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Emotional Dynamics of Student Projects

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Abstract

Every student tackling a real problem on location in a company they don't know faces a series of crises. After the initial fact finding, a blank fog descends in which the jumbled mass of technical and human issues seems incomprehensible and the problem insoluble. In fact, the mind is sifting very sensitively but careful support is needed to help the student keep panic at bay long enough to learn by experience this is so. At a certain point, glimmers of understanding begin to take shape in the fog. Supportive dialogue helps this recognition process. The truth may be uncomfortable and support to develop the courage to say it and guidance to find the diplomacy of how to say it fruitfully for all the team in the company, are essential. The quality of human tutorial support for the student through these stages crucially affects the student's professional competence later. The paper presents visual models of this sequence, the style of support necessary at different stages and possible patterns of emotional resistance, all of which help both students and staff recognise and gain confidence in the pattern of the process.

Key words: Engineers, student projects, companies

1. INTRODUCTION

A perennial trap in the education of young engineers is the tendency to focus on communicating the technical information which engineers use - the scientific knowledge - as being at the core of the process. Engineering is, in fact, an art. In the Royal Charter given to the Institution of Civil Engineers, the first professional engineering institution in the world, in 1821, engineering is defined as "the art of directing the great sources of power in nature for the use and convenience of man". Engineering *uses* science but *is* an art. Moreover, engineering is a profession. It carries public responsibility. Engineers have to be able to sustain public trust. Engineering *uses* science but *is* an art and *embodies* an ethic. It is not enough just to teach the science and to avoid the human, professional dimension because it is hard to articulate. When something is hard to articulate, one should strive hard to articulate it.

It is, perhaps, helpful to look at the learning process itself in a little depth before proceeding to look at the emotional dynamics of project work. This will help distinguish the actual learning process from the perceived learning process and will help distinguish support of the professional learning process from the more visible information-imparting technical "teaching" role.

2. EXAMPLES PAPERS

In Cambridge, part of the structure of teaching in engineering is that every lecturer distributes to the students one examples paper every four lectures. This examples paper will usually have about ten questions on it, carefully graded from the initial simple questions which make the student focus on the basic concept covered in those lectures, through a progressive series of examples ending in quite complex questions making use of that understanding. It will typically take a student five hours to work through that examples paper. They will then have an hour's supervision, perhaps in a pair, consolidating their understanding of it.

This six hours of learning and learning support, for every four hours of lectures, itself says something about the importance of the two halves of the process, but what is much more interesting is that the student will typically spend an hour on question one and at least half-an-hour on question two, and will frequently, in a tutorial, ask why the questions are not put in the opposite order, because the questions at the end are so much easier than the ones at the beginning. What is clear here is that the blank staring into the fog until the concept makes sense, which IS the learning process, is only remembered as a hated struggle whereas the applying of it, which comes later, is remembered with interest. It is essential to appreciate this difference because it is the former which needs recognition and support. The second stage is self-supporting.

The most striking example of this learning sequence occurs when teaching thermodynamics. Unlike most other areas of engineering, most students have little prior understanding of any of the basic concepts of thermodynamics and moreover a whole new language has to be learned (entropy, enthalpy, etc.). In Cambridge, they have to survive a whole term of ploughing through fog before it begins to make sense and become interesting. It is thus normal, the term before, to warn them that this will be so and to give them some simple things to read, so that they have at least met some of the vocabulary. There is then no warmer experience than to have them come into a tutorial the term after (after having trudged with them through a full term's fog) grinning all over their faces, saying "you were RIGHT! It IS interesting!"

3. PREPARING FOR PROJECTS

Industry-based projects are a major part of the fourth year of the Manufacturing Engineering course at Cambridge. They involve close contact between members of staff and companies, always concern real problems and give real responsibilities to the students and provide real benefits to the companies. They require close involvement and both technical and tutorial support from the members of staff, all of whom have substantial industrial experience themselves. It provides an intense coaching-style teaching format in which the tutors themselves are professionally committed and in which the students see their tutors at full stretch. Many would say that this is the only way professional behaviour can actually be taught [1].

