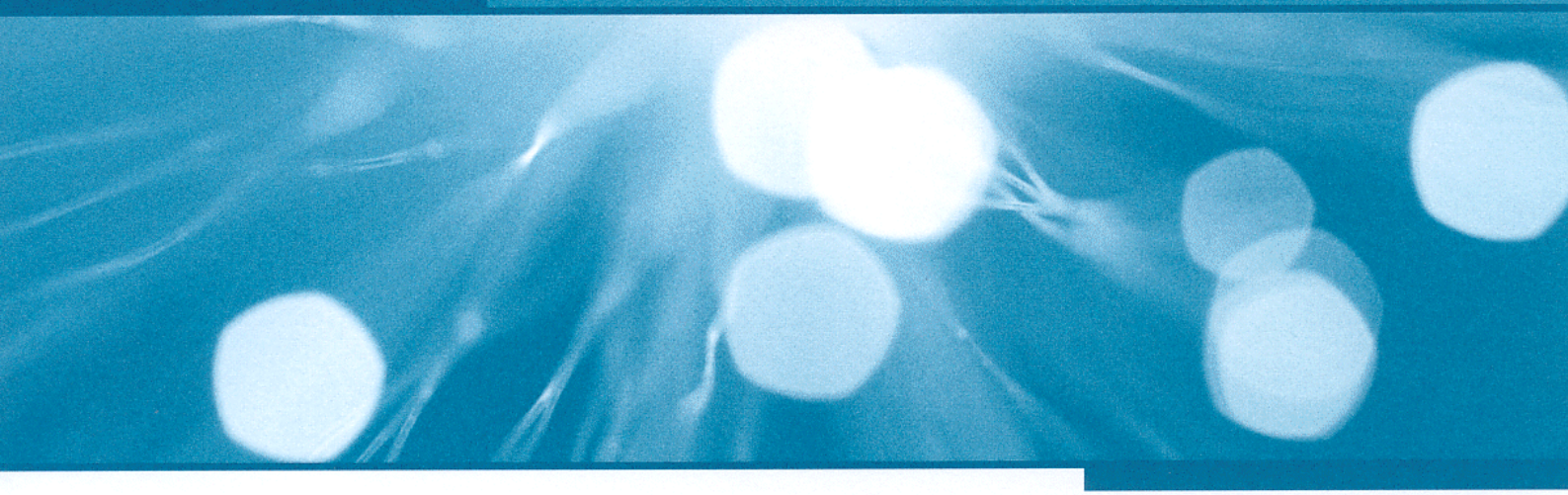
PDP Guide



Engineering Subject Centre Guide: Personal Development Planning for Engineering Students

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The Higher Education Academy Engineering Subject Centre

Authorship

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Personal Development Planning (PDP) for Engineering Students

Introduction

By the academic year 2005-2006, all HEIs are expected to have in place their own policies for the implementation of Personal Development Planning (PDP). PDP is part of the Progress File for Higher Education. The Progress File will provide each student with:

- A transcript - a record of their learning and achievement
- A means by which the student can 'monitor, build and reflect upon their personal development'. It is this process which is referred to as PDP

This guide, commissioned by the **Higher Education Academy Engineering Subject Centre** aims to provide an introduction to PDP for all engineering academics along with references to further resources to support those implementing PDP and Progress files into the curriculum.

Contents

Section 1

This section of the guide provides clear and simple answers to the most frequently asked questions that academics within the Engineering disciplines ask about PDP including:

- What is PDP?
- What are the requirements for implementing PDP?
- What are the intended benefits of PDP?
- How does PDP fit into the Engineering context?

Section 2

This section of the guide outlines approaches that could be adopted to implement PDP.

Section 3

This section helps readers to consider the merits of supporting and delivering PDP through electronic means.

Section 4

This section provides Case Studies of PDP practice within Engineering.

Section 1: Frequently Asked Questions

What is PDP?

Personal Development Planning is *'a structured and supported process undertaken by an individual to reflect upon their own learning, performance and / or achievement and to plan for their personal, educational and career development'*. The primary objective for PDP is to improve the capacity of individuals to understand what and how they are learning, and to review, plan and take responsibility for their own learning. This will help students:

- become more effective, independent and confident self-directed learners;
- Understand how they are learning and relate their learning to a wider context;
- Improve their general skills for study and career management;
- Articulate personal goals and evaluate progress towards their achievement;
- Develop a positive attitude to learning throughout life.

