INNOVATION IN WORK-BASED DOCTORAL LEARNING: INITIAL FINDINGS AND OBSERVATIONS FROM THE PRINCE OF WALES INNOVATION SCHOLARSHIP PROGRAMME AND ITS NEW PEDAGOGIES

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Abstract

Work based PhD placements are not new, but they are not common in the UK. Pedagogic research into the real-life effects of work based doctoral learning requires large enough cohorts to make useful assessments and the Prince of Wales Innovation Scholarship (POWIS) programme offers a unique on-going opportunity to do so in the UK context. The POWIS programme is also an interesting test subject as the programme is in early stages and is able to take on board recommendations and to improve it methods.

The POWIS programme began in 2009 and is considered innovative in its own right in that it places PhD scholars full time in private companies for the duration of their studies to invent, investigate or develop intellectual property on behalf of the host company. Scholars are able to access the resources of both the company and the university as well as project management support andco-ordination from experienced staff at the University of Wales that have undertaken PhDs through work placement themselves. The programme was initially set up by the University of Wales in response to a failure by universities to collaborate effectively with private companies in Wales.

Research undertaken between 2007 and 2009 confirmed that the PhD placement model could overcome many of the problems previously experienced with academic-industry collaboration. At the time the pedagogy behind this model was not well understood but was considered to be suitable, practical and that positive quality results could be achievable using existing best practice methods experienced by programme staff prior to the programme being designed.

Since 2009 the programme has placed 31 scholars and they have already been responsible for innovations in the companies where they are placed. Interestingly the pedagogic model involved has also had benefits as it appears to be able to overcome some of the barriers to structuring learning, inspiring idea generation, improving critical thinking and thesis completion that are experienced in the traditional PhD model.

The paper outlines initial observations and feedback from the programme participants that suggest positive results for student motivation, depth of learning and student engagement as well as some major improvements on the traditional doctorial study pedagogy in the UK. The research also raises questions on how the private sector input may bias or otherwise influence academic rigour, and if it does, how this may have an impact on the quality of research degrees offered in this way.

Keywords: Innovation, pedagogies, Prince of Wales, scholarships, PhD, doctorate

1 INTRODUCTION AND BACKGROUND

1.1 Trends in doctoral education

A recent article in Nature [1] stated that the number of PhDs earned each year has grown and continues to grow across the OEDC at rate a greatly in advance of the number of academic posts available. One of the major highlights of this article was the recognition that most doctoral graduates don't go into academia. While this has been recognised as the case in the UK for some time [2] [3] [4] the drive to increase the number of PhDs, in the face of reduced funding and reduced research posts

still continues and postdoctoral graduates often find themselves in positions that do not require a PhD to perform, or lose out to lesser qualified and more 'streetwise' graduates when applying for jobs [1][5]

There are many complex and often political reasons for this trend in UK Higher Education Institutions however, these are subject of many other papers and will not be discussed further here. What is worth noting that they do exist and have been covered extensively in the literature since 1999 and the Dearing Report and in particular its recommendations around providing higher education for the wider context, for employability and for student life-long learning [6].

As well as this growth in PhD numbers against a backdrop of unemployment for successful doctorate graduates, it has also been made clear since by a number of authors, most comprehensively reviewed by Sinclair in 2004 [7], that the quality and standard of PhD supervision and examination is inconsistent at best, inadequate or poor at worst. Sinclair's report didn't just focus on the context of Australia in which is was written, but cited a wealth of research into the status of PhD teaching and learning in the United Kingdom which concluded that the situation in the UK, as in Australia and Nordic countries, was*:*

' a research training environment associated with poor supervision, inadequate levels of departmental support and limited access to quality infrastructure high attrition rates and slow rates of completion for research students '

These two points raise a bipartite question for postgraduate educators: is the current pedagogy for PhD research and supervision as effective as it could be; and, is it turning out graduates that are fit for purpose? Making the assumption that there will be no drop in the availability of potentially brilliant PhD students able and willing to pursue this prestigious qualifications, suggestions have been made that the PhD system in the UK could move towards that practices in Germany where the PhD is marketed not only as advanced training for academia but also as advanced training for position in the wider workforce [1].

