflective practice, defined as a critical process in refining artistry in a specific discipline, as beneficial to both pre- and in-service educators for professional development. It involves thoughtfully considering one's own beliefs and experiences in applying knowledge to practice, while being coached by professionals in the field. Florez (2001: 4) describes the reflective process as the collection of descriptive data from a variety of sources — such as a learning diary, comments from peers and colleagues, and theoretical literature — to gain a balanced picture of practice. The method requires commitment and professionals should be given time to experiment and master it, as it may be emotionally challenging. The process becomes a continuous cycle of self-

observation and self-reflection. The goal is not to address a specific problem, but rather to observe and refine practice in general and on an ongoing basis. Reflective practice can lead educators to a deeper understanding of their own style and effectiveness in education. Other benefits include flexibility, immediate usefulness and sustainability. It also promotes professionalism, as it calls for the ongoing exercise of intellect and responsibility (cf Florez 2001, Ferraro 2000, Kachingwe 2000).

Evans *et al* (2002) propose the use of personal learning plans in conjunction with portfolios and mentoring as effective means of self-reflection and self-directed learning, contributing to effective CPD evaluation. A personal learning plan is effective in terms of its flexibility and personal relevance. It leads to changes in knowledge, practice and professional development (Evans *et al* 2002: 83).

1.2.3 A move from individually focused learning to collaborative efforts

Reflection in isolation does not, of course, ensure that individual professionals have the support and encouragement to implement changes in practice (Hart *et al* 2000: 39, Kachingwe 2000: 32). Reflective dialogue enhances opportunities for meaningful interaction and encourages professionals to provide support by observing, sharing ideas and skills and recommending materials for study (Steinert 2000: 46, Kutner & Tibbetts 1997). Collaborative efforts improve productive focus and create an environment that contributes to meaningful learning. Reflection can take place collaboratively through mentoring, peer coaching and evaluation, discussion of professional literature, analysis of practice exemplars, case studies and the creation of professional learning communities (cf Lee 2001, Kachingwe 2000, Knox 2000).

Interactive sessions are more successful than lectures in creating sustained interest and active participation, input and eventual learning (Odini 1999: 102). Workshops, seminars, conferences and presentations are commonly used in CPD as collaborative initiatives (cf Steinert 2000, Kutner & Tibbetts 1997). Evans *et al* (2002: 79) and Odini (1999: 103) do not consider compulsory attendance at such events a viable alternative to effective CPD provision, as the learner continues to be dependent on someone else's agenda for desirable learning, which limits the potential for the application of learning. Kachingwe (2000: 31) distinguishes

between learning and participation. Learning refers to the process by which cognitive changes occur in the mind. Participation is an activity that has the potential to produce learning, but does not guarantee it. Kutner & Tibbetts (1997) further emphasise the importance of active participation in needs assessment and the design and implementation of learning activities. The US Personnel Development Policy (1999) stresses the value and necessity of active participation in all CPD initiatives.

Computer-supported collaborative learning can enable professionals to pursue self-managed, independent learning through collaborative interaction. Web-based learning is a cost-effective option and facilitates interactive and follow-up procedures (via Internet chat rooms, teleconferencing, or e-mail). Listservs offer an opportunity to share information via an e-mail forum, and can create a supportive, collaborative and experience-based learning environment. Facilitators need to be highly trained to ensure optimal use and development of computer-supported CPD programmes. The majority of online programmes, however, are still instructor-led, with text-based reading and few interactive learning opportunities. Learners may also be resistant to e-learning because of a lack of direct interaction, or due to reservations about programme quality, security issues or inadequate technological skills. But, as technology-based resources have become necessary tools for conducting business, it is imperative for e-learning to find its place in CPD as well (cf Steinert 2000, Florez 1997).

1.2.4   A shift towards problem-based learning and practice

Castle *et al* (1998: 329) cite three major models in the provision of CPD in practice: the pre-technocratic or apprenticeship model, the technocratic model and the post-technocratic model. Nowlen (1988), as quoted in Mott (2000: 25), draws a different distinction, namely between the update model, the competence model and the performance model for the provision of CPD. There are various similarities between the two approaches and they will therefore be discussed in an integrated manner.