What are the requirements for implementing PDP?

The Quality Assurance Agency for Higher Education (QAA) set out in their Guidelines on Personal Development Planning (PDP), published in 2001, a number of expectations. These are that:

- At the start of a programme, all students should be introduced to the opportunities for PDP.
- Students will be provided with opportunities for PDP at each stage of their programme.
- The rationale for PDP at different stages of a programme will be explained.

Furthermore, each HE Institution is expected to:

- Develop a policy for PDP.
- Determine strategies for its implementation.
- Specify the nature and scope of opportunities for PDP, and the recording and support mechanisms to be adopted.
- Offer PDP to each student across the range of awards it provides.

What are the intended benefits of PDP?

The effective practice of Personal Development Planning can provide a number of benefits to both students and academic tutors.

For students, an effective scheme should enable (or help) them to:

- reflect critically;
- Become more independent;
- Adopt a more pro-active approach to their academic study, extra-curricular pursuits and career planning;
- Make links and gain a holistic overview of their studies within a modular environment;
- Capitalise on their learning in a variety of contexts.

For academic tutors, an effective scheme should:

- add value to the learning-teaching experience;

- Help students take greater responsibility for their own learning;
- Facilitate more effective monitoring of student progress;
- Enable tutors to provide more focussed and more effective academic support and guidance;
- Supply a mechanism for recording the tutorial and pastoral support provided to students, for fostering career-related skills, and for writing meaningful employment references;
- Enhance tutors' capacity to demonstrate the quality of the support they are giving to students and provide a means of evidencing at the level of individual students that intended learning is being achieved;
- Where applicable, help to improve the effectiveness of work-based or work-related learning.

In addition to the benefits outlined above, it is assumed that an effective system of PDP would:

- Increase student retention.
- Improve student progression.
- Enhance students' key skills.
- Make students more 'employable'.

What are the characteristics of effective PDP practice?

The characteristics of effective PDP practice are likely to include:

- integration with mainstream academic pursuits;
- Links to the intended learning objectives and outcomes of programmes;
- Support and endorsement by lecturing staff, underpinned by support from the institution.

Effective practice should also:

- reflect local customs, practices and circumstances with regard to the format and operation of the scheme;
- Complement good practice inherent in existing activity and practice;
- Build upon existing partnerships between learners and academics.

How does PDP relate to existing practice?

Personal Development Planning (PDP) is a new way of articulating existing principles and practices.

Its introduction will be mainly a matter of making coherent and explicit to all students the presence and the value of established processes that are central to learning in higher education. Academic tutors have always encouraged students to:

- Make progress towards intellectual independence
- Become more self-aware
- Plan for, and take responsibility for, their own development

Academic tutors bring their existing skills to support students in this, providing feedback, challenges and different perspectives to help their students identify possibilities for change.

Many routine academic practices are built upon this in implicit ways. The introduction of PDP will make it explicit that dialogue between tutor and tutee supports not only the student's

deepening understanding of their subject, but also the student's growing ability to think critically about their own performance and how to improve it.

This is already made explicit within the curriculum, where modes of study or assessment involve challenging students as individuals to develop a piece of work over time and/or to undertake a process within which progress is reviewed continually. Examples include:

- Formative assessments
- Independent research projects
- Group projects
- Assessed seminar presentations
- Reflective commentaries / logs
- Portfolio-based assessment

How does PDP fit into the Engineering context?

For engineers, PDP can be seen as rather like IPD (Initial Professional Development) and CPD (Continuing Professional Development) started while at university. Indeed many of the processes common to IPD and CPD, such as skills auditing, competence assessment, skill development, action planning, evidence gathering, reflection upon practice, and documenting activity or evidence are common to effective PDP practice.

As part of the Engineering Council UK's United Kingdom Standard for Professional Engineering Competence (UK-SPEC), engineers are expected to:

- Carry out the continuing professional development necessary to maintain and enhance competence in their own area of practice (E4)
- Lead teams and develop staff to meet changing technical and managerial needs (starting presumably with themselves) (C3)

www.uk-spec.org.uk

The QAA Subject Benchmark for Engineering does not mention PDP explicitly but does refer to lifelong learning and the ability to learn independently (Table 2 – Business Context), and to time and resource management – e.g. can identify the critical activities within a personal plan of work

In the Engineering Professors' Council (EPC) Graduate Output Standards, we find:

