ID 034: Student Learning at the Interface of University and Industry, demonstrated in Final Year Civil Engineering Assignments

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Abstract
This paper engages with student learning at the inter-face of the university and the workplace. It examines student essays submitted in partial fulfilment of a course in Professional Practice that forms part of the Civil Engineering under-graduate degree at the University of Cape Town. Specifically, this assignment tests competence in one of the Engineering Council of South Africa's eleven exit level outcomes, that of Engineering Professionalism (ELO 10).

The assignment requires that the students' reflection of their understanding of ELO10 in the light of their practical workplace experience goes beyond an objective account of what was observed on-site. It needs to engage with the significance of the specific practical experience on their understanding of what it is to be a professional. This effectively enables a transformative engagement where both the student and the context of learning (the construction site) are changed by the interaction.

The analysis reveals important contributions from the student that can strengthen the professional ethos of industry. In this way the research plays a transformative role in both industry and the university, as it extends the knowledge of student learning as regards ethics and professionalism.

Introduction

Student learning within a professional engineering qualification may be seen to transition from a focus on acquiring professional knowledge through the development of the ability to apply professional judgement towards the goal of expertise (Young and Muller 2014). This paper sets out to document this transition in student learning regarding what it is to be a professional as demonstrated in engineering students' responses to their engagement with industry as part of the fourth year course, Professional Practice, within the under-graduate Civil Engineering degree at the University of Cape Town. As such, the students' assignments are accessed as evidence of students' learning relating to professionalism that occurs at the intersection of the university and industry.
The interface of the university and industry is examined as a particular site of learning-in-practice for students. The analysis will aim to interrogate the following questions:

- What learning?
- Learning by whom?
- Learning for what purpose?

From this critical engagement, strategic initiatives are identified to enhance the transformative effect of the engagement within the engineering profession in South Africa.

Theoretical context

The research profiles learning occurring at two distinct levels:

- Overt student learning regarding professional practice as demonstrated in student essays
- Covert learning concerning power relationships and priorities that is acquired by means of the students' involvement with professionals at the construction site.

The theoretical context builds on an understanding of learning as both acquisition of knowledge and the development of discursive identity (Allie et al., 2009: 362) where opportunities are identified for students to acquire and practise discourse relating to their development of a professional engineering identity.

Engineering professionalism may be positioned as a threshold concept in that it "open[s] up a new and previously inaccessible way of thinking" (Meyer and Land, 2003:1) about what it is to be an engineer. This needs to be made accessible to students in order for them to engage with the concept in a manner that facilitates it becoming part of the engineering students' discourse and identity. Engaging with professionals on a construction site thus provides a platform for the student to engage with the concept of professionalism in a practical context. Reflection on that experience provides the opportunity to integrate contextual knowledge with theoretical knowledge in a way that requires the learner to move between theory and practice and to engage with the process of professional identity as the '"being and becoming" dimension of learning (Kinchin, 2016: 92).

As a threshold concept, "professionalism" provides a portal to troublesome knowledge that is not immediately accessible (Meyer and Land, 2003:1). A growing understanding of professionalism enables the student to grapple with the consequences of expanded knowledge in both practice and theory and to be prepared for the next steps in taking on that professional identity. Troublesome knowledge may be defined to include one or more of the following types of knowledge:

> "ritual knowledge (that forms part of the routine of the discipline, but whose underlying meaning may remain opaque to the novice observer); inert knowledge (that may remain isolated and disconnected from real-world problems); conceptually difficult knowledge (that is difficult to grasp and whose acquisition may be impeded by commonly held misconceptions); alien knowledge (which comes from a perspective that is not held by the student and may be counter-intuitive); tacit knowledge that can remain hidden from view and is rarely verbalised, even by experts in the discipline; and linguistically inaccessible knowledge where disciplines utilise specialist terminology or jargon, to help brevity in communicating complex ideas within the community but which may exclude 'outsiders' from that community (Kinchin 2016:92).

In applying this definition of troublesome knowledge to professionalism, there is a clear sense of the word operating on several levels including "ritual" knowledge and "jargon" by the engineering profession; "conceptually difficult" knowledge, "tacit" knowledge and even "alien" knowledge.