The pre-technocratic model has an instrumental focus, with restricted contributions from educational institutions. It is primarily applicable to the initial stages of professional development (Castle *et al* 1998: 329). This model corresponds to the update model discussed by Mott (2000: 25). Its central aim is to keep professionals updated, but it fails to incorporate the subjective, social aspects of knowledge into the professions.

The technocratic model has become the predominant form of CPD for a wide range of professions in recent years. Its curriculum involves a systematic knowledge base, the application of this knowledge base to professional practice, and supervised practice in the workplace. This model is typical of situations where organisations have control over curriculum content and assessment. Fragmentation of the curriculum due to the separation of theory and practice is its major limitation. Practice components, as well as problems encountered in practice, are often marginalised rather than integrated with theory (Castle *et al* 1998: 329). The technocratic model is similar to the competence model discussed by Mott (2000: 24). The goal of this model is to develop curricula built on the competence required in specific work settings by means of a combination of current relevant knowledge, self-image, and self-directedness. It provides a more complete picture of what good practice entails than the update or pre-technocratic model, but it does not take the larger interdependent systems (such as social, political or organisational systems) into account. This characteristic corresponds to the fragmentation evident in the technocratic model.

The post-technocratic model emphasises professional competence through the experience of practice and systematic reflection on that practice. Competence involves the performance of work activities that are complex, technical, specialised and professional, including design, planning and problem-solving, with a significant degree of professional accountability. Partnerships between the educational institution and the learner/professional form a central component of this model. It also emphasises assessment that is performance-based, encourages access, accredits prior learning and allows the learner a wider choice of learning modes (Castle *et al* 1998). This model is very similar to the performance model (Mott 2000: 25), which takes into account the specific professional, the complex networks of interdependent systems surrounding professional practice, and the interaction between them, as well as emphasising critical self-assessment through reflective practices.

These different models are all used in CPD initiatives. The ideal would be to progress to the post-technocratic or performance model, but this is not always possible within the aims, purposes and limitations of various CPD initiatives. Multiple, integrated approaches that address the complex and ever-changing characteristics of a programme and clients'

identified needs are more suited to the current educational reality. Needs assessments identify ways of improving instruction and/or a programme, individual learning preferences and preferred approaches to CPD, and gaps in existing CPD (Kutner & Tibbetts 1997). Needs assessment should be followed by co-ordinated programme development that fosters critical reflection and meaningful collaboration. This should be sustained over a long period and form a coherent whole. A comprehensive professional development plan can help to attain a balance between individual learning needs and preferences and organisational programme goals (cf Knox 2000, Kutner & Tibbetts 1997).

These paradigm shifts influence the manner in which CPD is provided.

2. Methodology

The research is focused within the interpretative paradigm and aims to present a descriptive analysis of the CPD offered to university lecturers in the natural sciences (cf Henning *et al* 2004). An understanding of CPD was sought from university lecturers' point of view by means of semi-structured interviews and a mostly open-ended questionnaire. Both these measures included questions on the providers and the forms of provision of CPD utilised by the respondents. Babbie & Mouton (2001: 233, 289) propose both interviews and questionnaires as suitable methods in a qualitative descriptive investigation. The questionnaire was designed to support and check the data obtained through the interviews in order to achieve triangulation and improve the quality of the analysis. Grounded theory methods provided a flexible strategy for data analysis.[1]

A purposive sample was drawn for the interview phase. It comprised eight respondents chosen for their expertise relating to CPD within higher education. The total target population for the questionnaire comprised the 119 permanently employed academic staff members of the Faculty of Science at the US.

This population was divided into five main categories: junior lecturer, lecturer, senior lecturer, associate professor and professor. A stratified random sampling technique (Babbie & Mouton 2001: 191, Gay 1987: 107)

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1   Henning *et al* (2004), Babbie & Mouton (2001) and Strauss & Corbin (1998) were used to inform this study.

was used to select the sample in such a way that the subgroups iden-
tified according to post level were equally represented in the sample. The
strata therefore included all levels of expertise, with post level as an
indication. Ten respondents were randomly selected from each stratum,
except for the first (junior lecturer), where only four possible respondents
were present, of whom all were selected. There were therefore altogether
44 randomly selected respondents (36.97% of the total population of
119). A response rate of 65.91% was obtained and 24.37% of the total
target population participated in the study. Gay (1987: 114) recom-
mends a minimum sample size of 10% of the total target population for
a descriptive study, while Babbie & Mouton (2001: 261) suggest five to
twenty-five respondents as a sufficient number of respondents in a qua-
litative study at this level.