Before students are launched into these responsible tasks (and their degree depends on our assessment of the quality of their professional competence, in a total sense, in their handling of these tasks), there has been much preparation. Nearly all Cambridge engineering students spend a year in industry before coming to University. The first two years cover the full width of engineering subjects and at the end of the second year, we interview again those who now wish to pursue manufacturing. This is oversubscribed nearly two-to-one and we look for breadth of interest and ability, as we include much management, and finance and accounting, as well as a breadth of technical material, in the manufacturing course. We then begin, in tutorial mode, to relate the material covered in lectures, particularly the human aspect, team dynamics, managerial styles, etc. to what they have themselves experienced in the companies in which they have worked. We are thus from the beginning integrating experience with theory, so that they illuminate each other.

They also have a dozen full day visits to different companies, in entirely different industries, around the country, each visit involving considerable discussion with the engineers there and each visit followed by an hour's team debrief, teasing out what we saw, not only technically (different industries are technically very different), but managerially. We find this is an important sequence in that it takes a year before they can really

see what is going on in a company when they walk in, instead of 'seeing' stereotypes which they themselves read into the situation. It is also a year before they can properly hear their own intuitions and not only pick up the nuances in what is or is not being said to them (or acted out in front of them), but also confidently interpret and articulate those nuances into something meaningful (a clue to a problem perhaps) and, build an appropriately diplomatic constructive response to them. Without this prior attuning of the eyes and ears, and both technical and human 'antennae', plus much guided confidence-building in a very realistic but Cambridge-based major project involving much industry contact but built entirely around student initiatives, it would not be possible to launch them at the fourth year projects.

4. PROJECT BRIEFING AND SUPPORT

For a fortnight's project, done as a pair of students, in a company and in a city which they do not know and have only selected days before going there, the students are given the following tutorial outline of the emotional dynamics they may expect to experience. This is, of course, in addition to the technical brief established for the project.

They are warned that while they have a written brief (and the tutor's verbal brief) established from prior conversations in the company, that is merely a small group of people's way of pointing to a problem at which they do not actually have sufficient time to look. Thus they must expect that by halfway down Monday morning in the company, they will have heard at least five other versions of what problem is, and they will know that none of them are true, because it is more complicated than that. Also, they need to understand that by lunchtime, people who cannot even tell them what the problem is will, nevertheless, be sucking at them for an answer. At this point, their adrenaline-fired alertness at the newness of it all begins to go into information overload. Responsibility overload arrives in the same moment, and as a dense fog descends in which the whole thing seeing totally incomprehensible and insoluble and a crazy thing to have embarked on, raw insecurity threatens to destroy any self-confidence the students ever had.

At this point, they need each other. They also need their colleagues back at their digs in the evening. And probably on Tuesday morning, the tutor will get a phone call seeking some sort of emotional support, couched in phrases along the lines of "It seems that the real problem isn't that, but is something like this. Is it o.k. if we sort-of explore a bit and end up amending the brief?" Crucially we might observe that, in setting the project in the first place, the tutor has had to make a serious judgment about where to pitch the project to really stretch - but not to destroy - the students. The tutor's own understanding and supportive response to this first query is then a key stage in coaching that growth process. Their confidence is on the limit, yet he is telling them that if they will hold out, they will get there. They proceed for the next three days on borrowed confidence and it is crucial for the

development of their own confidence, that their trusting confidence in what their tutor says will be so, is not betrayed. It is here that the maturity of judgment, both the competence and the confidence and also the professional courage of the tutor as a professional himself (as a professional manufacturing engineer, as well as a professional teacher) is put to the test, and will or will not impart an increment of professional maturity to the student.