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1.2 The apposite doctorate for today's society

Back in the year 2000, Winter *et al* [8] stated that Higher Education Institutions (HEIs) were facing a fast moving and changing environment, where the HEI was being encouraged to come into closer cooperation with other workplaces and that there was an uncertainty about the foundations of knowledge. This only backs up the supposition above and it appears that the rise in professional doctorates in the UK including DEng, DNP, DNC, DNurse and DBA qualifications [9] is a direct response by universities to provide fit for purpose response to this need. However, even though these new doctoral qualifications are numerous and increasing every year, these don't cover the full range of `new knowledge workers' that are seeking a higher research degree to differentiate themselves in the job market. In particular this applies to those who operate in areas not covered by specialized doctorates or those who wish to pursue trans-disciplinary programs [10]. In fact, the potential difficulties of having such a wealth of new degrees validated and quality assured means that professional doctorates are unlikely to ever cover a wide enough range of subjects to the standard and expectations of employers.

With this situation becoming acute for many institutions, there is a surprising lack of literature on how to exploit this new opportunity to create and deliver the apposite doctorate between subject of practice or work-based PhDs [2][8] and an even lighter coverage on the suitable teaching methods for this approach.

What the review of the existing, and scarce, literature does show is the base line problem facing the existing establishment; why PhD students don't complete their degrees. As well as the expected lack of completion due to lack of academic prowess, other results suggest lack of funding, lack of suitable supervision, offers of other greater opportunities near the end of their research and unsuitable research environments. There is even less critical literature on the suitable pedagogies for successful PhD supervision and nearly nothing on how these are affected or can be improved by undertaking PhDs in a working environment.

It seems that much of the literature into pedagogies for PhDs and suitable supervision is responding to the supervisor agenda – increasing the numbers of students in order to support departmental research, supporting supervisor's need for more time to supervise or just to state unfairness in the process with few strategic suggestions for improvements to address these issues. This paper

presents a case study of a programme of work-based PhD students in the UK and the hypotheses that this model could not only overcome some of these problems, but also improve the consistency of PhD education and producing apposite doctoral graduates capable of usefully contributing to employers' needs outside of academia.

2 HOW THE DOCTORAL CANDIDATE IS TAUGHT

2.1 Seeking answers in the literature

Commonly used handbooks and instructional texts available to doctoral supervisors provide much guidance on the structure of the thesis, methodologies for research, research discipline, the requirements of the doctoral candidate, checklists of examiners' requirements and other elements of the doctoral *process*. However, there appears to be a dearth of content on the pedagogies for teaching doctoral candidates, which would be seen as a major and obvious omission in other forms of teacher handbook. The phrase 'doctoral candidates' is a clue here. It is used instead of 'doctoral student' and there seems to be an unspoken assumption that the 'doctoral candidate' has learnt everything they need to be taught in their field with the exception of new knowledge learnt through their own experimentation, investigation or analysis. The general expectation appears to be that they do not require pedagogies at all, but rather support in their candidature that comprises; assistance with resources to undertake their research, advising on topic or field, and developing the academic writing style. Taylor and Beasley [11] do not mention the term pedagogy in their extremely popular standard textbook 'A Handbook for Doctoral Supervisors' instead taking an approach which suggests that the PhD candidate isn't a student but a future colleague in need of direction. This is not a failing on the part of the authors, but more on the culture of doctoral supervision in the UK as a whole.

A deeper look into other texts and journal articles which compare the modes of learning between standard and work based learning for research students [12, 13, 14, 15], suggest that the following are most commonly utilised:

- Self-directed, or externally directed research
- Attending conferences or lectures
- Experimentation and testing
- One to one tutorials

Of these, only one (experimentation and testing) utilises psychomotor and cognitive skills, the others primarily being affective modes of learning that rely heavily on reading, watching listening as opposed to the more active learning modes of debating, presenting, making, participating, teaching, or explaining.

In the case of professional doctorates or new-mode doctorates, a range of affective pedagogies more commonly associated with undergraduate degrees or adult learning may also be included: seminars and workshops as well as observation, practice and reflective or action learning. All of these are what can be called adult modes of learning; they are the responsibility of the student and rely on the student's motivation and willingness to learn to be effective and for learning achieved through them to be retained and utilised.