Investigation of formalised structures of CPD, such as those found
in the fields of psychology and medicine, contributed to its internal
validity. The qualitative nature of the study limits generalisation of the
results to other professions, but the sampling methods ensure that the
results are applicable to the specific population of university lecturers.
The qualitative methods and sampling procedure thus support external
validity within the specific population. The supporting literature studied,
the information obtained by means of in-depth interviews and the pilot
testing of the interview schedule and questionnaire helped to ensure
relevancy and clarity. The research design and methodology aimed to
make the study replicable and therefore reliable. Bias was avoided by
means of a well-planned sampling strategy and the study of relevant recent
literature to guide the construction of the interview schedule. The ques-
tionnaire was pilot tested and standardised to limit instrumentation bias.

3. Results and discussion

3.1 Who provides continuing professional development?

3.1.1 The formal sector

The influence of the state on CPD provision is most evident in the ac-
tivities of the NRF. The fact that many respondents in the study mentioned
that they were involved in NRF initiatives, or had received funding from
the NRF for research projects, demonstrated further NRF involvement.

Responses indicate that the Thuthuka Programme has borne some fruit in the context studied. This Programme was initiated by the NRF to position young South African academics strategically. Its initiatives aim to ensure that young researchers become significant players in the National System of Innovation (NSI) and that they eventually qualify for NRF rating. The programme is specifically aimed at women, black, and young researchers in the areas of science and technology, as they remain under-represented in academic positions, especially at senior levels (NRF 2004).

The Research Capacity Development (RCD) Strategy is another NRF initiative. It focuses on establishing physical or virtual centres of research excellence where leaders in a specific field can sustain and improve their expertise, while mentoring and developing young researchers (NRF 2004). An example of such a centre of excellence is the Centre for Invasive Biology in the Faculty of Science at the US.

The NRF is a research-focused organisation and its CPD provision will therefore be aimed at research development. From responses no evidence could be found of state involvement in the provision of CPD focusing on the other roles of a lecturer. It is here that higher education, as a part of and a partner in the formal sector, becomes an indispensable CPD provider.

Management plays a key role in the provision of CPD in higher education, as it promotes collaboration between various stakeholders and makes decisions about provision (cf NRF 2004, Kutner & Tibbetts 1997). The respondents in the present study indicated that lecturers value active managerial support for the reward and funding of excellence and innovation. The Personnel Development Policy of the US (1999) emphasises the importance of senior management's commitment to CPD, including the allocation of a budget for developing potential, the creation and maintenance of an infrastructure for development, moral support for CPD initiatives, opportunities for study leave, and the establishment of a system that encourages and rewards CPD. The US's Research Management Plan (2003) furthermore envisions the sustainable development of academic staff in the specific area of research, by placing a premium on appointing, promoting, retaining, supporting and rewarding academic staff for excellence.

CPD provision to support integrated practice in higher education remains problematic. McDonald (2001: 35) states that the minority of CPD educators possess dual qualifications in both their specific discipline and

the field of education. This dilemma emerges in the present study as an inability to interpret and apply qualitative research within practice, especially in the natural sciences environment, where such research is not commonly used. Consequently professionals may need guidance in this field, as qualitative research informs much of the body of knowledge in teaching development. Any form of guidance should, however, be approached with care, as these professionals are experts in their own subject areas who may find it unsettling to confront their ignorance in another field. The professional identity of the CPD educator is also important, as this response from a lecturer indicates: "[…] you are going to get the message most effectively to people if it comes from people within the faculty."

