SUPPORTING CDIO IMPLEMENTATION WITH PERSONAL DEVELOPMENT PLANNING

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Abstract
Recently all universities in the UK were obliged to introduce Personal Development Planning (PDP). This involves establishing a system to enable students to maintain a record of their personal development, along with personal plans to remedy any deficiencies. The literature indicates that universities and individual schools and departments have responded in different ways, and the systems introduced have varied significantly in terms of their objectives and effectiveness. As a CDIO collaborator, the School of Mechanical and Aerospace Engineering at Queen's University Belfast made use of the CDIO Syllabus in the design of its PDP system. The system is described in the paper and it is demonstrated that PDP can help address a number of the CDIO Standards. The compatibility between PDP and CDIO is such that it is recommended that the CDIO collaborators consider adopting PDP in order to support their implementation of the CDIO approach.

Keywords: Engineering Education, CDIO, Personal Development Planning, PDP

1. Introduction

The results of a major inquiry into higher education in the UK led by Sir Ron Dearing were published in 1997 [1]. The inquiry, which was the first of its kind since 1963, set out a vision for higher education for the ensuing twenty years. One of the proposals in the inquiry report was that universities in the UK should develop systems whereby each student would have a "progress file". This was to consist of "a transcript recording student achievement" and "a means by which students can monitor, build and reflect upon their personal development". For many universities providing a transcript of achievement was already a part of normal practice, but the need to support students' personal development was a new requirement.

The Quality Assurance Agency (QAA) is responsible for setting standards in UK higher education. By 2001, the QAA had fleshed out the detail of the Dearing proposal and issued guidelines as to how it should be implemented [2]. Universities were to introduce "Personal

Development Planning" (PDP) by providing "structured and supported processes to develop the capacity of individuals to reflect on their own learning and achievement, and to plan for their own personal educational and career development". As a result, all students were expected to maintain "personal records of learning and achievements, progress reviews and plans that are used to clarify personal goals and can provide a resource from which material is selected to produce personal statements (e.g. CVs etc) for employers, admissions tutors and others". The QAA stated that PDP arrangements should be operational in all UK universities by the start of the 2005/6 academic year.

2. The Implementation of PDP in the UK

The primary objective of PDP is to improve the capacity of students to take responsibility for their own learning. This includes taking responsibility for developing their own skills, and in particular those related to employability. In general, universities have responded to the QAA requirement by focusing on the personal record that each student has to maintain to document progress, note evidence of achievement, identify deficiencies and plan actions to remedy each deficiency. (This personal record tends to be referred to as the "progress file", although strictly speaking the latter also includes the student's academic transcript.) In a number of cases the personal record has been more akin to a portfolio, which may include documents and artefacts that attest to the progress the student has made. While some universities have adopted systems that involve hard copy progress files, most have introduced on-line versions by developing bespoke software or customizing software that is available commercially.

Apart from taking different approaches to the mechanics of maintaining a progress file, universities have varied in their understanding of the requirement for PDP. Some have responded by changing their curricula to incorporate more opportunities for students to develop "employability skills". In at least one case, the response has included the introduction of a course specifically designed to teach PDP [3]. The proliferation of approaches is due in part to the fact that many universities have produced PDP policies, but left the details of implementation to individual departments or schools. This point is underlined in a recent paper by Haigh [4] who notes that the introduction of PDP "has been patchy and subject to different interpretations even within institutions". Despite the QAA's aspiration that PDP would be "operational" in all UK universities by 2005/6, Quinton and Smallbone [5] claim in a recent paper that the "implementation of personal development planning is still at a fairly preliminary stage" and "the process of adopting this innovation may be a long one, requiring regular refinement". Seeking to explain this, Clegg and Bufton [6] assert that PDP "is a chaotic conception which might better be thought of as an umbrella term for a variety of strategies to help students think about their own learning and plan for the future". Also of concern is the fact that a significant proportion of students and faculty in universities that have officially introduced PDP are not fully engaging in the process. A recent survey conducted by Quinton and Smallbone [5] revealed that engagement among students ranged from 1% to 98%.