2.2 Common problems with current supervisory practices

Having identified that the research student needs different instructional methods to the child or adult learner, but that this concept is in it's infancy, it isn't surprising is also evidence that suggests that this hasn't been successful put into practice. The Higher Education Funding Council for England (HEFCE) study of PhD completion rates as recent as 2007 [16], states that between 30 and 37% of students in full time the study completed their PhD within four years. Given that funding for PhD students often runs out in three, and at most four, years it isn't surprising that around 25% of students failed to complete their thesis at all in a seven year period.

This phenomenon is duplicated in the USA, Canada, Europe, and Australia. In Australia, the study by Sinclair [7] collated data on completions and suggested that PhD research in Australia was suffering

the same problems as international counterparts, with students undertaking their candidature in an environment of “poor supervision, inadequate levels of departmental support and limited access to quality infrastructure”. In fact, research in Australia continues to move forward to identify the reasons for these failing in light of the damning report made on behalf of the Commonwealth and whether new methods have improved the process [4][17][18].

Park’s 2005 study into the common problems associated with poor completion and progression rates suggests that students that fail or are late to complete have common qualities:

- Repeated absences and not being missed or chased
- Missing scheduled meetings
- Failing to generate text
- Students mystified and confused by the PhD process
- No ability to pursue grievance against supervisors

In addition, common elements of supervision are considered to contribute to the pattern of failure or non-completion and supervisors that avoid them have much higher success rate.

- Inexperienced and ‘hands off’ supervisors
- No clear structure, nor teaching about the principles of a clear structure to manage the research
- Lack of ‘pastoral’ support,
- Being unavailable or minimising contact time
- Lack of trust between the supervisor and the candidate

Recruitment processes and additional teaching or training for candidates are considered to be positive ways to improve the likelihood of success, whilst statistical data from the HEFCE study of PhD students in the UK [16] suggests that age on entry can have a negative effect on completion rates, but that industrial sponsorship has no statistical impact on likelihood of completion.

2.3 Summary on doctoral teaching

Even at the initial stages of this research, it can be seen that the literature on doctoral students doesn’t focus on the teaching methods, instead treating doctoral candidates as self-motivated, independent adult learners, as characterised by the PhD students of the 1870s when the degree was first brought to the UK from Europe via the USA. In contrast initial research suggests that contemporary doctoral candidates occupy a niche in the learning environment that isn’t being addressed adequately and it should therefore come as no surprise that the results on successful completions show a worrying percentage of failures attributed to poor supervision and lack of student motivation.

3 RESEARCH INTO A NEW MODEL FOR PHD TEACHING

3.1 Research opportunity

The Prince of Wales Innovation Scholarship (POWIS) programme began in 2009 and is considered innovative in its own right in that it places PhD scholars full time in private companies for the duration of their studies to invent, investigate or develop intellectual property on behalf of the host company. Scholars are able to access the resources of both the company and the supervising university as well as project management support and coordination from experienced staff at the University of Wales that have undertaken PhDs through work placement themselves.

The programme was initially set up by the University of Wales in response to a failure by universities to collaborate effectively with private companies in Wales. Research undertaken between 2007 and 2009 [19] suggests that the PhD placement used in the POWIS model could overcome many of the problems previously experienced with academic-industry collaboration. At the time the pedagogies behind this model were not well understood but it was considered to be suitable, practical and that positive quality results could be achievable using existing best practice methods of supervision.

The POWIS programme also represents a further research opportunity in that the programme is managed by the same team, but the Scholars are supervised in different Universities in different disciplines. Other studies address students in single disciplines, such as social sciences, medicine, engineering or other disciplinary and cross-disciplinary frameworks but it appears that few studies have the latitude to investigate the obvious similarities between multiple disciplines, or research activities in the way that the POWIS process has in its short time to date

3.2 Research opportunity and methods

This study represents observations and findings from informal interviews and questionnaires undertaken to investigate the Prince of Wales Innovation Scholarship (POWIS) programmes as an ethnographic case study.

Research data was gathered by a member of the POWIS team, including primary data from student feedback, companies and external reviews and secondary data from external evaluation reports of the scheme.

