PHOTO: Sustainable development, combining techniques. Senegal. M.M. García Alcaraz

CHAPTER 3

Engineering education research, with a focus on engineering for development

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3 ENGINEERING EDUCATION RESEARCH (WITH A FOCUS ON ENGINEERING FOR DEVELOPMENT)

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EXECUTIVE SUMMARY

This chapter will introduce an extended case study, written from a personal perspective, as an example of the integration of Sustainable Human Development and the Global Dimension in engineering into science and engineering undergraduate education.

It will offer a non-engineering perspective on issues of complexity and mastery, as informed by the author's work with both engineering and non-engineering students over the last three years.

The chapter will conclude with some ideas about evaluation and educational research that could better inform work on the Global Dimension in Engineering Education.

A brief background into Engineering Education Research is provided for context before the chapter begins.

LEARNING OUTCOMES

After you actively engage in the learning experiences provided in this module, you should be able to:

- Understand the connections between research and teaching
- Understanding the role of education research in improving teaching and learning of the Global Dimension in Engineering Education.

KEY CONCEPTS

These concepts will help you better understand the content in this session:

- Team design projects, particularly the Engineers Without Borders Challenge
- Traditional engineering education assessment methods
- How non-traditional engineering education assessment methods resonate with the values of the Global Dimension

GUIDING QUESTIONS

Develop your answers to the following guiding questions while completing the readings and working through the session:

- How can we know if engineering teaching should be improved?
- How can the student's experience and response to engineering education inform teaching?
- How can researching the effectiveness Global Dimension in Engineering Education help to inform changes to engineering education in general?

BACKGROUND: ENGINEERING EDUCATION RESEARCH

Engineering Education Research brings together a relatively small community of academics, many of whom are also actively involved in delivering engineering education. Focusing on Engineering for Development within this, we find a very new and even smaller community, many of whom are – in addition – also active in international development work as well. Most of these researchers have a background in engineering rather than, say, the social sciences.

This community is growing in influence as the need for pedagogic change is increasingly recognised, as engineering employers increasingly demand 'global skills' and as the advocacy and support from civil society organisations grows (particularly from the 'Engineers Without Borders' movement, which engages many engineering undergraduates, and also the 'Big Beacon' movement). To date, most of the research on Engineering for Development within engineering education consists of case studies and student evaluations by those within this community; it is still too new a field to find published longer-term research conducted by social scientists or educationalists.

Engineering Education Research is associated with the wider Engineering Studies field. Engineering Studies emerged in the 1980s, has roots in Virginia Tech and the Colorado School of Mines in the USA and focuses on the inter-disciplinary study of engineers, engineering and (in some cases) the formation of engineers. There are a number of regional and international networks such as 'The International Network for Engineering Studies (INES)', the 'Research in Engineering Education Network (REEN)', the 'International Federation of Engineering Education Societies (IFEES)' or the 'European Society for Engineering Education (SEFI)' which published the European Journal of Engineering Education. New publications are emerging, such as the 2014 'Cambridge Handbook of Engineering Education Research', and books such as 'A Whole New Engineer' and 'The Case for Working With Your Hands'. There a range of conferences, such as the annual 'World Engineering Education Forum' and the international 'Engineering Education Conference' series in Europe (the fifth of which was held in Coventry, UK in 2012 on 'Innovation, Practice and Research in Engineering Education' and included a session on the Global Dimension in Engineering Education). There are also a number of relevant centres, such as these in the UK:

- Aston Engineering Education Research Group
- Manchester Science and Engineering Education Research and Innovation Hub
- Kings College London Centre for Research in Education in STEM
- Engineering Subject Centre's Education Research Special Interest Group
- University College London Centre for Engineering Education

However, engineering education research centres tend to focus on Science, Technology, Engineering and Mathematics (STEM) at the primary and secondary educational levels or on, say, the evaluation of Problem Based Learning. No centre has yet focused major research on Engineering for Development in engineering education or on the Global Dimension in Engineering Education.