- Ability to exercise Key Skills in the completion of engineering-related tasks at a level implied by the benchmarks associated with the following statements: Key skills for engineering are Communication, IT, Application of Number, Working with Others, Problem Solving, *Improving Own Learning and Performance* (1.2.1)

PDP is further emphasised by:

- Ability to critically review real target systems and personal performance. This includes the ability to *Identify professional, technical and personal development needs and undertake appropriate training and independent research* (1.2.7 (c))

www.epc.ac.uk/epc_pub_output_standards.html

In the latest 'Output Standards for Accredited Engineering Programmes', part of the Engineering Council UK's 'The Accreditation of Higher Education Programmes' (a supplementary publication to UK-SPEC), general transferable skills are stated as including:

- *.. planning self-learning and improving performance, as the foundation for lifelong learning/CPD*.

www.uk-spec.org.uk/Output_Standards/Accreditation_HE_Progs.pdf

Thus the activities that commonly characterise PDP are synonymous with the stated and implied expectation placed upon student and graduate engineers, as outlined by professional engineering bodies.

Section 2: Implementing Personal Development Planning (PDP)

The extent to which individual tutors and departments need to introduce additional activities or resources to meet the requirements of PDP will depend to a large extent upon the degree to which current practice meets the needs of students and the minimum expectations described in Section 1. The most likely additional features that will be required will be:

- Tools (electronic or paper-based: see section 3)
- Guidance and support to:
    - Enable students to plan their development
    - Record achievement and progress more systematically
    - Encourage learning through the reflective and planning process

Introducing PDP may involve a significant effort in setting up systems if they do not already exist. However, much of what is required may already be happening, albeit by other names and possibly as unconnected activities. This is particularly true of engineering programmes. By their vocational nature, and influenced by institutional accreditation, engineering programmes have long included professional skills. Project work in particular has engaged students in recording and planning their own work. Rather than set up new systems from scratch, it may be much more efficient and effective to map existing practice, modify existing processes, and tie them together in a more integrated approach.

How much work is involved depends on what is already in place and how seriously you intend to take PDP. If the intention is a minimalist approach, designed to satisfy the minimum requirements and no more, the amount of effort involved may not be that great. Such an approach may, for example, involve little more than formalising the personal tutor system, if one is in place, by ensuring a minimum number of one-to-one meetings between tutor and tutee and putting in place a preparation and recording system to support them.

Let us examine the possible approaches in more depth:

The Minimalist Approach

One approach is to do the absolute minimum – no more than is required to meet QAA and/or your institution's requirements. At this extreme, PDP can be seen as a "bolt-on extra" involving some formalisation of personal tutorial support, the provision of university transcripts, and providing students with some facility for maintaining a Progress File. The Progress File could involve the greatest effort, but there are many paper-based or electronic versions readily available that could be used. This approach addresses the required "mechanics" of PDP, without necessarily involving many, or any, extra resources.

The main advantages of this approach are:

- It requires minimal input from academic staff,
- It is relatively quick and easy to set up,
- It will encourage students to think about career choices both at university and afterwards.

The main disadvantages of this approach are:

- It is unlikely to have much impact on student learning,
- It will not enthuse students to become more independent learners,
- It may become little more than a 'ticking the box' exercise,
- It will not address the spirit of PDP and stimulate any deep reflection in students.

The All-Inclusive Approach

An alternative approach would be to fully embrace the spirit of PDP. Here, PDP would be seen not as a “bolt-on extra” but as the natural extension of good teaching practice. Enabling PDP would become a key feature in the planning of every single teaching session. Such an approach would involve most academic staff in re-evaluating their theories of learning and teaching.

The main advantages of this approach are:

- It provides a fully integrated learning and teaching experience.
- It provides all students with the means of relating the curriculum to their personal progression.
- It provides students with fully tailored support and guidance.
- It enhances student retention and progression.

The main disadvantages of this approach are:

- It involves a major culture change in the way that some academics operate.
- It may have significant resource allocation implications.
- It involves considerably more effort in initial planning of learning and teaching activities.
- It may create unreasonable levels of expectation among students.

The Pragmatic Approach

A more realistic approach might be to adopt a position between the two approaches outlined above. This would probably involve:

- Mapping existing practice to identify where PDP is already being delivered within the curriculum
- Where appropriate, building in further opportunities to enable students to plan their learning, develop skills, and reflect upon their experiences
- Adopting tools and / or systems to enable students to audit skills, and to record achievement
- Providing support and guidance to ensure that students are able to benefit from the PDP opportunities on offer

The adoption of more than just a minimalist approach is likely to pay dividends. Most engineering departments are faced with progression and retention challenges that are increasing with pressures to widen participation in HE. A large part of the difficulties faced by students is their inability to cope with the degree of autonomy expected by universities.