Analysis has been undertaken in the form of thick description of the observations undertaken as well as simple key word trend analysis.

This study is considered to be an initial review of the programme to date in the context of the pedagogies and methods used with the POWIS scholars as analogues of doctoral candidates in a work-based environment.

4 FINDINGS

4.1 About the Prince Wales Innovation Scholarships

Each doctoral candidate undertakes a PhD in Wales (UK) for a three year period. The PhD is supervised by a University using its usual PhD agreed and validated processes. The Scholar receives a generous £20,000 per year scholarship bursary and a one off £5000 research grant eligible to be spent on IT equipment and software, travel, subsistence and training or workshops. All PhDs are supervised using a process validated by one of 6 Universities that has received a confidence judgement by the Quality Assurance Agency (QAA)[20] No change is made to the administrative process of the candidature.

The real changes are as follows:

- Placement in a company undertaking research designed and required by the company (Industrial Supervisor)
- Amended academic supervision role
- Innovation Fellow
- Regular quarterly meetings
- No overhead for administrative costs

Each of these elements is addressed below to provide a basis for understanding the success factors in the POWIS pedagogies.

4.1.1 Placement in a company

Each POWIS Scholar is recruited to undertake research required by, and based full time in, a company in Wales. In order to be eligible for the scheme, the company can be any size, but most are small (less than 49 members of staff) and many are start ups or in the early phases of growth. The company pay between £16,000 and £20,000 per year for the scholar, which contributes towards the Scholar's bursary, as well as the research grant, management, fees and supervision costs [21]. The company must provide the research opportunity, an industrial supervisor to act as 'line manager' at the work place and also to commit to providing research environment suitable for a doctoral candidate.

4.1.2 Academic supervision

The only changes from the usual supervision of doctoral candidates is that the supervisor is paid on an hourly basis, as evidenced by timesheets sent to the University of Wales Global Academy (the project sponsor), and as such no administration fee is paid to the central administration of the university as is the case with other placement schemes. In fact, there is little if any administration required by the supervisor other than that which would normally be required for a standard student to enrol, register and progress on the programme. The academic supervisor is also required to provide evidence of 70 hours of supervision per year, including face to face, online, telephone or background research to the project, giving a consistently high amount of supervisión [22]. This level is considered to be high in comparison to many PhD supervisory experiences in practice.

4.1.3 Innovation Fellow

The last member of the expanded supervisory team is the Innovation Fellow. The Innovation Fellow works for the University of Wales Global Academy, the department that runs the scheme in Wales, and is either a graduate of a work-based PhD scheme, or a University industrial liaison officer with valuable experience of the work-based environment and excellent knowledge of the academic process. The Innovation Fellow's role is to the project manage the POWIS projects, to make sure that the Scholar is able to communicate effectively with both the academic and industrial supervisors when there may be perceived tension between the two, to assist the Scholar to get additional skills or training, familiarise the scholar with the PhD process and structure where required and to assist them to widen their research and work networks and skills.

This role encompasses the four traditional siloes of University employment, and in doing so steps over traditional boundaries between: administration, human resources and finance; project management and central business development; academic support, and; academic (research and teaching).

4.1.4 Regular quarterly meetings

The POWIS process requires the supervisory team of the Industrial and Academic supervisors, plus the Innovation Fellow to meet with the scholar four times a year on a formal basis. These meetings take the format of a formally chaired business meeting, with agendas, minutes and other tabled papers as would be expected in the workplace. The meetings address any issues of conflict as well as updating all parties on progress, giving the Scholar a chance to practice their presentation and communication skills around the project in a business-like environment, whilst also providing opportunities for the academic and industrial priorities to be aligned.

4.1.5 No overhead for administrative costs

The University of Wales (the project sponsor) does not pay any administration or overhead costs to the supervising university, other than the costs for hourly supervision. As such, the programme is not as attractive to Universities that use similar programmes such as KTP or Case scholarships to improve cash flow into the University. This results in a form of self-selection – the academic supervisor and university have to be certain and enthusiastic about the collaborative project with the industrial partner before agreeing to take on the PhD supervision role. As a result, the supervision is often of a high standard, with the supervisor taking an active interest over and above the 70 timesheeted hours per year motivated by the involvement with the company and the real-life problem solving opportunity [23].