Student learning is seen to be both the focus and the context of the research, and thus open to be changed by the process of reflection (Lillis, 2015:41). This is inherently different to the view which considers research learning as objective and requiring arms' length reflection of a static reality. In learning it is "the change, the dynamism between knowledge structures that is of greatest interest" (Meyer 2008:97). In this context of working at the interface of the university and industry, this process can be seen to model a "genuinely dynamic social process" (Engestrom and Sannino 2012:49) of learning that supports the process of transition that takes place in the students.

There is the assumption that the process of engaging critically with professional engineering policy and practice is potentially productive and beneficial. In this way there is both an analytical purpose, as well as a transformative intent. Furthermore, it models an implicit understanding of the potential of the university to play a transformative role within and in collaboration with industry.

Practical context

This analysis contributes to the debate exploring the readiness of engineering students to participate effectively in industry (Martin et al., 2005; Pauw et al., 2006)). By focusing on student responses to this engagement with industry shown in their assignments, the paper contributes to building new knowledge about students' learning regarding engineering professionalism and ethics in their under-graduate degree. Professionalism is thus positioned as a significant aspect of the engineering students' identity.

Students encounter the construction site as a professional space and are required to reflect on that experience from the perspective of a particular learning outcome relating to engineering professionalism. This encounter is overtly structured by the Engineering Council of South Africa's policy (ECSA 2014) of assessing student competence in terms of Exit Level Outcomes (ELOs). ECSA uses these ELOs to assess students' preparedness to work in industry and to take on their professional role as engineers once they are qualified. Each course or module in the engineering under-graduate degree has specific outcomes attached to it. Within the under-graduate engineering degrees, fourth year students are assessed by how adequately they achieve the eleven exit level outcomes, as defined by ECSA.

This paper examines how artefacts of a particular engagement between the university and industry, produced within the Professional Practice module, demonstrate levels of student learning in relation to their aspirant responsibilities in terms of the exit level outcome 10, that of engineering professionalism.

Overview of Professional Practice Module

In the Professional Practice course, students are allocated in teams to an engineering company contracted to a local, current engineering project. Students are required to make contact and to set up a meeting with the different parties managing the project. They are to visit the construction site and to engage with the project in a number of ways and to produce a number of assignments that include two 300 word essays relating to ELO7, The Impact of Engineering Activity and ELO 10, Engineering Professionalism, as well as a group report on aspects of professional practice and a group presentation reflecting on the significance of their learning in relation to the project.. This requires the students to inform themselves of the content of the ELO and to reflect on how these principles can be demonstrated. Students then need to use their developing engineering discourse, related to professionalism, to emphasise and reflect on what they have observed, in order to demonstrate their competence in this discourse.

This engagement between students and industry within the course occurs on several levels that include:

- the students' **experience** of a professional environment through immersion in the day-to-day operations of a project and
- the students' **reflection** on that experience.

In the specific assignment that forms the basis of the data of this research, the particular ELO that the students are required to demonstrate understanding of, is that of engineering professionalism (ELO10). This relates to

the students' understanding of their role as an engineer, beyond that of technical expertise. ELO10 connects specifically with the content of the ECSA Code of Conduct which defines professional conduct for qualified engineers.

Methodology

Student assignments over two years (2016 and 2017) were collated and examined in order to identify the concepts relating to the ELO of engineering professionalism as used and identified by students. For 2016, 92 student essays were examined and for 2017, 85 essays were examined. A list of themes and concepts relating to ELO10 was compiled showing the number of times the different concepts were referred to or discussed within the assignments over the particular year. There was no significant difference in quality of answer that could be attributed to gender or race, although there were several students who failed to engage with the concept of professionalism in a way that demonstrated their understanding of it beyond personal benefit. In these cases the students needed to rework and resubmit the assignment in order to be credited with competence in the exit learning outcome.

Key concepts implicit in ELO 10 were identified. These were correlated to the specific sections of the ECSA Code of Conduct. The related assessment criteria from the ELO were examined and analysed in order to distinguish the different levels of knowledge they engage with. Student essays were analysed to see how they have engaged with these concepts and criteria. Interesting examples have been profiled showing how students engaged with the complexity of concepts and the different forms of knowledge.