3. Developments in Other Countries

The adoption of a national policy to introduce PDP is unique to the UK. However, the introduction of some aspects of PDP in departments and schools in other countries has been

reported in the literature. Within engineering education in the USA the focus has been on supporting the acquisition of the "professional skills" referred to in the ABET accreditation criteria. Richerson et. al. [7] report the use of a portfolio called the "professional development transcript", which enables students to record their exposure to seven professional skills drawn from the ABET criteria. Students then use their experiences "to undergo a self-assessment, identify their strengths and weaknesses, and develop strategies to improve their skills". Students are told not to overlook "their participation in outside activities, clubs and service learning opportunities". McNair et. al. [8] describe a digital portfolio, or e-portfolio, that students use to record progress against the six ABET learning outcomes that concern professional skills. However, the main objectives in this case were to assist faculty with the development of assignments that address professional skills and to facilitate assessment.

Australian universities have been particularly active in promoting the development of student skills. Carroll et. al. [9] describe e-portfolio software that was designed and introduced primarily to improve students' capacity for reflective thinking. The functionality of the software exceeds that which is normally found in the progress file software that UK universities use to support PDP. Its main elements are a "repository" where students can archive digital materials they feel will assist their learning, a "writing environment" for student reflection, a "collaboration tool" for sharing ideas and knowledge, a "social networking tool" and "teaching support tools" that provide tutors with access to a student's portfolio for assessment purposes.

4. PDP Implementation at Queen's University Belfast

Queen's University Belfast (QUB) was among the universities in the UK that devolved responsibility for the implementation of PDP to individual schools. However, the University developed an on-line progress file facility, called the "e-folio", that allows students to record their progress against a list of skills defined by their school, log evidence to support claims of progress and identify actions to enhance their skills. The on-line facility also provides guidance and links to web resources that may assist skill development. In addition to the e-folio facility, the University monitors PDP implementation across all schools, and offers training and advice.

As a CDIO collaborator, the School of Mechanical and Aerospace Engineering at QUB viewed the introduction of PDP as an opportunity to provide support for its implementation of the CDIO approach. Conversely it was felt that CDIO had a role to play in assisting the introduction of PDP. After a pilot study during 2006/7, PDP was incorporated in the first year of each of the School's degree programs during 2007/8. The key steps in the PDP system introduced by the School are:

1. Students are informed about PDP at an early point in their introductory course. (Appropriate introductory courses are included in all degree programs in line with CDIO Standard 4.)
2. Students complete an assignment in their introductory course to develop their word processing skills which involves producing a CV based on their current achievements, skills and experience.
3. Students email their CVs to their personal tutors. (Each student has a personal tutor that he or she meets with regularly on a one-to-one basis.)

4. Students discuss their CVs with their personal tutors, and the tutor moves the conversation from the present to the future by focusing on the skills that the student will need in employment and the opportunities available to acquire these skills.
5. Each student is asked to complete a PDP questionnaire which lists a total of 94 learning outcomes concerning skills and attributes that are divided into eight categories. The students rate the extent to which they currently meet each learning outcome, provide evidence if they claim competence in a particular category and identify appropriate actions if they need to improve their competence. (A section of the PDP questionnaire covering one of the learning outcome categories appears in Figure 1.)
6. Students email their completed PDP questionnaires to their personal tutors and a meeting is arranged where the student's ratings are discussed. Amendments or additions to the student's responses are made if both parties agree. In effect the completed questionnaire becomes the first version of the student's "progress file".

Students will update their questionnaire responses, in conjunction with their tutors, when they return to university for their second year (using the "2nd Year" column shown in Figure 1). Their revised ratings will reflect the progress they have made during their first year (including the summer vacation period). It is intended that the next step will involve a transition to the University's e-folio facility, although some customization of the e-folio will be necessary before it is compatible with the PDP questionnaire. The transition will require students to transfer information from their questionnaires. Thereafter they will assume responsibility for maintaining their e-folio files, although tutors will monitor their students' level of activity. Tutors will also continue to meet regularly with their students to discuss their personal development.

The policy of not introducing students to the e-folio in their first year is based on the need to introduce PDP on a gradual basis, with faculty involved to provide guidance and encouragement. In many cases students coming to university have no previous experience of reflecting on their learning, and the ability to engage in metacognition has to be acquired. Writing a CV as a starting point anchors the process in a familiar context, and with the help of a tutor this can be converted into the forward-looking attitude that the student must have in order to plan his or her personal development.