4.2 Observations of the scheme in practice

Since 2009 the programme has placed 39 scholars in 28 companies in west Wales. Of these, eighteen have been running for longer than twelve months with three reaching the two year milestone in December 2011. During this time two scholarship agreements have been terminated as a result of lack of academic quality and progress and another scholar has voluntarily left the scheme. The remaining 36 scholars have all progressed smoothly through the academic quality processes in place for progression.

It is clear that any observations made at this point can only relate to how the POWIS model impacts on the scholarly process in the early stages of the PhD and make some assumptions on how this will carry through to the final year of study and completion. This is not to say that the observations are without merit; the first year is an important stage in the PhD process when many students can waste

valuable time, slowing completion, or leave the programme altogether often citing lack of motivation, inadequate support or stress.

The rest of this section summarises the observations made of the scholar progress, the process and the outputs as a result of the POWIS programme to date during their first years.

4.2.1 Observations of the process

As has been stated earlier, the POWIS model utilises the same quality assurance and validation process as the traditional doctorate but it varies from both that and the professional doctorate programmes in that it introduces a series of project management controls into the process; the application process, the recruitment system, Quarterly Review Meeting (QRM) and varies the role of the supervisors. These observations are corroborated by information from the two external evaluation exercises undertaken on the Project during 2009 and 2010 [23][24] and the observed effects are examined in more detail below and will be explored later on as contributors to the likely high completion and success rate of each academic project.

Industry Panel, application and selection

The first non-traditional process that informs each POWIS project is the independent industry panel application and selection process. During this process the proposed project is tested by a panel of industry leaders for economic rigour. This is because the part-funding for the project to date has come from economic development monies of the European Union and so the application process tests eligibility criteria for each project and whether the project under assessment will increasing the investment potential, bottom line profits, number of staff employed or additional university collaborations of the applying company. If the project is unlikely to result in any of these positive economic benefits, the part funding will not be provided and the project will not go ahead. It has been observed that this process imparts a level of authenticity to each business project that both cements the relationship of the industrial collaborator with the project but also informs the perception of the Scholars and academic supervisors that each project is a necessary and important piece of work driving economic change.

Recruitment process

Recruitment for POWIS scholars differs from the traditional process in that the industrial supervisor plays a key part on the recruitment team. Standard announcements for the scholarships advertise the higher than average scholarship bursary of £20,000 per annum plus £5k research grant while the standard criteria also state the applied nature of the PhD projects and may state that work experience is desirable. These are criteria much more familiar to graduate schemes than typical PhD studentship advertisements.

The potential scholars then apply by sending a CV and personal statement. The decision to request free prose rather than a form-driven application process has received positive feedback from the supervisors in that the personal statement allows the recruitment team to identify whether the candidates have been proactive in researching the scholarship, how they have prioritised and focussed their communication and how they come across as a individuals. While these are areas that are considered important but not essential for an academic recruitment, the POWIS process is recruiting a person to join a small team for a minimum of three years and fit with the team is considered to be absolutely essential. Applications from recent graduates with excellent cutting edge research have lost out to less academically proficient candidates with relevant work experience that represented the right enthusiastic or pragmatic attitude at interview.

This form of selection may be one of the factors in the high satisfaction rates with the POWIS process from the point of view of the scholar and the industrial collaborator and may be a contributing factor to success rates later on; the POWIS process selects self motivated and enthusiastic individuals that value the ability to study for an academic qualification in a way that has a direct application in the real world.

Quarterly Review Meeting (QRM) process

As stated earlier, each scholarship starts with an initial kick off meeting that brings together the ‘project team’ of scholar, academic supervisor, industrial supervisor and innovation fellow.

Meetings then occur every three months with the secretariat being performed by the Innovation Fellow and the meeting chaired by the business representative (industrial collaborator). This meeting is the

opportunity for any tensions between the parties to be aired. As stated, each party is contracted to the others through a number of agreements which require disclosure, participation and cooperation between the parties whilst reinforcing trust issues to do with confidentiality, publication and intellectual property. In practice such a contract requires a good working relationship between multiple parties and the Quarterly review meeting has been observed as the most commonly utilised practical opportunity for this to be reinforced. With a standard but formal agenda, Chair, minutes and papers as well as a requirement for presentation from the Scholar, the meeting also has a role as a training ground for students in business skills (presentation, communication, preparation and reporting) as well as a familiar and established process for the other parties to participate in.