Analysis of the criteria of assessment

Students need to show they have achieved competence in the exit level outcome relating to Engineering Professionalism. This is defined as being able to "demonstrate *critical awareness* of the need to act professionally and ethically and to exercise judgment and take responsibility within own limits of competence" (ECSA 2017). Here the exercise of engaging with an engineering team on-site as a case study needs to develop the ability to **demonstrate critical awareness *of the need to*:**

- act professionally;
- act ethically;
- exercise judgement;
- take responsibility within limits of own competence.

As the students are **not yet** professional engineers, they are not yet required to take on the actual responsibilities of the professional engineer.

The associated assessment criteria for engineering students, defined by ECSA in ELO10 and relating to the ECSA Code of Conduct, includes the following:

- **Being aware** of requirements to maintain continued competence and to **keep abreast** of up-to date tools and techniques;
- **Displays understanding** of the system of professional development.
- **Accepts responsibility** for own actions;
- **Displays judgment** in decision-making during problem-solving and design;
- **Limits decision-making** to area of current competence;
- **Reason about** and **make judgment** on ethical aspects in case study context;
- **Discerns boundaries** of competence in problem solving and design (ECSA, 2017).

These criteria can be grouped relating to three distinct areas of student learning. The first group of criteria requires the students to demonstrate **objective knowledge of** external issues, such as **being aware of requirements** and **keeping up-to-date** with technological tools and techniques.

A second group of criteria are those that require the students to **reason about** and **make judgment on** ethical aspects in case study context. This reflection requires the students to **apply their skill to reason** in a situation in which they are **not personally involved**. This will involve **theoretical** and **academic knowledge** and **the application of skills identifying issues and building a logical argument**. It does not require the inclusion of values or beliefs or emotions.

The third group of criteria requires the students to demonstrate **personal engagement** with issues, such as those required in **accepting responsibility** for own actions and **displaying judgment in decision-making** during problem-solving and design as well as **limiting decision-making** to area of current competence and discerning boundaries of competence in problem-solving and design. The criteria in the third group require different sorts of knowledge and response: knowledge about yourself and your abilities and a commitment to making ethical decisions that might have personal and professional cost. The responses to this group of assessment criteria cannot be learned academically but need to be learned in practice as the student responds to challenges in lived experience.

At a meta-level, the responses also require and even assume a level of conceptual understanding about what ethical choice involves, what counts as a decision, how decisions are made and what alternative ethical choices are available. It is significant that conceptual understanding is assumed both in the ELOs and in the ECSA Code of Conduct where there is no explicit attempt to engage with the meaning of words like “ethics”, “competence” or “integrity”.

These four categories of assessment criteria form the structure supporting what needs to be assessed in order to reliably assert that a student has obtained the exit level outcome relating to engineering professionalism (ELO10). The assessment task needs to demonstrate a variety of levels of knowledge:

- objective knowledge of systems and procedures;
- knowledge demonstrating skill, such as how to build an argument;
- self-understanding and an engagement with personal values and choices;
- conceptual knowledge (and engagement with the way one concept relates to another).

Assessing how the students reflect starts with an objective account of what was observed on-site, as well as a grappling with the conceptual knowledge required in the situation. It moves through the process of exercising judgement on an external issue through to the engagement with personal meaning-making. This process effectively enables a transformative engagement where both the student and the context of learning (the construction site) are potentially changed by the interaction.

Analysis of levels of student learning in response to Exit Level Outcome 10

The following analysis takes examples of student learning relating to the four areas of professionalism identified above and examines how particular student responses illustrate engagement with the four levels of knowledge identified previously.

The first example demonstrates how the student engages with an issue using three different styles of

knowledge. In this extract, the student demonstrates knowledge of the specific context:

> "An example of this would be that the tender document stipulated X man hours should be met. The contractor supposedly would not be able to meet this requirement. He/she was trying to negotiate with the client that if he/she used more BEE companies, would he/she be able to bypass these missed man hours."

Here the student attempts to represent the situation in an **objective manner**. The student continues and applies reasoning and judgment to the situation:

> "The contractor should strive to meet the man hours and if at the end of the project these man hours were not met then he/she should pay the penalty for this."

Here the student makes an **objective judgement** on a situation external to themselves. The student can be seen to respond to the requirement that they demonstrate the ability to "**reason about and make judgement on** ethical aspects in a case study context". They are not required to come up with a correct judgement.
Following on from this, on a third level, the student demonstrates **personal engagement** with what has been encountered when formulating a judgment on an issue: "I felt this to be ethically incorrect". This formulation shows a level of personal commitment to the ethical decision-making process that, although perhaps simplistic, nevertheless brings the learning experience into the sphere of personal **meaning-making**. It is within this context that students can exercise their developing sense of professional identity and commit to a particular version of ethical obligation.