The first tutorial visit to the students in the company occurs on the Friday morning and it starts very tentatively, because the perceptions of the students are still dominated by the fog. They have, in fact, by now gleaned all sorts of bits of information, both technical and human, and they have in fact been sifting it and structuring it quite effectively, but often this structure is totally unconscious and they still feel that it is hopeless, and their various initiatives are all disconnected and without shape, although they hope they might be in some way helpful. A warm, listening, supportive atmosphere is necessary and slowly out of the conversation, various trial thoughts start to emerge, of notions which are half intuited as being in the right direction, but which are reaching out to the tutor, as it were, as being their only hope of more confidence. They are sure they are right, actually, but are starving and in fear and desperately needing tender loving care and some emotional food. Once given observant attention, these embryo ideas and understandings leap into life and by the end of perhaps an hour's conversation, not only are they fairly complete in their essential form but two students are off the launch pad and streaking for the goal, knowing exactly (in embryo) what they want to say to the company next Friday in their project presentation, and what they need to achieve between now and then to make it fly.

At this point, the tutor stands back. There will be no more interaction until a debrief with the students after the presentation, when all can see how it went and how it was received, and when a further bit of coaching can be added if necessary, so that the students' report (which will go to the company within a fortnight of the presentation) can catch and edit, or strengthen, any parts of the communication which did not properly come across to the company in the presentation. It is the job of the archer to apply the stress to the bow, and to adjust the aim, but it is the job of the arrow to flight straight and true and hit the target. Success is its own reward and reflectively and progressively teaches insight into the process, until the student will confidently be his own trusty bow and his own clear-sighted archer.

5. REFLECTIVE THOUGHT

This emotional sequence, and also this style of support, is very effectively portrayed in a very readable form, in the little book "The One Minute Manager Builds High Performing Teams" [2] whose approach is summed up in Figure 1. There are, of course, many more erudite books which say the same thing (for instance, Deming's injunction "Drive Out Fear" [3]), but, like Goldratt and Cox's book "The Goal" [4] the one minute-manager

series gives basic practical guidance in an easily readable parable form which most students enjoy. They also give basic practical guidance on the guidance process. Where they do not give such good guidance is on the more subtle levels of the emotional resistance which occur, sometimes in the student, but more importantly, sometimes in people in the company, which the student has to be helped to see and helped to handle. A more profound version of Figure 1 can help illustrate some of the critical differences between real and faked responses to change (Figure 2).

It is a truism that any good idea is obvious afterwards. It is also true, however, that every idea implies change and change can be feared, and thus resisted, for all sorts of reasons, varying from the simple and natural fear of the unknown, to seriously painful previous experience of insensitively driven uncaring change.

The first two forms of resistance are subtle but very pervasive. Ridicule, which can be very playful, but nevertheless always has hidden teeth, always has the unspoken aim of trying to make you stop saying what you are saying. It attempts to use the mechanism of shame, belittling what you are saying, to cow you into silence. The problem of change then goes away.

When that fails, cynicism takes over. This is a deflection mechanism in which, while I apparently cannot stop you saying this stupid thing, I intend you to understand that I don't believe it and so I am not going to give any support to it whatsoever. The mechanism behind cynicism is that, if I do give some commitment to something, I am then exposed, and if it goes wrong, I know from past experience I will get hurt (emotionally) and so I'm not going to give that commitment.

In this way, both ridicule and cynicism convey important messages. They both inform you that the person concerned is insecure with the process of change and is in fact asking for help. Perceptive warmth and resilient caring are essential components of that help and humour a crucial lubricant, but help there must be. Such a person going through the emotional cycle of change and growth is signalling that they are much more frail on the one hand, and at the same time have much more to lose than an average person, because for them, change is a path already lined with deep wounds; not only unhealed wounds but the doubly painful wounds of growth promised, and needed, but not given: the double wound of betrayal.