It has been observed that the meeting often identifies and addresses assumptions that industrial and academic parties make about the project in hand but would otherwise never reveal and could result in the scholar receiving conflicting requests or messages.

In part time or full time work-based PhDs, the student is the portal through which the academic and industrial supervisors communicate. This often leads to tensions as the student is given different priorities or direction by both and has to choose which to obey at the risk of offending the other.

In the QRM process, any tensions are discussed openly by all parties and the discourse informs the decision, with the Scholar both an active participant with an active 'voice' in the discussion and also fully aware of the thought process behind decisions. The Innovation Fellow also plays an important role (as will be discussed further below) in questioning assumptions, testing direction and priorities and having an independent understanding of both the PhD and commercialisation processes.

This also represents a positive change to the traditional PhD process where any discourse on the subject of study is limited to the student and academic supervisor (or supervisory team) and the diversity of viewpoint is rarely introduced from outside sources. Having no third party as mediation has been reported as the cause of tensions between PhD students and supervisors and ultimately for non-completions. This challenge is overcome by the regular and sacrosanct QRM process that is one of the basic tenets of the POWIS programme.

Innovation Fellow role

While the QRM process is a formal role for mediation of supervisory tensions and encouraging discourse, in which the innovation fellow has an important role as mediator, translator and occasionally referee, the role encompasses a much wider group of tasks.

The single line in the Innovation Fellow job description that relates to POWIS states simply

"Support the needs of the Innovation Placements (Scholars) "

Reading any web forum which lists the complaints (and occasionally praises) of PhD students about their University or supervisors gives an idea of the range of issues that the Innovation Fellow portfolio includes. Add to this the role of technology transfer and translation, business advisor, incubation manager, coach, mentor, project manager and risk consultant and the picture of the role becomes clearer.

The job description and the role in practice does not place limits on how that should be done, where or with what resources. Since 2009, Innovation Fellows have helped arrange mortgages, organised visa applications, intervened with local councils to have scholars' children placed in local schools, given friendly advice on relationships, been a shoulder to cry on in the case of bereavement, coached scholars through panic attacks, assisted companies in the writing and application of patents, trademarks and registered designs, acted as test subjects for company product development, given design reviews, read hundreds of pages of draft reports, delivered parcels, provided transports, mediated arguments with landlords and facilitated relationships and networks with potential export partners overseas, provided advice on bolstering company board membership.

Two external reports on the POWIS programme as well as numerous feedback exercises have stated the presence of the Innovation Fellow as the unique selling point and strongest aspect of the POWIS scheme. The role appears to be responsible for the high level of student satisfaction, the mutual trust and respect between the academics and business and the level of positive economic and academic activity that have been observed. While some of the pastoral activities stated are not unfamiliar roles to some more altruistic and proactive staff in international offices or first year tutors, the breadth of activity expected of the Innovation Fellow, and that each innovation Fellow seems to expect of themselves.

Not only is the joint academic, administration and business liaison role more multipurpose than the traditional roles found in larger universities, but the recruitment of staff to undertake this role is far from easy. The only apparent commonality between the staff current in the role is their past experience of having undertaken academic study whilst working or part full time, a pre-existing network and level of trust amongst target communities, an unwavering dedication to do 'whatever it takes' to achieve their mission objective of delivering economic development in Wales through innovative business and academic relationships as well as recognition and acceptance that this is not a nine to five endeavour.

At the time of writing the average age of the Innovation Fellows is 37 years old but this relatively young team appear to have a 'fan club' of highly experienced, industry experts and professors that act as referees for them. To quote businesses, business support providers and academics from the 2009 external review [24]:

"When you meet good quality people they catch in your mind. And they have good quality people" "I'm a big fan of the programme…and very impressed with the calibre of people there" "my contact was absolutely brilliant".