Most of the target population for this study had doctorates in the natural sciences. A member of the faculty would typically have a qualification on a similar level in the natural sciences, ideally within the same discipline. Small group sessions with a team of presenters, including subject specialists, would seem the most effective means of providing CPD within this professional arena. However, academic support centres remain indispensable in terms of generic knowledge and skills input. The role of such centres in creating and facilitating opportunities should not be underestimated. Academic support services provide CPD in regard to lecturers' teaching practices. The US has created the Centre for Teaching and Learning (CTL) with the intention of facilitating opportunities for the continued professional development of academic staff in terms of teaching. The Professional Educational Development for Academics (PREDAC) orientation programme for newly appointed lecturers, needs-based workshops, consultations, advice on the compilation of a professional portfolio, and student feedback are examples of the support services offered by the Centre (US 2004).

Alternative provision strategies could be considered, to suit specific CPD needs in terms of teaching development such as grouping subject areas with a common interest in and approach to teaching. One participant suggested collaborative grouping of Biology, Microbiology, Biochemistry, Botany and Zoology; Physics and Chemistry; Mathematics, Statistics, and Computer Sciences. Shadow work with successful researchers and lecturers was another option suggested. The essential point remains that lecturers in the natural sciences form a unique subculture and perceive themselves as a heterogeneous group playing a significant role in provi-

ding CPD appropriate to their unique needs. It is therefore important that academic support centres remain responsive, providing needs-based workshops tailored to the real and specific needs of various academic contexts.

3.1.2   The informal sector

Each discipline within the natural sciences has various professional organisations to which it can contribute. These associations are, however, mostly research driven and do not focus extensively on the other roles and responsibilities of the typical natural science lecturer in higher education.

The South African Council for Natural Scientific Professions (SACNSP 2003) is a general statutory body supported by the Natural Scientific Professions Act 27 of 2003. Its powers in terms of education and training are to determine standards of competence for the purpose of registration and to assist educational institutions with input into the training of registered and prospective professionals. It is responsible for the protection of the public and the environment against any harmful scientific practices of registered persons, as well as for maintaining the integrity and status of scientific professions. It monitors the standard of services rendered by registered persons (SACNSP 2003: 1, RSA 2003: 3). No respondents indicated knowledge of, or registration with, this council. As registration does not seem to be compulsory, and the implementation of the Act applies only to registered persons, its sphere of influence seems to be limited at present. This situation may change.

3.1.3   The commercial sector

Lecturers should maintain practical expertise within their specific field of practice. Learning will then be a process of transformation, rather than a mere transfer of information (McDonald 2001: 35). The responses of participants in the study clearly indicated that involvement outside the confines of the traditional university classroom and laboratory is essential if lecturers want to succeed in their professional practice. Contact with relevant industries seems to be important as it provides a way to keep up to date with new research, broaden subject knowledge, obtain ideas and contacts for project work, and find employment for students. Industry (used here as a generic term for the commercial sector) provides important and practice-based opportunities for CPD on which lecturers in the natural sciences are eager to capitalise in their own practice.

Higher education itself seems to play the most significant role in the provision of CPD to lecturers in the natural sciences. The higher education system therefore needs to find ways to collaborate with the other provision sectors in order to promote and provide CPD for integrated practice in the natural sciences.

3.2 How is continuing professional development provided?

The manner in which CPD is provided is discussed according to the major paradigm shifts in the provision of CPD identified by Lee (2001).

3.2.1　Providing CPD that encourages experimental learning

On the one hand, experimental learning and innovation already form part of natural science lecturers' professional practice as researchers. These lecturers may, however, be resistant to innovative learning strategies in the other sectors of their practice — including teaching, community service and administration — which lie outside their primary subject interest. Experimental learning may also be hampered by an established or preferred learning pattern developed over time. Individuals with an established and/or strong learning preference may find it difficult to adapt to new and innovative strategies as they feel comfortable and competent within their own style. The challenge lies in integrating their roles, responsibilities and approaches to learning in such a manner that learning in one sector informs another, in an environment where teaching and learning about science take place simultaneously. The lecturer needs an environment in which critical thinking and innovation are encouraged, learning leads to competence, and skills are developed that enable him/her (and his/her learners) to address future challenges.