UNESCO plays an important role in supporting Engineering Education Research. Through its UNITWIN / UNESCO Chairs Programme, there are chairs in: Continuing Engineering Education (Beijing); Co-operation between Higher Education and Industries (Beijing); Problem-Based Learning in Engineering Education (Aalborg); Peace, Human Rights and Democracy at an Academy for Engineering Educational Research (Pune); Engineering Education (Tehran); Science, Technology and Engineering Education (Krakow); Distance Education in Engineering (St. Petersburg). These are alongside the UNITWIN network in Humanitarian Engineering (Coventry) and chairs in Sustainable Engineering in Developing Communities (Haifa) and Engineering for Human and Sustainable Development (Trento). In addition, the UNESCO Engineering Report published in 2010 included sections on Engineering Education Research and strongly advocated for the development of Engineering Studies and the growth of Engineering for Development in engineering education. Indeed, the report recommends solving the problems of engineering education by using Engineering for Development, in order to help solve the problems of the engineering profession and the world.

INTRODUCTION

Over the last three years, I have developed a cross-faculty programme of study called 'Global Challenges' at Imperial College London (the university's full name is The Imperial College of Science, Technology and Medicine). This programme comprises eight undergraduate courses that can be studied as ancillary modules or as co-curricular options. These options form part of our wider 'Imperial Horizons' programme, which also offers languages, humanities and business options. The courses cover a wide range of Sustainable Human Development and Engineering for Development topics and form a coherent curriculum with an emphasis on independent learning, enquiry skills and inter-disciplinary approaches to real-world problems. The case study used in this chapter is our 'Engineers Without Borders (EWB) Challenge' course (other chapters in these GDEE courses have also used this case study).

The EWB Challenge is a student-focused design-based competition to encourage students to consider the Global Dimension while problem solving for a real developing community. The EWB Challenge is delivered to mixed discipline second year undergraduates, which allows students to work in multi-disciplinary teams involving engineering, science and medical students. The inherent diversity in approaches and experience within the teams provides a fertile base for the students to explore their collective skillset and define their own axis of engagement with the project. The course shares elements of core theory and methodology with the other second year courses, which focus on poverty, communication in development and local sustainability – and there is the opportunity for further cross-fertilisation of ideas between the courses.

Over the three years that the EWB Challenge course has been running, it has been evolved to privilege the practice of process, rather than a pre-occupation with product. We explicitly introduce the students to methodologies from disciplines such as the social sciences, art and design and business studies to better enable them to grapple with the complexity of the real world – and to move them away from the linear thinking common to their core degree studies. This is also an opportunity to offer a complementary approach, rather than replicating work they have already completed.

The EWB Challenge course, though still relatively new, provides an instructive example of the need for research into engineering education itself. The chapter will show that evaluations of the EWB Challenge course have taken an action research approach (as discussed in the previous chapter) because attempts to apply only conventional, linear assessment and evaluation methodologies would diminish the embrace of the complexity of the real world that is emphasised by the course. More research into this type of engineering education is needed to help such educational approaches become better understood and more mainstream – and so this chapter will suggest some lines of research for the future, based on the experience of the EWB Challenge course.

ROLLING OUT THE EWB CHALLENGE

The EWB Challenge course has now been delivered to five cohorts of students, and has markedly developed from our initial pilot. When I began developing the course, the aim was to create a course that 'fit' the core aims and values of our wider Global Challenges programme, and that offered something different to the work any of the students would come across in their main courses of study – whether they were from an engineering discipline or, for example, from maths, biology or medicine.

I also think that course design and effective teaching and learning requires that we listen and learn from the students. This is the only way that we can determine how they are interacting and engaging with the world and wider issues of human development and what they need as learners and future professionals in order to make meaningful choices for themselves and be effective and active in work and in life. I therefore purposely designed a very open pilot that would allow me to observe the students existing values and working practices, and to target areas for further development.

The EWB Challenge is an engineering design challenge that is built around the problems faced by a real community in a developing country. The organisation Engineers Without Borders UK provides us with a detailed design brief and some contextual information about the community. The students need to focus their efforts on one particular aspect of the design brief, identify a specific problem, write a design question and design a solution. For example, they might choose to look at the energy aspect and the problem of indoor smoke from cooking, and then develop a design question that leads to a solution such as an establishing an improved cookstove social enterprise. They must consider the Global Dimension of engineering to ensure that their solution is culturally, socially and economically appropriate, and that it is sustainable – both environmentally and for the community to maintain and operate.