Students are unlikely to put much effort into maintaining a PDP portfolio unless it is explicitly part of the curriculum, is well supported by resources and guidance, and is seen by students to be valued by staff. Two notes of caution should be sounded:

- Firstly, if students are asked to do something without the proper support and guidance this is likely to prejudice students against the whole idea - an integrated approach is critical.
- Secondly, offering a too rigidly structured system can have its drawbacks. The whole idea of PDP is that students should eventually manage their own lives, and, by definition, they can only do this in their own way and not somebody else’s way - students should be able to modify any recording system to suit themselves and gain a feeling of ownership over it.

Section 3: Personal Development Planning (PDP): Electronic Tools

Electronic PDP tools are certainly quite popular. These offer the academic a ready made 'solution', whilst they appeal to students who have become accustomed to on-line systems and would expect their PDP recording portfolio to be electronic.

However, before adopting an electronic system there are a number of questions to ask:

- Are you going to create your own or use one of the many electronic packages now available?
- Are you going to fit in with any institutional policy – gaining support and compatibility?
- When your students leave, will they be able to access their Progress File and develop it into a CPD record?
- Where will the records be kept (e.g. on the university/departmental server or on the students' transportable media)?
- Who will have access to the records?
- What technical expertise is required to maintain and run the system?

Advantages of using Electronic PDP Tools

A major advantage of using an electronic system is that it can connect easily with the Internet, thus creating exciting new opportunities for accessing support materials, learning tools and other materials. A number of dedicated websites are becoming available which will provide specialist support and which will have the potential for developing and hosting generic materials and tools. The Internet is also able to provide links to similar activities outside HE, such as employer organisations and Professional Bodies.

Electronic PDP tools can encompass some or all of the following:

- On-line services for students, so that they can move freely around a university's Intranet to access tips, advice and support workshops
- Chat rooms to share ideas and information
- Links with other records/databases within the institution
- Flexible updating and modification of both system and records
- Customisable systems/documentation
- Links to the Internet and other resources such as:
    - Dedicated websites hosting information, tools and materials
    - Websites containing support materials for particular communities e.g. NUS, Discipline Networks, Student Record Officers, Professional Bodies, Employer Associations
    - HE institutional websites offering practical examples to support PDP
    - Universal tools that can be accessed to support PDP

Electronic PDP tools also offer the following advantages:

- Accessible for all students within the university
- Ease of use for entering and storing information at any time
- Ease of production of reports, electronic or paper-based, such as CVs
- Manageable over the whole institution
- Paper-less
- Non-threatening for the user
- Facilitates interactive activities between the tutor and students e.g. learning logs
- Can be easily amended and added to at any time

Section 4: Personal Development Planning (PDP): Case Studies

The following brief Case Studies offer an insight into possible implementation strategies for PDP within an Engineering context:

- Glasgow Caledonian University
- University of Exeter
- Southampton Institute
- Loughborough University (RAPID)
- University of Glamorgan

Glasgow Caledonian University

Within the School of Engineering, Science and Design ongoing PDP is seen as part of student support. This approach seeks to optimise retention through a student support system based on the "Triple C Model" of care, control and consistency. An extremely active first year tutor has taken on the responsibility for co-ordinating existing activities within a framework of PDP. A whole range of additional support is provided. This involves an induction programme which includes, for example, ice-breaking activities and group projects to establish student-student contact and friendships at an early stage. Absence is identified as the clearest indicator of a student being at risk and detailed monitoring of absence leads into a systematic and graded follow up system. Thus PDP becomes part of an integrated student centred approach to academic practice.