The 2010 external review [23] gave the following feedback from scholars:

"The Innovation Fellow's role is very useful and probably necessary. They have dealt with all the problems I had effectively"

"The Fellow also has some expertise in my field which has added benefit. They have been helping evaluate a number of software packages"

"The presence of the Innovation Fellow means that communication is very strong – they have created the environment in which we [the scholars] can be successful. There are no excuses!"

The high level of student satisfaction, the mutual trust and respect between the academics and business and the level of positive economic and academic activity that have been observed seems to be in large part due to the Innovation Fellow role.

4.2.2 Observations on the academic supervision

The Academic supervision role is much more contentious. As has been stated, the Academic Supervisor is brought on board on timesheeted basis as collaborative partners and the drivers to do so appear to be the ability to retain more research students for little administrative or financial burden. Unlike other schemes where the academic supervisor benefits from an additional overhead rate for supervising a workbased placement, the supervisor is paid only for supervision time spent with the scholar, which in turn benefits the project, on a payment per hour basis. Any additional collaborative projects negotiated between the academic and industrial collaborators is considered to be a separate agreement, with the requisite additional contractual negotiations.

This has been observed as overcoming some of the issues that other work-based PhD models face where the academic supervisor faces a dilemma between providing a service to the company or a service to the student. In the POWIS model the allegiance is to the student and in maintaining the academic quality of the output. Both of these things, facilitated by the QRM process, are of value to the Company as they drive the project to be both rigorous and the scholar to be motivated.

In the early stages of the project, prior to the application process for the scholarship the level of academic input to the early project design has been varied. In practice, this appears to be appropriate. Where industrial collaborators have clear knowledge and practical expertise of their company and market needs going forward, the academic supervisor is not required (nor welcome) to question those assumptions and this is one of the most commonly observed factors in the breakdown of trust in industry/academic relationships. Business collaborators have stated having negative experiences of 'know-it-all' academics that try to change projects to suit their own research strands or that disrespect the knowledge and experience of business collaborators. In these situations, the company designs the project and the academic is utilised to bring their experience and knowledge of a subject or discipline to direct the scholar in a way that will help solve the problem.

In other cases, the Company is seeking academic expertise because they have recognised that they are lacking the knowledge or knowhow to overcome a barrier or challenge to growth. In these cases,

the academic supervisor provides alternative knowhow or strategic thinking to company direction and may dentify both the problem and a possible route to the solution.

In both of these types of relationship the scholar is the common factor that maintains the relationship as well as undertaking the practical activity to test or create the proposed solution. This may have a negative impact and reduce the possiblilities of cutting edge research.

4.2.3 Observations on pedagogies

Common to all PhD candidates is the increasing ability to teach their supervisor as their study progresses.

In the case of PhD students, this is one of the major differences from traditional pedagogies or androgogies. All doctorate models, not just PhD s share this characteristic, however the ways in which that research is directed, supported with learning and ultimately utilised to examine and judge suitability for the final degree differ.

Observations of the POWIS scholars suggest that the scholars utilise the following pedagogies that utilise a wider range of visual, auditory, read/write and kinetic learning modes than either the traditional or professional models and may result in deeper learning as well as making them more employable in practice.

- Observation and demonstration
- Mimicry or simulation (Experiential learning)
- Learning by teaching – communicating findings to others in the company and promoting change
- Reflexive reporting to the company
- Continuous formative assessment through the quarterly meeting and reporting processes

These additional methods of teaching engage and reinforce the cognitive and psychomotor learning of students while the practical application of the work appears to motivate students by placing them in a real world, rather than simulated or virtual environment, where the consequences of their activities are real and affect people, not theories. The placement with the company is an exercise in observation – it not not only prepares the students for the real life world of work, in a protected educational environment, but provides observation on the pressures, pitfalls and opportunities of undertaking research in the workplace. Because of the requirement to communicate regularly to the industrial supervisor and others on progress towards the milestones set out early in the project, the scholar utilises cognitive learning earlier in the process than traditional models, applying, analysing, creating and evaluating the data that they take in through the affective learning undertaken most often in the traditional learning.

This is a broad generalisation. Every candidate and supervisor relationship is different, however the likelihood of a student in the POWIS model being encouraged and required to integrate a higher degree of cognitive and psychomotor learning earlier in the research process cannot be questioned.