The course was designed to facilitate the students to plan and complete their own design project, with ten structured steps to work through during the ten weeks of the course (see Figure 1). The students were given support as they asked for it, but were not required to work in any one particular way or follow any specific methodology (although we did introduce the use of a binary dominance matrix / decision matrix / Pugh method for step 4).

1. **Meeting the team and tackling the design brief** – students were encouraged to explore the expertise and experience of their team members, and to read the design brief
2. **Allocation of design areas** – students pitched for the area of the design brief that they wanted to focus on in their teams, and explored this area in more depth
3. **Writing the design question** – students were required to focus their work with the design brief and write a design question to guide their work
4. **Identifying the factors for success** – students were asked to think about what be required for their design to be considered successful, and how this could be evaluated and measured
5. **Working through potential solutions** – the students were encouraged to document as many potential design ideas as possible and relate them back to the design question and success factors
6. **Pitch and submit** – the students pitched their ideas to their colleague to obtain feedback and submitted their ideas to their tutors for further feedback
7. **Revision and technical specification** – the students were required to demonstrate incorporation of the feedback and to start fleshing out their design with technical detail
8. **Problem solving** – the students were challenged to identify potential problems with their design and solve them
9. **Documentation of the design process and solution** – the students had to document their design process and relate it to the initial brief, their design question and factors for success
10. **Presentation of the final design** – the students were required to make a formal presentation of their final design, with consideration of the community for whom the design was targeted

Figure 1. *The ten step design process for the EWB Challenge course*

Each week the students had to complete a ‘Progress Goal’ which was a short answer question that demonstrated whether the students understood the step of the process that they were completing and allowed them to comment on their own approach. In addition, the students were informally interviewed about the process during the course.

Designing the course in this way allowed us to gain a really good understanding of how our students were working and thinking. Admittedly, we were working with a small sample of students, in a very specific institutional context, and we were not following any rigorous research methodology. At the end of this chapter there will be some discussion of research methodology that ideally would be implemented to give validity to any observations or findings. The development of this course has been based on empirical observation of the students and reflection on the quality of work produced (participatory action research).

Initial observations

The most striking and frustrating observation is that our students seem to be incredibly goal-focussed. In both this early pilot and further iterations of the course, we have a large number of students who design a water filter in the first session, without even reading the design brief. Exploration of this with the students reveals that many students believe that engineering is about designing the ‘perfect’ solution, and then adapting the situation to make use of the solution. This way of thinking doesn’t just come from the engineering students – I recently had a physics undergraduate who stated “*this course is wasting my time. I could have come up with the solution in the first week, then spent the rest of the course perfecting it*”. I then asked how the student would know what problem he was attempting to solve if he didn’t read the brief, and how he would know whether his solution would work in the real world if he didn’t engage with the community. He responded “*it doesn’t matter. I know clean water is an issue for poor people and my solution will be perfect, so they will want to use it*”. I challenged him further and asked exactly what or who the solution would be perfect for, and he replied “*the solution itself will be perfect*”.

This example highlights the first issue that I have been attempting to address with developments of the course:

My students find it hard to engage with the real world
and to maintain realistic expectations of their interaction with the world;
they are pre-occupied with achieving a goal;
they believe they can achieve ‘perfection’

In a way, this leads on to the next issue that has arisen. In many ways, our students do not have a very developed sense of identity – whether professionally speaking or in terms of their skills and strengths. This is something that we work hard to develop during all the Global Challenges courses.

We focus on deconstructing what the students think when they begin a course, and letting them reconstruct this in the light of the experiences they have with us and the work they do. However, what they believe they know about themselves and their potential as scientists or engineers is very tied to the concept of mastery.

Sometimes this can manifest as an arrogant sensibility, and their projects sometimes demonstrate a strongly paternalistic approach to engaging with others or offering solutions in a development context. At other times, mastery manifests in a very bounded approach to the world. The students are however unwilling to recognise their borders and the simplistic / reductionist lens that they use to make the real world ‘fit’ their approach, and to make their solution ‘successful’.