The peaks and troughs of this emotional cycle are thus far more intense than the previous happy risk-taking. Any who have been involved in child care know Barbara Dockar-Drysdale's work on what she called frozen children [5], and on the careful development of the crucial relationship of trust which is necessary to allow that child to regress back to that point of frozen growth and complete it in some meaningful way, and become able to progress again out of that crucial dependence into true, confident independence. In a more positive context, the care of early emotional growth of children so effectively laid out by, for instance Maria Montessori [6] is absolutely fundamentally relevant to this sort of

task, because the emotional cycle is the same whether change is being faced at three or thirty three.

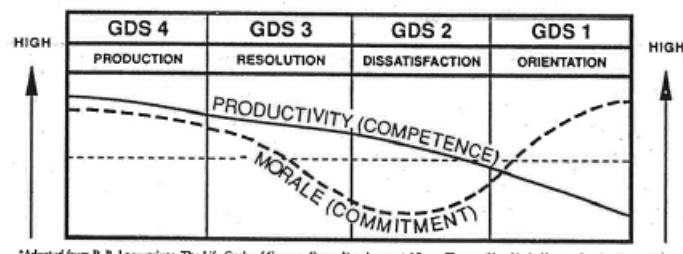
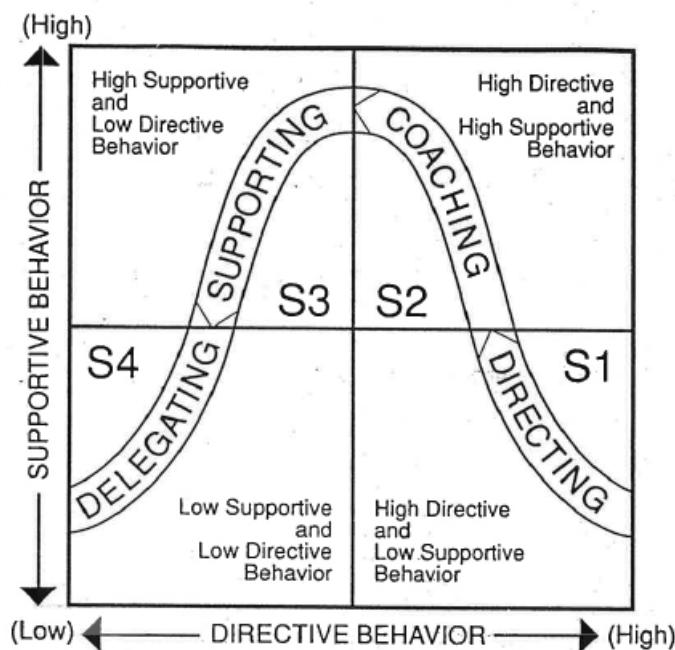
6. CARING FOR THE PATH OF PAIN

Polite (but numb) acceptance, linked to an internal sense of depression and anxiety, may be the first response to 'threatened' change (and here it must be seen that 'threatened' is in the eye of the recipient, whether or not it is in the mind of the initiator at all). Active resistance will follow, which may be more extreme and more emotionally violent than ridicule and cynicism, but has the same intention of repelling the threatening change. The difference comes in the next step, which is not a resigned acceptance - which by its very nature is in fact a turn-around, even though it may be grudging. In the genuinely insecure, the next step is an increasingly serious, indeed a desperate, last stand, a genuine peak of despair, which, if pushed past (as one must, often for the good of the individual concerned) will be followed by an equally genuine total

collapse, a slough of despond in which nothing that ever worked in the past now works to keep despair at bay. What, in the anxious but trusting student was a state passed in high tension, is for this person a state passed in total disintegration, and they need watching like a hawk.

They need a life-support machine. There is a rebuilding process going on, but it is going on at a much deeper level and will in due course, form a much more fundamental change. It is not at all incorrect to say that while the previous person could handle the change within the range of their ego, this person is beyond that and is having to rebuild themselves from the soul up. They can do it and they will be a different person because of it, but it is not a trivial task and their need for the insights and support of another soul while in that trough is an absolute imperative. The Twenty-third psalm is relevant at this point.