It has been noted that the introductory course required by CDIO Standard 4 provides the opportunity to inform students about PDP. The CDIO Syllabus also had a role to play, as it was the source of the learning outcomes listed in the School's PDP questionnaire. Specifically a customized syllabus was produced for each degree program using the CDIO Syllabus, and entries in the syllabus relating to student skills and attributes were selected to form a subset that was applicable to students in their first year. Detailed learning outcomes were then generated for this subset, which were listed in the PDP questionnaire. When students transfer to the e-folio at the start of their second year, the list they will be presented with will contain additional outcomes relating to new skills they are expected to acquire by the end of their second year. Further skills and their associated outcomes will be added at the start of the third and fourth years, so that the fourth year list will cover all of the learning outcomes defined for a student's program.

2	PRESENTATION SKILLS		RATING SCALE	True	True to a large extent	True to some extent	Not True	1st Year	2nd Year
				3	2	1	0		
A	ORAL PRESENTATION	a	I can present a talk to an audience of, say, 20 or more people without becoming unduly nervous.						
		b	I can talk to an audience in a confident manner without hesitation in my speech.						
		c	I can present the points I want to make in a clear, concise and interesting way.						
		d	I can maintain eye contact with an audience, while only occasionally looking at my notes (or the screen).						
		e	I can use appropriate gestures in order to emphasize points.						
B	POWERPOINT PRESENTATION	a	I can produce a basic PowerPoint presentation that includes headings and bullet points.						
		b	I can include a diagram in a PowerPoint slide.						
		c	I can import images into a PowerPoint presentation.						
		d	I can import video and sound clips into a PowerPoint presentation.						
		e	I can include a table in a PowerPoint slide.						
		f	I can use the custom animation facilities in PowerPoint.						
		g	I can use the slide transition facilities in PowerPoint.						
							TOTAL (out of 36)		

EVIDENCE TO SUPPORT YOUR CLAIMS OF COMPETENCE IN PRESENTATION SKILLS:

POSSIBLE ACTIONS TO IMPROVE YOUR COMPETENCE IN PRESENTATION SKILLS:

Figure 1 Section of the First Year PDP Questionnaire on Category 2: Presentation Skills

5. Supporting CDIO Implementation with PDP

The most obvious way that PDP supports CDIO is that it directly addresses one of the skills in the CDIO Syllabus i.e. "2.4.5 Awareness of One's Personal Knowledge, Skills and Attributes". To use CDIO's ITU classification, this skill is "introduced" in an introductory course, "taught" by personal tutors and "utilized" when students complete their PDP questionnaires.

CDIO Standard 2 requires specific, detailed learning outcomes for personal and interpersonal skills, and product, process and system building skills. Unfortunately students are often unaware of the learning outcomes that have been devised for their degree programs. If, as indicated, the learning outcomes for skills referred to in Standard 2 are listed in the students' PDP questionnaires and progress files (and they are required to think about each one), the School's expectations should become much clearer, and the time devoted to producing learning outcomes will be more worthwhile. It could be added that in their roles as personal tutors, faculty will also become more familiar with the program outcomes, which is a further benefit.

CDIO Standard 3 calls for an "explicit plan" to integrate personal and interpersonal skills and product, process and system building skills into the curriculum. A companion paper presented at this conference [10] refers to the "explicit plan" as a Skills Development Plan and makes the point that such a plan should include a review of all possible opportunities for students to develop their skills. The review should extend to work placements or internships, study abroad programs and extra-curricular activities. As a result, part of the responsibility for meeting program outcomes may be assigned to periods when students are away from university. During these periods faculty will have little influence over whether or not students participate in learning activities that address the program outcomes. However, if a PDP system is in place, students will be aware of the outcomes they are expected to achieve, and can be told that it is their responsibility that the outcomes are met. Hence PDP can support the attainment of program outcomes in situations where students are away from university.

CDIO Standard 11 deals with the need to assess all of the skills and attributes referred to in the program learning outcomes. This is a challenge, especially in the case of attributes that relate to personal traits such as self-confidence, perseverance, initiative and adaptability. However, the PDP questionnaire and progress files will list outcomes relating to personal traits and other skills and attributes that are difficult to assess. Hence all skills and attributes will at least be self-assessed as part of the PDP process. The question is whether or not self-assessment is an adequate surrogate for objective methods of assessment. The literature is relatively positive on this question. Bartimote-Aufflick and Thomson [11] conclude after a study involving applied science students that "students are well able to assess themselves realistically". Cassidy [12] compared students' estimates of marks with marks awarded by tutors, and the results indicated "a good level of self-assessment skill in the majority of students". However the author qualifies this statement by noting that "those students judged as more able academically were also more able to self-assess with more accuracy". A similar exercise by Sarin and Headley [13] came to the same conclusion, but the authors make a distinction between formative and summative assessment, by noting that "if the purpose of student self-assessments is formative in nature, their use can be justified" but "the use of self-assessments to satisfy summative evaluation requirements is questionable". Arguably the student skills and attributes that are difficult to

assess are dealt with adequately through formative assessment, and hence self-assessment can be regarded as a viable alternative.