So this issue might be summarised as:

**my students have a strong sense of disciplinary identity –
that their role in the world is to use their specialisation
to 'master' nature and problematic situations;
in order to maintain an ability to be successful and achieve mastery,
they fail to engage with the real world, and work within
un-acknowledged boundaries that over-simplify the context**

For me, as a non-engineer, I see:

- Students who struggle to make an empathic connection with the real world, or with the people they are trying to help;
- Students who possess limited self-awareness about their approach;
- Students who have a strong sense of how they should achieve their goals, which largely follows a linear thinking process established within their disciplinary study.

In order to unpack this a little, and to think about how to work more effectively with the students to increase their awareness of the Global Dimension in engineering – and to give them practical approaches to Sustainable Human Development and Engineering for Development – I have explored the existing influences on these students and tried to bring together an inter-disciplinary toolkit to give the students new approaches and insight into the issues.

THE PROBLEM WITH REAL-WORLD PROBLEMS

Words like multi-disciplinary, inter-disciplinary and trans-disciplinary are used in a post-modern context to talk about learning, research and knowledge though they have no common or agreed definitions. For the purposes of this chapter, and in my work with students, I define the terms as follows:

- **Multi-disciplinary:** bringing together distinct ideas or methods from multiple disciplines to enhance understanding of a phenomena (the disciplinary contributions remain distinct)
- **Inter-disciplinary:** synthesising new methods or approaches to a phenomena by combining disciplinary ideas or methods (the disciplinary roots of the contributions are acknowledged, but the product belongs to no discipline)
- **Trans-disciplinary:** approaching a phenomena with no disciplinary lens at all (completely independent of disciplinary boundaries)

Thinking outside of disciplinary boundaries can be incredibly helpful but we must recognise that Western education systems – and indeed Western thought – are largely adherent to a strongly disciplinary structure. Our students have been taught within this framework, and have chosen to specialise within disciplines and sometimes even sub-disciplines. Integrating ideas that step outside these boundaries must therefore begin with a recognition of why these boundaries exist in the first place, and what they mean to our students and to the wider professions.

Disciplinary contexts

Modern engineering began in the Scientific Revolution of the 1600s, emerging from a background of scientific discovery and methodological development. In the UK, engineering emerged as an apprenticeship profession (Watson, 1982). John Smeaton is first credited with establishing the practice of engineering as a discipline in England when he coined the term ‘civil engineer’ (meaning non-military engineer) (Culligan and Peña-Mora, 2010).

Shortly after this, in 1771, the first professional body representing the profession of engineering was founded. Initially a rather informal gathering of like-minded professionals, called the ‘Society of Civil Engineers’, it changed its name to the ‘Institution of Civil Engineers’ in 1818 (Institution of Civil Engineers, n.d.). When they petitioned for a Royal Charter in 1828, they defined their new discipline as “*being the art of directing the great Sources of Power in Nature for the use and convenience of man*” (Institution of Civil Engineers, 2014). This statement remains part of the latest version of the Royal Charter, first approved in 1975. So we see that the idea of ‘mastery’ has a long and established heritage within the discipline of engineering.

There are now several engineering disciplines, and many sub-disciplines. The great benefit of organising learning and research into disciplines is that it allows a division of labour and greater specialisation of knowledge (Holbrook, 2010). As we learn more and more about the natural world and our presence in it, there becomes too great a body of knowledge for each individual to know everything. In the interests of cultivating depth of knowledge, the disciplines serve us well. However, the disciplinary approach to the world becomes less useful as the disciplines become more boundaried, and approaches and methodologies become distinct across disciplines.

It might therefore be the case that Sustainable Human Development and Engineering for Development makes demands of engineering that may best be answered from a non-disciplinary standpoint.

Within the domain of Sustainable Human Development there are a number of critical tensions – possibly the most important of which being between the local and global context. Approaches to analysing problems, our valuing of knowledge and expertise and the engagement of communities and implementation of change are all part of this tension. The public discourse encourages us to value the global approach – we are told that global action is needed to combat sustainability challenges such as climate change. But is it global ‘action’ that is required, or rather global engagement with local action? Can any sustainability challenge be answered by a global or widely implemented homogenous response?

The Global Dimension in engineering and a growing awareness of Sustainable Human Development attempt to re-organise and deploy existing knowledge and expertise in novel and more effective ways. With regards to the engineering profession, the question posed seems to be do we need more engineers, new types of engineers or engineers with a new sensibility?

Complexity in the enemy of mastery

If engineering is a problem-solving discipline, and Sustainable Human Development presents a number of problems, why is a new approach needed?