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Figure 1. Summed approach of the "The One Minute Manager Builds High Performing Teams" [2]

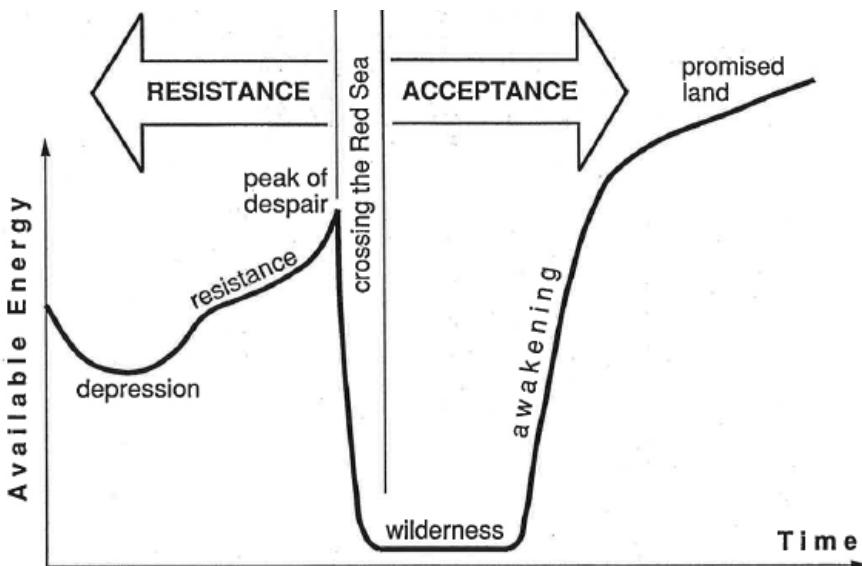


Figure 2. Critical differences between real and faked responses to change

Support of this kind is not a task for the faint-hearted. But equally, no truly professional engineer will dodge this responsibility. The kind of reflective guidance given to people who potentially have to mentor people through this kind of growth is well documented in "The Cambridge Manufacturing Leaders' Programme" [7]. Engineers grow civilisation and they grow civilisation in the people they lead to growth, just as much as they support civilisation by the products they produce. The appearance of words like 'involvement' and 'competence' and 'leadership' and, indeed, 'investors in people' and even more interestingly the return of words like 'virtue' to managerial debate, all signify the retrieval of a socially valuable professional dimension to engineering, and those involved in engineering education can grow by proceeding to make it articulate in everything they do.

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Emocionalna dinamika studentskih projekata

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Rezime

Svaki student koji se prihvati stvarnog problema na licu mesta u kompaniji koju ne poznaje susreće se sa nizom kriza. Nakon početnog pronalaženja činjenica, polako se razilazi magla neznanja u kojoj pomešana masa tehničkih i ljudskih pitanja izgleda nerazumljivo a problem izgleda nerešivo. U stvari, mozak istražuje veoma pažljivo, ali neophodna je obazriva podrška kako bi se pomoglo studentu da panika ostane pod kontrolom dovoljno dugo da bi se iz iskustva naučilo da je to normalno. U određenom trenutku, sjaj razumevanja počinje da dobija oblik u magli. Dijalog kao podrška pomaže ovaj proces prepoznavanja. Istina može da bude neprijatna, pa podrška da se pronađe hrabrost da bi se to reklo, kao i pomoći da se pronađe diplomatski način kako to reći da bude korisno za ceo tim u kompaniji, od velike su važnosti. Kvalitet ljudskog mentorstva kao podrške studentu tokom ovih procesa presudno utiče na profesionalnu kompetenciju studenta kasnije. Ovaj rad predstavlja vizuelne modele ovog sleda, stil podrške neophodan u različitim fazama i moguće sheme emotivnog otpora, odnosno sve što pomaže i studentu i osoblju da prepoznaaju i da budu sigurni u sheme procesa.

Ključne reči: inženjeri, studentski projekti, kompanije