Another way of operating in this personal knowledge sphere would include formulations, such as the following where students went beyond the requirements of the assignment to reflect on the impact of the engagement with the project on their own sense of what it is to be a professional engineer:

> "This project has taught me to look deeper into the way professionals present themselves and given me an understanding of how I should behave when I enter the profession."

The two formulations involving personal engagement show a distinct difference in their understanding of the scope of their responsibility: in the first the student responded as a professional engineer making a judgement on an external situation as a participant and stakeholder; in the second, the student shows a clear and sustained attempt to engage in meaning-making.

Both these examples engage differently with meaning-making. In the first there is awareness of learning by association through exploration and engagement with a case study. It also involves modelling professional decision-making within a context where there is limited responsibility. In the second there is a reflection on the learning that has occurred relative to the student themselves and to the developing sense of professional identity.

Conceptual learning

The following section will demonstrate variations in student expressions of their learning as related to the application of conceptual knowledge in ELO10. As regards how students define the concepts of professionalism and ethics, it is evident that the terms are used in a variety of ways with very different effects. Students may choose to use an existing definition of professionalism, such as the way in which engineers, "conduct themselves in their work as well as in society" (IEEE, 2012, as quoted by a student). This quote is reasonably

neutral and shows a narrow understanding of professionalism. This demonstrates the need to be cautious about settling for a particular existing definition rather than engaging critically and personally with the definition in terms of the experience on-site.

The extract below shows the student exploring the limits and relationships of the two concepts "professionalism" and "ethics":

> Professionalism refers to behaviour that adheres to specific standards within a professional field. In terms of engineering this refers to the adherence to defined standards with regards to communication etiquette, time management and delivery of designs and products of an acceptable quality. Professionalism also requires ethics. Ethical behaviour involves integrity as its fundamental principle with further issues like accountability, equity and consistency with how one makes decisions.

This student has differentiated between professionalism as conduct adhering to certain standards, and ethical behaviour which is seen to be principle-based. Another student demonstrated awareness of the complexity of demands on the engineer and an awareness of the obligation of professional responsibility even in the face of challenges to personal interest:

> "Engineers are required to display this trait [professionalism] in all their work particularly when considering the potential effects of their projects on the physical, social and economic environment within which they are working. This means that in situations where an engineer knows that the impact of their activity may be adverse, they must immediately cease the activity and reconsider their method of implementation or even the entire activity. This reconsideration must be done regardless of potential monetary losses and even at the expense of their own material wealth and reputation."

It is evident that the student extends the sphere of professional responsibility to counter individual interest and principle.

Many students associate professionalism and ethics with an obligation to consider the interests of the wider society:

> "Engineering professionalism involves ethics and a responsibility to use the training received as an engineer for the benefit of the greater good of the public and not for self-gain".

This shows a clear conception of the professional having an obligation to the public beyond their own interests. The following extract builds on this conception showing clear reasoning and the application of this wider definition of professionalism:

> "The contractor also employed workers from neighbouring disadvantaged communities. This decision was both ethical and professional. This showed that an engineer's professionalism doesn't only stop at the design or construction phase but includes the consequences of the engineering project on the lives of the community he aims at helping".

Students show their valuing of the need to shift from a professional culture that is compliance-based to an actively ethical culture:

> "However, while the concepts and guidelines of professionalism are well established for most engineering projects they have no meaning unless acted upon by those in the industry. This calls for the conscious practice of these guidelines".

This can be seen as both a challenge to industry and as a motivation moving industry towards a transformative agenda.

Students' demonstration of ability to exercise judgement

Students demonstrate their ability to exercise judgement and identify (un)ethical behaviour in different ways. In the first example, an infringement is contextualised in terms of the relevant code of conduct:

> "Client displayed biased behaviour when they had decided to only employ labourers from a specific ward. This was viewed as unfair as it prevented the other wards from obtaining employment. This resulted in protest action from locals. According the ECSA's Code of Conduct (2017), any form of employment should be fair, unbiased and lead to no possible conflict of interest".