The answer lies in the nature of the problem. Unlike our organisation of knowledge, research and technical processes, problems in the real world do not abide by disciplinary boundaries. This means that many problems require the expertise of more than one discipline to be effectively tackled. Hansson (1999) advocates inter-disciplinary practice for solving problems of this nature. However, he also notes that inter-disciplinarity, “*no matter how desirable, is very hard to achieve*” (Hansson 1999: p. 340).

There are two helpful approaches that might aid our understanding of why the complexity inherent in the real world presents problems to our existing disciplinary thinking.

Rittel and Weber (1973) have been very influential in their classification of problems as either being ‘tame’ or ‘wicked’. A wicked problem might be defined as one that meets the criteria set out in Figure 2. These criteria also help us to understand why effective solutions are so hard to achieve.

1. There is no definitive formulation of the problem (the exact nature of the problem is hard to understand)
2. Wicked problems have no stopping rule (there is no ideal solution or marker that would indicate that the problem has been completely resolved)
3. Solutions to wicked problems are not true or false (they are usually good or bad, or more often better or worse)
4. There is no way to test the solution (implementing a solution will cause waves of intended and unintended effects over a limitless timescale)
5. Every attempt to solve the problem is the only attempt (by testing the solution you are changing the context and therefore creating a new problem and potential solution that is not tested)
6. Wicked problems do not have a set number of solutions (you can never know whether every solution has been considered)
7. Every wicked problem is essentially unique (when comparing even the most similar wicked problems, there will be some overriding characteristic that differs and is considered important)
8. Every wicked problem is a symptom of another problem (you cannot solve problems by tackling the symptoms alone)
9. Wicked problems can be framed in numerous equally valid ways (there is no correct explanation for a problem, or correct way to view a problem)
10. There is no immunity for unsuccessful intervention (in science, hypotheses are meant to be tested and either corroborated or falsified; whereas the solution to wicked problems needs to be right first time, there is no tolerance for mistakes)

Figure 2 *The definition of a wicked problem* (adapted from Norton, 2012)

Approaching Sustainable Human Development from an engineering and design perspective forces us to reduce complex real world problematic situations to simple, bounded design questions. This might explain why so many attempts to achieve difference and progress with Sustainable Human Development do not succeed. Recognising and acknowledging the complexity in these contexts will require us to think, work and act differently.

Complex systems are nicely defined by Snowden and Boone (2007). They involve large numbers of interacting elements that interact in a non-linear fashion; the history of the system is integrated with the present; they are dynamic and are more than the sum of their parts; and they may appear ordered and predictable when they are not.

Snowden's Cynefin Framework (2000) can further help us to see the difference in approach needed depending on the complexity of the situation. He defines four types of situation – simple, complicated, complex and chaotic. Simple and complicated situations are ordered, with obvious cause-and-effect relationships. Examination of the situation can help you to determine correct answers or actions. Complex and chaotic situations are not ordered and have no obvious cause-and-effect relationships. Correct actions or solutions cannot be pre-determined, but rather 'emerge' from the situation itself. He also goes on to describe a fifth state, 'disorder', where multiple perspectives vie for prominence, and there is much conflict. See Figure 3.