CDIO Standard 12 concerns the need for program evaluation, primarily for the purposes of continuous improvement. Program evaluation should include an analysis of assessment data to establish the extent to which program outcomes have been met. As indicated, some outcomes are inherently difficult to assess but PDP can provide an alternative if self-assessment is acceptable. The use of self-assessment information for program evaluation may be informal with faculty providing feedback on outcomes that their tutees found difficulty to achieve. This may lead to a consensus that changes are needed in the program to improve the delivery of the outcomes involved. Alternatively, it may be possible to aggregate student self-ratings (providing this can be done anonymously) in order to produce statistical data for each learning outcome listed in the students' questionnaires or progress files. The data obtained would then be considered along with the available objective assessment data, as a basis for informing program evaluation.

In the School's case, tutors submitted their students' PDP questionnaire results for entry into a spreadsheet (with the students' identities removed). Subsequent processing of the data suggested a number of changes that will be made next year, primarily to the introductory course curricula. For instance, additional material will be introduced to improve students' awareness of their career options, more attention will be paid to critical and creative thinking and new assignments will be introduced to improve information literacy. To accommodate these additions, the time spent on developing computing skills will be reduced.

Figure 2 provides an overview of the role that PDP can play in supporting and enhancing the CDIO approach. The figure highlights the direct contribution of PDP to the development of metacognition. It also reflects the fact that a different set of learning outcomes is needed for each year of a program as new skills are added to the list. As implied in the figure, students are expected to seek opportunities for developing skills through extra-curricular activities, work placements and study abroad programs. The resulting improvement in their skills or attributes should be reflected in the ratings they award themselves in their questionnaires or progress files, and they should make a point of recording the supporting evidence. The role of PDP as a source of information for program evaluation is also shown. As noted, this may be limited to qualitative feedback from tutors but, if anonymity can be preserved, useful input can be obtained from the self-assessment data that students produce. Hence it is apparent that there are a variety of ways that PDP can enhance the implementation of CDIO.

6. Discussion and Future Developments

The introduction of PDP for all first year students in the School has been reasonably successful. Student engagement was encouraging if not complete, with 75% of the students submitting PDP questionnaires and discussing their responses with their tutors, sometimes at great length. In itself the increased dialogue between students and tutors represents a significant benefit.