This shows the students' ability to motivate for specific action in terms of their understanding of a particular code.

Students show their awareness of the practical challenges to implementation and the consequences of unethical decisions to long-term self-interest. In the next example, the student applies their new knowledge concerning ethical behaviour to the context of the construction site and shows the ability to reason about and make judgments on ethical aspects in context:

> "In order to deliver the product up, the tendering process was run twice before construction activity could begin. This was … due to the first contractor having defaulted on a project some time back. However [despite]… the bidding price of the contractor having rendered him the winner, his lack of integrity in past projects deprived him the opportunity to be selected for the project. This encounter reinforces the importance of loyalty and integrity in the engineering industry. That is to say it is essential to comply by the standards of quality work over … compromised work quality".

Students also picked up on the difference between compliance as a tick-box exercise in order to escape prosecution versus applying compliance in the interests of the public:

> "At the client's request, there was no requirement in the tender documentation for the use of emerging contractors or local labour. Although the Consultant negotiated with the contractor to maximize the use of local labour where possible after the tender had been granted, it is my analysis that this was not professional nor ethical".

Students showed understanding of the obligation to ensure the professional execution of a job even where it went beyond the requirements of the contract:

> "The contract did not stipulate that the clearing of culverts needed to be done. However, the contractors did so out of concern for potential flood hazards. This was an example of the contractor acting by their ethical obligation to the profession to safeguard the environment and protect life".

This student takes the opportunity of the reflection to protest the inadequacy of settling for compliance at the expense of ethical responsibility. The student writes:

> "The consultant claimed that their responsibility would be to only erect signs, which state 'no pedestrian access' and they, thereafter, could not be held liable for any accidents. This although technically deemed acceptable by the safety officer, is an unethical situation as no actions are in fact being taken in order to actually prevent pedestrian access to the site".

Such formulations are significant in that they contribute to a discourse of professionals as ethical and being obligated to serve public rather than commercial interest.
The extract below shows an objective response to a situation where a worker died:

> "When the accident occurred and resulted in the death of the worker, the construction manager was cleared of any charges. All regulations were met and the traffic accommodation plan was strictly followed".

This response is inadequate precisely because it stays at the level of description and does not attempt to engage with exercising judgement or meaning-making. As aspirant professionals, it is precisely in complex situations like this that professionals will be called on to exercise judgment.

Students show growing confidence in their ability to make judgements that impacted the status quo. Here students demonstrate their own transformative power when they demonstrate agency in a situation in which conflicting cultural norms are experienced. The student assertively (and courageously) put forward a new position justifying an alternative norm of conduct that could expand the conception of what it is to be professional:

> "According to the stipulated rules, the majority of the personnel on site were not permitted to communicate with visitors unless prior permission was given. This rule, however, was at odds with African social convention which dictates that whenever contact is made between 2 individuals, the younger of these individuals must respectfully greet the other, and a minor degree of small talk is expected…. While this convention is at odds with the stipulated rule [convention], its purpose is to reinforce social cohesion".

This contribution is particularly interesting in the way it affirms the student's role to actively engage with and transform the system. The student presents a case for a shift of convention and the incorporation of different practices to affirm the values of a different stakeholder group.

This contribution raises important questions as regards who is represented by existing standards and conventions. Affirming and incorporating new contributions could be very significant in ensuring all stakeholders see the professional standards and codes as representative of values they can endorse.

These examples point to the responsibility of the university to equip students with the skills to distinguish appropriate responses in situations of different complexity. Furthermore, it recognises the value of providing the opportunity for students to formulate judgements and recommendations relating to their case study.
Because of the requirement on engineers to act with integrity and responsibility, it is essential that assessment requires the students to engage with their personal value systems and to develop the skills to relate these values to the choices they will be faced with and the decisions that will need to be made.

> "This project has taught me to look deeper into the way professionals present themselves and given me an understanding of how I should behave when I enter the profession".

Learning needs to be conceptualised as differentiated and to be scaffolded on the different criteria of the specific exit learning outcome. Here the requirements of the assignment need to be specified in relation to what is required of the student.