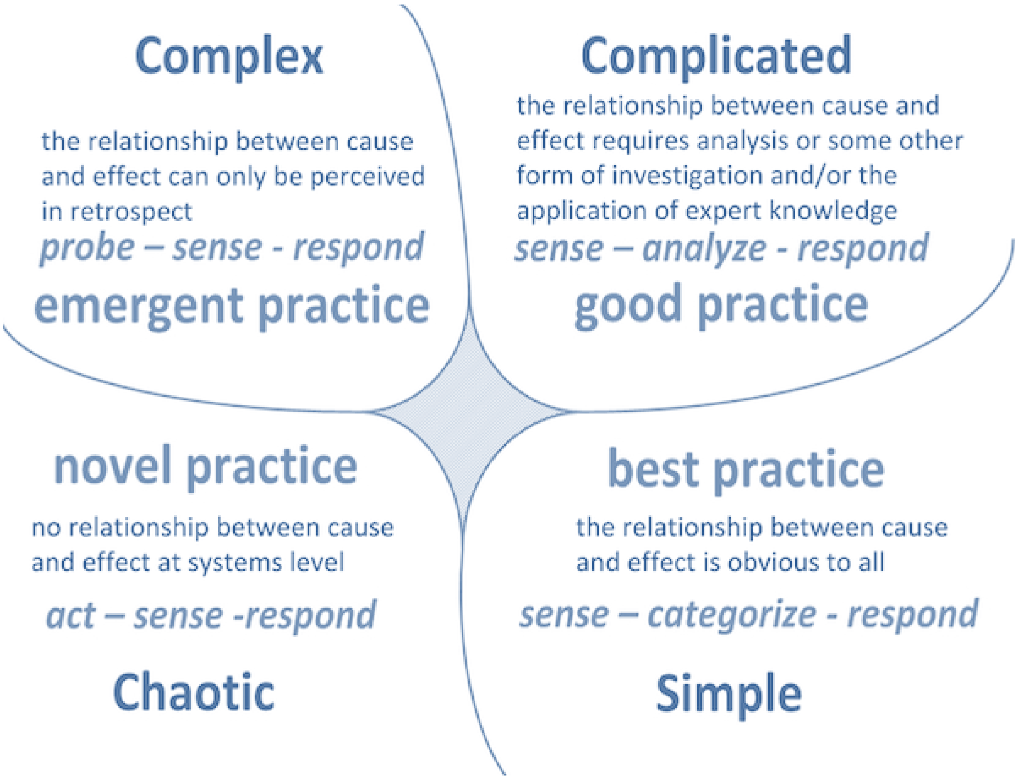

Figure 3 *Cynefin Framework with central domain being 'disorder'* (Snowden, 2000)

Whether we view Sustainable Human Development as a set of wicked problems, or as complex, chaotic or disordered situations, it is clear that conventional problem-solving approaches are unlikely to achieve helpful solutions.

DESIGNING THE EWB CHALLENGE COURSE FOR IMPERIAL COLLEGE STUDENTS

Returning to the EWB Challenge course, I have learned that my students are highly goal-oriented, believe that they should achieve ‘perfect’ solutions, have a strong sense that they should be able to ‘master’ any given problem or scenario and that they work in a very linear fashion with little self-awareness.

I am requiring them to tackle wicked problems, in a complex, real-world setting and want them to be able to develop inter-subjectivity in their approach and feel empowered to work outside their disciplinary experience and context. I am asking them to overcome the effects of the historical development of knowledge, education and their professions and the conventional and institutional status quo that shapes their formation, their future careers and their world view. These are big demands from an ancillary module.

The course has now been developed to cover four main areas of exploration – design brief analysis, conceptual design, technical specification and implementation planning.

- **Design Brief Analysis:**
  In this stage the students work to understand the context of Sustainable Human Development and Engineering for Development. They are introduced to boundary critique (Ulrich, 2002) as a way to manage the complexity of the community situation they are working with. This allows them to generate deeper understanding of specific aspects of the situation without denying the complexity. To assist with this exploration we introduce the students to an adapted version of soft systems methodology (Checkland, P and Poulter, J., 2006). This allows them to quickly create dynamic visualisations of complex systems (such as the community they are studying) and identify areas that could be targeted for directed problem solving and therefore are ideal opportunities for their design projects. In addition we encourage the students to develop their inter-subjectivity by using the soft systems methodology to explore different stakeholder perspectives of the scenario, and to use ‘empathy maps’ as developed by Alexander Osterwalder (2010).

  The use of these social science methodologies helps us to push the students further in two ways. Firstly, it helps to slow the students down. Having to learn an unfamiliar methodology from a foreign discipline is challenging and forces the students to take a methodical approach to examining the design brief. Secondly, the unfamiliarity and distance from their disciplinary experience, means that the students are less likely to unconsciously revert to using their ‘usual’ approach to their work. We found in the pilot that some students went through the motions of following the process that we outlined, but created their design solution using a completely different process.

  During this period, the students are also conducting background research to further their understanding of the local and national context of the community they are studying.

- **Conceptual Design:**
  The students should now have a good understanding of the community that they will be designing for, and of the design brief. At this point the students begin to develop design questions that they refine in groups. They are given sketch books and have a number of sessions to gather design inspiration and develop a series of sketches of potential design solutions to their design question (see Figure 4). We encourage the students to design freely, without considering technical practicality at this point. We also ask that the students make as many sketches or diagrams as possible. They are also able to collage illustrations and photos from multiple sources.