The participants in this study grasped the advantages of an integrated approach to CPD, as they adapted it to their own practice in creating an environment conducive to learning. They were exposed to new teaching methods (for example how to teach students from disadvantaged backgrounds), created learner-centred environments, and demonstrated a holistic approach to teaching. The science lecturers clearly understood that their learners had diverse learning needs. The same principle may be applied to their own CPD. Providers of CPD need to understand their clientele and provide for its diverse needs in terms of experimental learning.

3.2.2 Less reliance on existing research findings, more critical self-examination

Self-directed learning and reflective practices were evident in the responses of the study population. They indicated self-motivation, curiosity, commitment, professional pride, self-improvement, student feedback and the challenge to communicate knowledge effectively as the main driving forces in developing as a reflective practitioner. Reflective practice is also promoted by the initiatives of the academic support centre (the Centre for Teaching and Learning at the US), as the facilitators at this centre try to deconstruct lecturers' realities and help them to confront their own assumptions on learning and professional practice.

Subject-specific development opportunities are mostly self-initiated, while learning is generally of a self-directed, opportunistic nature. Reading featured as one of the main self-directed individual development strategies of the respondents, a fact which corresponds with the findings of McDonald (2001: 35), who identified reading as the dominant method of purposeful learning for practising professionals. Whereas reading is centred on subject-specific information, feedback mechanisms occur on an informal collegial and supervisory basis. However, learning will only be meaningful if the learner receives sufficient evaluative feedback (Odini 1999: 102). The lack of evaluative feedback on self-directed CPD initiatives was one of the main shortcomings of the current CPD practices of the valid study population. Peer evaluation is common among the research fraternity, as all presentation and publication of research papers is done under peer and expert scrutiny. This, however, is not the case with regard to teaching practices.

One of the respondents added that CPD should be quick, as well as cost-and-time efficient, in order to succeed at any level. As a result of this kind of pressure from CPD clientele, an increasing number of the CPD programmes offered by tertiary institutions are in a distance learning format (Costley 2001: 58, Knox 2000: 14). CPD programmes already in operation, such as those in Psychology, can be used as a template for creating similar programmes for lecturers in the natural sciences — especially if the time constraints of lecturers in the natural sciences are taken into account. This can also be a time- and cost-efficient way of reaching a larger or a more specific audience than arranged seminars and

workshops, depending on the need and purpose of the programme. The way in which such programmes are presented should be critically reviewed. Distance learning programmes commonly rely on a more structured approach, but should not be overlooked as a viable option in the provision of CPD (Brew 1995: 53). The US presents various distance learning programmes which are mainly (although not exclusively) aimed at more advanced levels of study. The MPhil (Leadership in Education), which aims to develop competent educational leaders, and is collaboratively presented by the Faculty of Education and the Graduate School of Business, is of relevance to lecturers in the natural sciences (US 2003). The MPhil in Higher Education, offered by the Centre for Higher and Adult Education, presents another option for lecturers who want to develop their expertise within the field of higher education. The limited contact time encourages self-directed learning. Although it is debatable whether distance education is the best CPD option for lecturers at the university itself, it is one of the possible routes.

3.2.3 A shift from individually focused learning to collaborative efforts

A definite need exists for collaborative initiatives in the natural sciences. The participants in the study were consistently positive about such learning initiatives. These initiatives include informal collegial interaction, but national and international exposure and collaboration were also stressed as important professional development opportunities. Respondents indicated a need for intradepartmental workshops involving colleagues at all levels and stimulating debate on aspects of teaching and research. An academic year day for the natural sciences was also proposed, with lecturers introducing their research in ten-minute presentations to the rest of the faculty.

Mentoring is an ideal way of providing collaborative CPD on demand. The Thuthuka Programme is a good example. Mentoring can also take place on an informal basis within departments. Reflection, coupled with peer consultation, serves as a source of validation, counsel and affiliation during periods of risk-taking, conflict and role transition — all of which are inherent in learning and change.

A campus-wide move towards e-learning has created opportunities for collaborative learning at the US. Lecturers have had to develop their e-

teaching capabilities with the campus-wide WebCT initiative. Although this was initially greeted with some resistance, and even though the system has shortcomings, it led to development and innovation within this area.