For further information see: Beggs and Smith (2003) A New Paradigm for Maximising Student Retention in Higher Education, IEE Seminar on Engineering Education 2003, Southampton Institute, 6-7 January or visit the following website: http://esdstudent.gcal.ac.uk/webpass/pdf.html

University of Exeter

The School of Engineering and Computer Science provides one example of how developing a dialogue between staff and students can be established to help induct students into the processes of Personal Development Planning (PDP). For the last three years, all first year engineering students in electronic, mechanical and civil engineering, and engineering and management, were asked to review their learning at the end of each week throughout the first term. At the end of each week, the students were asked to fill in a form comprising a range of both multiple-choice/tick-box type questions and more open-ended questions about their academic studies over the past week. The forms were then passed onto a study skills counsellor who provided written constructive feedback on every form before they were returned to students via personal tutors before the end of the next week. The aim was to engage students in a dialogue about their learning processes and to encourage reflective habits prior to using an electronic recording achievement system for longer term Personal Development Planning (PDP). Passing the forms back via personal tutors drew those tutors into a dialogue that could be sustained after the first term, when the forms were no longer used. The study skills councillor was able to provide extremely useful feedback to staff on how lecture programmes were going, and the system provided ample information to identify at-risk students at an early stage.

For further information see: www.engsc.ac.uk/downloads/miniproject/systematic_learning.pdf

Southampton Institute

A system is described, at Southampton Institute, of using induction of new first year students to start the process of PDP. This induction aims to give students the skills necessary to begin to take responsibility for their own learning and to enable both staff and students to proactively identify if and what additional support is needed. Induction sessions include: learning techniques, learning styles, team building, information literacy skills, essay writing skills and assessment information. A significant increase in students knowing where to go for support and advice and information is reported as one of the key benefits of the scheme.

For further information see: Alan Robinson and Mark Udall 'Developing the Independent Learner: The Mexican Hat Approach'
www.engsc.ac.uk/downloads/resources/independent.pdf

Loughborough University

In the Department of Civil & Building Engineering, the RAPID (Recording Academic, Professional & Individual Development) Progress File (http://rapid.lboro.ac.uk/), an electronic (web-based) personal development planning (PDP) tool, enables students to input and maintain information on a password protected data-base. Using RAPID, students can maintain a record of achievement, and can audit and develop skills compatible with the competence requirements of the relevant Professional Institution for their degree course. Students are encouraged to audit a broad range of skills to help assess strengths and weaknesses prior to engaging in a skill development process involving identifying a skill development opportunity, creating an action plan, executing a skill development plan, reviewing and reflecting upon the activity undertaken, and documenting evidence of competence gained. This process mirrors that required for the completion of most competence-based professional development programmes. The RAPID system provides on-line exemplars and guidance to help support students in these activities. In particular, advice is provided on skills auditing, action planning, reviewing, evaluating, and reflecting upon actions taken and processes engaged in. In addition, the importance of documenting valid, current, authentic and sufficient evidence is highlighted.

Beyond Loughborough the RAPID Progress File has been extensively implemented with well over 2000 students in 10 HE Institutions. This has involved the use of RAPID in a variety of curricular contexts including the support and assessment of work-based learning, the delivery and development of key skills, and the enhancement of student / tutor dialogue. A comprehensive evaluation programme has confirmed the positive impact that RAPID has had upon student learning and progression.

For further information: contact the RAPID Project Manager, Alan Maddocks (A.P.Maddocks@lboro.ac.uk)

University of Glamorgan

Embedding Personal Development Planning into a Key Skills Module

Dr Steve Lloyd and Eleri Bowen, School of Technology, University of Glamorgan

Introduction

As a result of recommendations from the Dearing Report (1997), all UK higher education institutions by the year 2005/06 must offer students an opportunity to engage in Personal Development Plans/Planning. The module in this case study was an existing skills based module, at the School of Technology, redesigned to meet Personal Planning objectives and encompass activities recommended to achieve these objectives (QAA).

Background

The majority of students studying this module (approx 35 per class) have no previous experience of explicit skills development. Students are given guidance on the key learning tools and tasks for self-development via a one hour tutorial session once a week (10 credit module). Tutor guidance is offered (group and individual basis) rather than explicit teaching of skills to encourage learner autonomy during the module, and further self-development on completion of the module.

Methodology

The module was designed using Biggs' Theory of Constructive Alignment (1999). The QAA primary objectives for Personal Development Plans/Planning were adopted as the learning objectives for the module, (Learning Objectives: Examine **What** and **How** you learn/**Plan** and **Organise** own personal development/**Review** success of development/ Take **Control** and **Responsibility** over own learning).

The learning tasks for the module were those tasks recommended by QAA as the activities students should be involved in to manage and develop their learning successfully, and thus attain the learning objectives. (Learning Tasks: **Gather information** on learning experiences and achievements/ **Reflect** on these experiences/ **Identify a learning need** from this information**/ Create a plan** for development/ **Develop skill**/ **Review progress** towards goals set/ **Evaluate** success in attaining these goals).