What is more, is that the above identified groups of teaching method are not specific to discipline, nor do they require special training on behalf of the industrial or academic supervisors involved in the process, although the innovation Fellow is often aware of the ways in which these cognitive and psychomotor learning styles are needed to reinforce the positive outcome and requirements for progress.

4.2.4 Observations of scholar outputs and experience

As a result of the POWIS project the scholars have stated the following as outputs of their experience:

Directly working on new products, processes that will have a commercial benefit. To date the 38 scholars can claim they had direct input to the creation of 71 collaborative projects with universities, 44 products, processes or services registered, 15 products processes and services launched, and £9.7m of investment in companies [25].

Courses including project management, team building and intellectual property and innovative networks, meeting and learning new skills from experts especially experienced practitioners.

When questioned, scholars have stated that the “Phd has more value because it is applied research”. Factors contributing to this that are repeated as themes often include the large network of scholars, companies and academics that the programme brings together regularly and that each scholar considers to be a valuable asset, the high likelihood that the research will be commercialised and the valuable PhD qualification (as opposed to having no qualification or a less prestigious one). This is particularly popular where the scholar is based in a very small company where their work is a vital part of the company growth or development and changes can be made instantaneously as a result of the Scholar’s input. Lastly, an observed theme is the collaborative nature of the discussions between Scholars. Traditional and professional doctorate students observed by the author in a departmental context are often in a conflict situation, competing for resources, praise and time with supervisors. The POWIS Scholars don’t share supervisors, nor are they in the same field or discipline and so the ease with which they can support each other and provide assistance to each other should not be surprising. However, the overwhelming responses from the first 16 students, was that the community of scholars contributes greatly to their scholarship experience and they would hope for more.

When asked to state what they would like to see as improvements, the responses have been vague and often operational. The provision of a timetable and more time were common themes, and seem to be common to all PhDs in the UK, given the data from 2007 HEFCE report on completions of PhDs. Given the short timescales required for business outputs, it would be preferred by the project sponsors to keep the scholarships as a three year programme, however the level of completions and outputs in that time will need to be assessed over the next few years to provide accurate data to analyse whether this is realistic.

5 DISCUSSION AND CONCLUSIONS

Since 2009 the programme has placed 31 scholars and they have already been responsible for innovations in the companies where they are placed. Interestingly the pedagogic model involved has also had benefits as it appears to be able to overcome some of the barriers to structuring learning, inspiring idea generation, improving critical thinking and thesis completion that are experienced in the traditional PhD model.

The paper outlines initial observations and feedback from the programme participants that suggest positive results for student motivation, depth of learning and student engagement as well as some major improvements on the traditional doctorial study pedagogy in the UK. The research also raises questions on how the private sector input may bias or otherwise influence academic rigour, and if it does, how this may have an impact on the quality of research degrees offered in this way.

This Innovation Fellow role appears to be the greatest individual change from the traditional PhD or Professional doctorate programmes. Although it isn’t stated explicitly there is an understanding that the Scholars are undertaking a new variant model of phd which aims not to produce the next generation of lecturers or professors, but the next generation of employable experts with an academic qualification. This understanding is accompanied by a tacit agreement that the traditional PhD process in Universities in Wales requires a second layer of mentoring, teaching and direction to give students that additional factor of employability and ability to cope in the work environment.

The POWIS Project represents an excellent opportunity for continued study as the first cohorts of scholars move throught the scheme. At this stage, there is a high likelihood of the projects benefitting from the research being completed and implemented as a result of the continual opportunities for learning, data gathering and motivation by the supervisory team. However, the potential for the scholars to all complete and submit their theses successfully is less certain. A high number of conflicting pressures act upon each scholar to complete their academic as well as commercial reporting and as a result there is a potential that students will neglect to submit final theses in favor of continued paid employement at the placement company or another employer. There is therefore a need to continue the research and observations of the POWIS scholars as they complete their PhDs. Scholars will be surveyed regularly as supervisors to further establish the ways in which the POWIS model can be utilised to improve doctoral teaching in the workplace, and to determine how effective the model is in the long term when compared to the UK average completion rates for full time doctorate study.

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