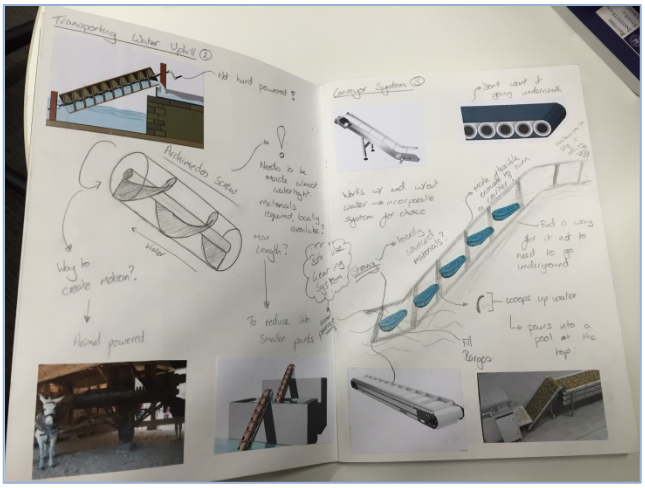

Figure 4 *Photograph of a sample of a student's sketchbook*

- **Technical Specification:**
  The students vote on which conceptual designs they want to take forward to technical specification and form their final teams. Up until this point they have been working in informal teams to help them share as much experience and expertise with as many other students as possible. They now start to specify materials, dimensions and functionality of their designs. They need to discard the impractical or impossible and focus on bringing the best ideas together into a workable design. They must also consider the economic practicality, environmental sustainability and sociocultural appropriateness of their ideas.

- **Implementation Planning:**
  Using the knowledge gained about the community in the first phase of the course, the students now work to create a multimedia package that will act to both communicate their design, and facilitate local implementation. They must consider whether there are initial set-up requirements (time, funding, labour, expertise) and how their idea will be maintained and further developed in collaboration with the community. The students are also asked to reflect on the quality and type of communication they have been able to establish with the community and the impact that this might have had on their final work.

PEDAGOGIC CONSIDERATIONS

Since one of the core aims of all our Global Challenges courses is to develop independent learning skills with the students, none of our courses employ subject experts as tutors. We work with junior researchers from around Imperial College who offer excellent support for the students in terms of enquiry skills, critical thinking and independent learning. With respect to the content of the project, the tutors and students ‘learn together’.

Our curricula follow a ‘process-oriented’ approach (Kelly, 2004), where we mark the students equally for the demonstration of their use of processes such as soft systems methodology, as well as for the product or design that they end up with. We allow the students a lot of freedom to determine the exact areas within the scenarios that they work on, and expect them to take responsibility for their own working practice.

We are working towards an emancipated classroom, where the students and tutors are co-learners (Grundy, 1987 and Rancière, 2010). In fact, Rancière’s idea of the idea of the ignorant schoolmaster (Rancière, 2010) helps us to understand how this approach actually greatly benefits our students. It also means that as a group, we are emancipated from any implicit ideals that arise from disciplinary specialisation – namely the mastery that is so tied to science and engineering.

CONCLUSION

I have not yet had a chance to complete any formal or structured research into the efficacy of these approaches and they are merely presented here as an example. However, I would claim that I am working in the right direction with my course development based on the feedback from students, the quality of the work produced, and the fact that the students are following up work started on the course with external partners.

Planning formal educational research requires attention to several elements beyond the methodology of the research itself.

Firstly there is ethical approval to consider. Next there is the required expertise to make sure that the research methodology (whatever that might be) is correctly employed to retain the validity of any findings or results. There is the time required to administer and analyse the research. Finally, there is student recruitment or identification to consider. It is also critical develop a robust research question, which can effectively be answered by the planned research.

For most practising lecturers with minimal experience of educational research, action research is the best starting point (as presented in the previous chapter). Its very flexible approach enables the study of a range of areas such as teaching methods, learning strategies, evaluation and the thinking processes and value systems of the students (Cohen, Manion and Morrison, 2011). For me, this encompasses all the aspects that I am most interested in.

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