Conclusion

The workplace experience of the students on the engineering site is key to providing a context where the students can grapple with practical challenges in the light of their new and established values and their increased level of knowledge and skills. This enables the student to engage on various levels with the threshold concept of professionalism as it opens up new areas of understanding around what it means to be a professional. Once grasped, the threshold concept is transformative (Meyer and Land 2003:5) as it enables the student to position themselves in new ways relative to their discipline

This analysis clearly shows the importance of critical engagement with learning at the interface of the university and industry. It also demonstrates the importance of engagement with the artefacts of that learning in a way that recognises different types of learning that can be exhibited and provides the platform for insights and innovation to be channelled back into industry.

It is evident that students draw on different sorts of knowledge in their engagement with what they have learned in relation to the workplace. The different formulations are useful steps in developing an understanding of what professionalism entails as they transition towards a new confidence in their identity as a professional.
The process of unpacking student learning in relation to their role as a professional demonstrates the following:

- the importance of requiring sustained engagement with the concept of professionalism where it is the role and responsibility of the university to facilitate the students' shift from neutral observer to active upholder of behaviour that is ethical and professional
- opportunities for the university to engage with other constituencies, such as industry, need to be valued and engaged with in a manner which encourages mutual learning.

Implications of research

In relation to the assessment of assignments related to professional practice, this research affirms:

- assessment of competence can be more nuanced and better scaffolded to define the specific sorts of student learning that are required and that need to be assessed.
- the role of research to promote the agency and critical awareness of both staff and students involved in a course;
- the transformative impact of research on the participants: from the students and researcher to the institution and even industry;
- the value of partnership with industry for student work experience and professional practice in order to develop the skills of making judgements and absorbing professional values in a way that cannot be replicated outside the workplace;
- students as agents of change and as powerful contributors to the professional ethos rather than as passive receivers of an already established culture.

Research contained in the student reports needs to be shared with industry in a focused and strategic manner, where student experience and engagement is incorporated within the professional ethos of industry to effect innovation and change. This will require careful consideration of the existing channels and hierarchy of communication between the university and industry in order to ensure respectful collaboration around innovative contributions in order to build a transparent and responsive professional culture.

References

Allie, S., Armien, M. N., Burgoyne, N., Case, J. M., Collier-Reed, B. I., Craig, T., Deacon, A., Fraser, D. M., Geyer, Z., Jacobs, C., Jawitz, J., Kloot, B., Kotta, L., Langdon, G., le Roux, K., Marshall, D., Mogashana, D., Shaw, C., Sheridan, G., & Wolmarans, N. (2009) Learning as acquiring a discursive identity through participation in a community: improving student learning in engineering education, European Journal of Engineering Education, 34(4)359-367.

Engestrom, Y and Sannino, A (2012) Whatever happened to process theories of learning? Learning, Culture and Social Interaction 1 45–56.

Engineering Council of South Africa (ECSA) (2017). Code of Conduct. Engineering Professions Act No 46 of 2000. (2017). Government Gazette. 142(40691). 17 March. Government notice 41. Cape Town: Government Printer. Accessed: https://www.ecsa.co.za/regulation/RegulationDocs/Code_of_Conduct.pdf 20/04/2017.

Engineering Council of South Africa ECSA (2014). Qualification Standard for Bachelor of Science in Engineering (BSc(Eng))/Bachelor of Engineering (BEng).NQF Level 08. Document E-02-PE. Revision 4. 31 July 2014. Accessed 20/04/2017.

Kinchin I.M., (2016) Visualising Powerful Knowledge to Develop the Expert Student: A knowledge structures perspective on Teaching and Learning at University. Sense Publishers: Rotterdam.

Martin, R., Maytham, B., Case, J. M., & Fraser, D. (2005). Engineering graduates' perceptions of how well they were prepared for work in industry, European Journal of Engineering Education, 30(2)167-180.

Meyer, J. and Land, R. (2003). Threshold concepts and troublesome knowledge: 'Linkages to ways of thinking and practicing' in Improving Student Learning – Ten Years On. C.Rust (Ed), OCSLD, Oxford.

Meyer, J. F., (2008) Threshold concepts and the disciplines. Sense publishers: Rotterdam.

Pauw, K., Bhorat, H., Goga, S., Ncube, L., van der Westhuizen, C. (2006). Graduate Unemployment in the Context of Skills Shortages, Education and Training: Findings from a Firm Survey. Development Policy Research Unit. DPRU Working Paper 06/115.

Young, M. and Muller, J. (2014). Knowledge, Expertise and the Professions. Routledge: Abington.