The module was designed to encourage students to 'deep' learn and gain intrinsic interest in the material. Following Marton and Saljo's (1976) principles of 'deep' learning, students were allowed to direct their learning by selecting and justifying a key skill for development, and then detailing and experiencing the methods of improvement. Thus encouraging greater understanding into what is being developed, why it is being developed, and how it is being developed. This greater understanding can aid the transference of knowledge outside academia. Students were also actively encouraged to contextualize their development, using real life settings for skills development so they could understand the importance of personal development in their everyday lives.

The assessment for the module was established to measure a student's ability to perform the learning tasks rather than assessing the outcome/success of skills development, to encourage students to honestly reflect on the learning process. Assessment was made via two written reports. The first report details initial self-evaluation of learning/skills levels, the identification of skills for development and a strategy for development. Feedback was offered on completion of the assignment to encourage critical reflection with feedback, and to foster learner confidence in the set strategies. The second report details the portfolio of development and reflections on this development. Students were not penalized for unsuccessful development, but were rewarded for the ability to perform the learning tasks and thus attaining the learning objectives.

In addition to the assignments, further reflection on learning was encouraged via a two part questionnaire. The first questionnaire was distributed at the start of the module and the second at the end of the module. The questionnaire comprised of three sections. Section 1 – Knowledge of learning behaviour/ attitude to skills development. Section 2 – Perceived/actual difficulty of each learning task. Section 3 – Indication of Deep/ Surface Achievement learning strategy. A comparison between the start/end responses from each student's questionnaire was distributed at the end of the module, providing the student with information on: 1. Had knowledge on learning behaviour increased? 2 Had the level of difficulty in performing learning tasks been over/underestimated? 3 What was the intended learning style (deep/surface) and the actual style used?

Issues

The main barrier faced by the School of Technology was the lack of resources that could be dedicated to the development of PDPs. Therefore, adapting an existing skills based module proved to be a resource effective way of implementing PDPs. In terms of student development, many students struggled to manage their time effectively during the skills development stage. To alleviate this problem, this academic year further guidance on time management has been integrated into the programme.

Benefits and Success

Designing the module around Biggs' Theory of Constructive Alignment made the module design relatively easy due to guidelines offered by QAA. Following these guidelines and aligning tasks and assessment to the learning objectives ensured QAA primary objectives were met.

Student reaction to the module was overwhelmingly positive. Student questionnaire responses indicated that the majority of students embraced the opportunity to learn more about themselves. Due to the choice and flexibility of the module, the majority of students engaged in the module, with 95% of students displaying intrinsically motivated goals for the module (rather than extrinsically on 'grade' orientated goals).

The structured approach to the module (and assessment) encouraged students to develop each learning tool. Prior to the module, the majority of students had not undertaken any explicit personal development. One student stated *'I had thought about my own skills and how to assess them for the first time'.* Tutor guidance was invaluable in helping students acquire the learning tools and foster confidence, and the level of independence in developing skills also provided students with new found confidence in personal development. *'[The most important thing I learnt was] I <u>am</u> able to improve my skills, I know exactly my strengths and weaknesses'.* Another student wrote *'[the most important thing I learnt was] improved my confidence in my abilities to work independently',* indicating that students now have the skills to continue their personal development.

How Can Other Academics Reproduce This?

This module can be reproduced in any skills based module in any discipline, using the assessed assignments to encourage students to perform the learning tasks that will help them successfully manage and control their own development and learning.

Further Reflection

The module has undoubtedly been a success, achieving far more than was originally envisaged with the vast majority of students reporting and reflecting upon a rewarding and different type of learning experience. In truth the original delivery and design of the module was probably a little tentative and the feedback came as a very welcome surprise. Any nagging scepticism that was harboured toward the usefulness of progress files to the learner was dispelled following the student feedback. The confidence gained from the feedback has

encouraged further development and an attempt to evaluate the students' individual learning experience in terms of whether they experienced or engaged in deep or surface learning, and the degree of autonomous learning. Working toward a position whereby each individual student can be given feedback on the type of learning they have engaged in now appears to be an achievable goal. This was not one of the objectives of the module development, but would represent a considerable aid to the learner if it can be achieved. The obstacle to development is the time scale i.e. 1 experiment each year.