The Centre for Teaching and Learning also offers all academic staff the opportunity to receive and share relevant information via a campus-wide listserv. This initiative, called the SOLforum, aims to share articles and links to information on the Internet; stimulate insight, reflection and innovation, and share good practice in higher education.

3.2.4   A shift towards problem-based learning and practice

The establishment of a post-technocratic or performance model for CPD provision would greatly facilitate a shift towards problem-based learning and practice, as it may be assumed that the integrated needs analysis promoted in such a model would direct CPD towards the problems experienced in the specific sector. This is not yet the case in the natural sciences at the US. An integrated approach to needs analysis focusing on the complex and changing problems of the study population has not been established. It is therefore difficult to identify common problems and develop coherent systems of CPD delivery. This type of approach, however, runs the risk of promoting only formal learning initiatives.

The learning needs of respondents are generally addressed individually, as a problem arises. The most common response is by consulting sources perceived as reputable by the individual lecturer — mostly colleagues and other experts within the natural sciences. This type of informal learning does not always lead to the best possible problem-solving; nor is it always shared with others. Problem-solving through interaction with colleagues can be one of the most valuable learning experiences in professional development.

Problem-solving is often an unintended and incidental learning experience. However, most of what is regarded as CPD comes in the form of formal programmes. The emphasis on pre-defined formal learning causes informal learning to go unrecognised and unappreciated. There is much scope for harnessing this type of learning, as it can motivate learners to become more self-directed and creative in their learning efforts. It challenges the organisation to create a learning environment that fosters continuous productive learning, as promoted by Ramajah & Moorthy (2002), McDonald (2001), Kachingwe (2000) and Castle *et al* (1998).

4. Conclusion

The value of CPD in the current post-modern work situation is evident. Nevertheless, the lack of professional unity and identity among educators in higher education makes it difficult to conceptualise and provide CPD effectively in this professional sector. Lecturers in higher education are not a homogeneous group, so the purpose of CPD will differ according to their needs. The organisation in which they work and the policies determined by the state or professional organisations will play a deciding role in the ultimate purpose attributed to CPD in a specific context. Determining how to provide CPD is a complex and often elusive enterprise.

The formal, informal and commercial sectors were identified in this study as the main providers of CPD. The ideal provision of CPD was characterised by four major paradigm shifts, including a change in emphasis from transmission of knowledge to experimental learning; from reliance on existing research findings to reflectively examining one's own practice; from individually focused learning to collaborative efforts, and from mimicking best practice to problem-based learning and practice.

From the findings of the study it may be concluded that lecturers in the natural sciences at the US form a unique and yet heterogeneous group of professionals who are influenced by the formal, informal, and also the commercial sectors of CPD provision. The influence of each of these sectors differs in terms of its importance to the various professional areas of practice in academe, but centres mainly on the areas of research and (to a lesser extent) teaching.

The move towards more experimental learning is substantiated by the findings, but does not feature as strongly in all areas of academic practice. A move to more self-reflective practice was evident in the research findings, although evaluation and feedback seem to be lacking in these types of endeavours. CPD initiatives that are less formal in nature make it difficult for lecturers in the natural sciences to demonstrate evidence of the professional development that has taken place as a result of an initiative. Collaboration on both the formal and the informal levels featured strongly as a CPD initiative for this specific group of lecturers. No evidence could be found of a distinctive and integrated model of CPD provision within the institution. No focused CPD needs analysis of the specific study group existed. An informal problem-based approach

to CPD was, however, evident in individuals' approaches to CPD and in their interaction with colleagues.

CPD providers can capitalise on the evident paradigm shifts of the study population. It would be wise to take note of preferred and established learning patterns, prior knowledge and learning, and the areas of practice. Ways in which professional development can be captured and conveyed should form part of a more holistic approach to CPD. The context of practice is paramount if a problem-based approach is envisioned.

At present, CPD provision appears to be somewhat fragmented. A more integrated approach to CPD, taking all forms of learning into account, could lead the way to a learning culture within a learning organisation — to the benefit of lecturers in the natural sciences.

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