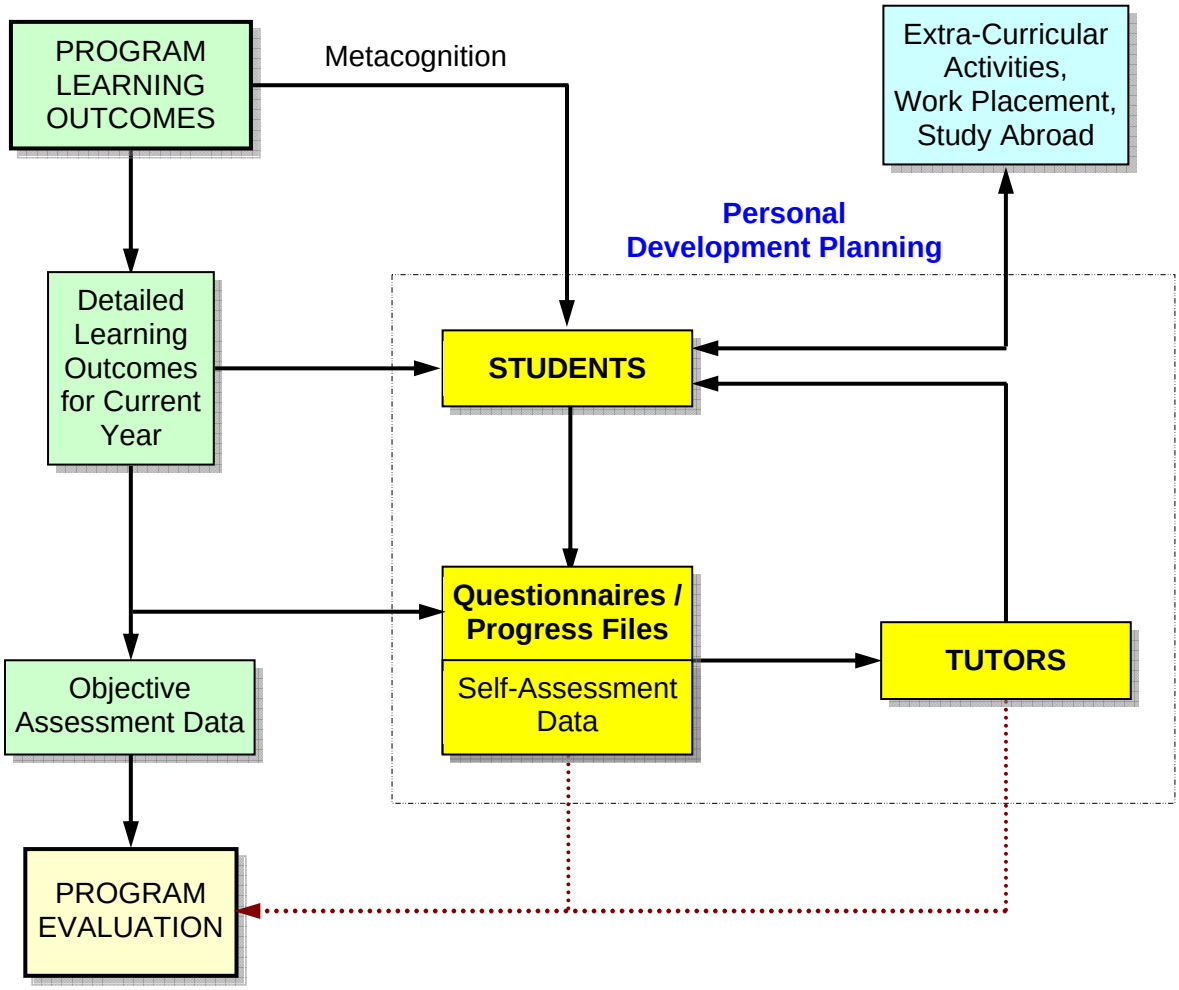

Figure 2 The Role of PDP in delivering Program Outcomes and informing Program Evaluation

The students who did not participate in the PDP program were, for the most part, students who are less able academically. This is a matter for concern and it is planned that next year more time will be devoted to preparing students for PDP in the introductory courses. Some of the additional time will be spent persuading students of the benefits of participating in PDP. However, a number of authors have questioned whether all students have the ability to engage in metacognition. Quinton and Smallbone [5], for example, note that it is possible that "some students are not able rather than not willing to engage in the reflection needed to undertake PDP". However, there appears to be no evidence that students cannot learn to reflect. Hence it may be that learning experiences can be included in the introductory courses that help students to develop their ability to reflect. To some extent this is following the example of Bowen et. al. [3] who believe it is necessary to "teach" PDP.

It has been noted that the School's intention is that students will transfer to an on-line version of the progress file at the start of their second year. It would be desirable if, in the longer term, the on-line facility could be provided with additional functionality. Consideration could be given to some of the features included in the software described by Carroll et. al. [9], which was cited as an example of an e-portfolio that was not developed specifically for PDP. The concept of

software that would support PDP, but at the same time allow students to archive useful material, collaborate with others and indulge in social networking is one that may appeal to a significant number of students.

7. Conclusions

The introduction of PDP represents a policy initiative that has been unique to the UK. Despite the difficulties and confusion, the initiative will have been worthwhile if, in due course, students accept greater responsibility for their learning and attach more importance to the development of their skills. The focus on skills is compatible with CDIO, and the CDIO Syllabus provides an important basis for identifying the skills that should be included in PDP questionnaires or progress files. CDIO insists on a curriculum that emphasizes active learning and includes extensive design-implement project work, therefore students will have significantly more opportunities to develop their skills than in a traditional curriculum.

The benefits are mutual, as PDP can assist the implementation of CDIO. PDP provides a mechanism for bringing the skills and attributes included in the CDIO Syllabus to the attention of both students and faculty. It encourages students to look "beyond the classroom" for opportunities to develop their skills, and provides a means by which they can monitor their progress. It also raises the possibility of informing program evaluation by generating feedback on learning outcomes that are inherently difficult to assess. In view of these benefits it is suggested that other CDIO collaborators could consider adopting PDP as a means of supporting and enhancing their implementation of the CDIO approach.

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