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Useful Sources:

The following sites offer further information, guidelines, case studies etc. about Personal Development Planning (PDP):

Centre for Recording Achievement:
The Centre provides a wide range of source documents relating to many aspects of PDP and key skills
www.recordingachievement.org/

The Higher Education Academy: This webpage shows how The Academy is working collaboratively with a number of organisations including the Centre for Recording Achievement (CRA) to produce web based information, guidance and resources. The aim of this work is to help HE communities develop their practice in relation to PDP.
www.heacademy.ac.uk/PDP.htm

The Higher Education Academy Engineering Subject Centre
For further resources to support academics in the development of PDP please see:
www.engsc.ac.uk/er/pdp/

Engineering Subject Centre Guide to Learning and Teaching Theory for Engineering Academics.
www.engsc.ac.uk/er/theory/

The PROGRESS Project
This FDTL project based in the Engineering Department at the University of Hull, in collaboration with a consortium from Huddersfield, Sheffield Hallam, Leeds Metropolitan, Brunel and East Anglia Universities. It has produced a number of guides to supporting students including:
Personal Development Planning for Student Retention and Progression in Engineering
www.hull.ac.uk/engprogress/Prog3Papers/PDPGuide.pdf

Quality Assurance Agency (for Higher Education) (QAA): www.qaa.ac.uk/
For guidelines for HE Progress Files see:
www.qaa.ac.uk/crntwork/progfileHE/guidelines/progfile2001.pdf

Examples of Electronic PDP tools include:

Keynote: Nottingham Trent University: www.keynote-project.co.uk

LUSID: University of Liverpool: http://lusid.liv.ac.uk

RAPID: Loughborough University: http://rapid.lboro.ac.uk

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- Providing a national *focus* that is an accepted and essential point of contact for all involved in learning and teaching in higher education engineering.

- Collating and disseminating *good practice* and innovation in learning and teaching in higher education engineering.

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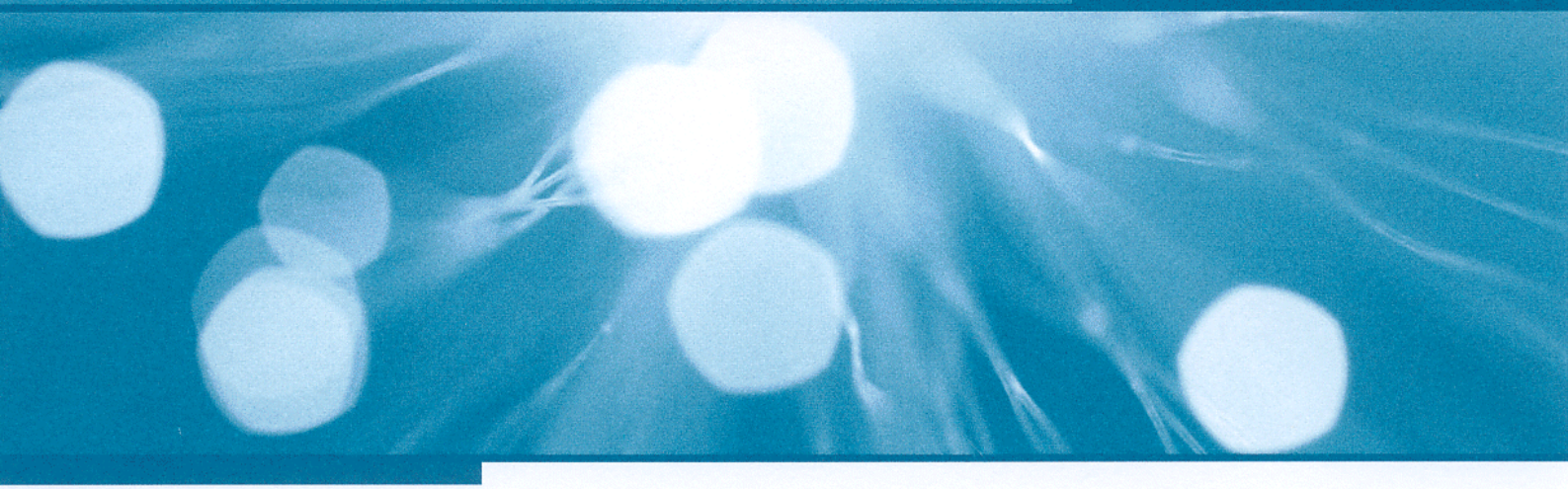

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