

Involving Young People in Scientific and Engineering Project Work

1. The success of a project depends primarily on how well it matches the character, capabilities and aspirations of the pupils. It demands the utmost from the teacher to get this right in perception and sensitivity. He must understand the pupil and his family background. The project must be big enough to excite but not too big to be daunting or tedious. Much depends on sensing qualities in the pupil, which may be scarcely revealed, that the project will develop. Most of these qualities are of character rather than scientific technique.

2. Choosing a project for a young person is rather like considering a climb for a young mountaineer. It must be of the right length and difficulty. It must suit his equipment. It must be possible to complete by the pupil with his teacher if they have not climbed it before. The climbers must be belayed at all times. In project terms it means that they must be able to contact someone who can solve any unexpected technical difficulty. The belaying of the pupil concerns the emotions as well as the technical side and the teacher must be able to get him out of these difficulties too.

The climb must not be too difficult at first or the pupil will become disheartened. Ideally, it should have several avenues of approach so the pupil gains experience in planning. The pupil will have ideas of his own during the climb and these must be seriously considered. If he wishes to go in a direction that the teacher thinks is a dead end, he should be allowed to do so, if there is time and subject to proper belaying, so that he learns by experience. There is always the chance that the pupil may have found something new. At all times the teacher must be transparently honest with the pupil.

The climb must be worthwhile from as many points of view as possible. I try to promote electrical aids for the disabled. In making these the pupils learn something useful to themselves, they help others, they get to know disabled people, who, in coming to terms with their disability have often learnt something about life that is immensely valuable to those they meet.

It helps if the task is spectacular too. In project terms this means that it is able to interest and involve others. If it is entered for a regional or national exhibition or competition, this interest and the status of those doing it are magnified.

3. Much of modern education is concerned only with the mind, not the person as a whole. A good project enhances all aspects of the personality. The requirements I look for in prospective pupils are grit (by which I mean an unwillingness to be defeated), a desire to go all out for something, a measure of reality about oneself, and a capability of being inspired and totally absorbed. All these a good project stimulates or brings into the open if a lack of confidence has hidden them. I do not require much scientific or mathematical expertise. If a pupil is committed and of average intelligence, he will acquire these with surprising ease when needed.

4. I try, as far as reasonable, to choose a subject

that is new both to me and the pupil. Preferably, it is something that no one has ever done before. Then I cannot be aloof from the pupil, like someone directing his swimming from the security of the shore. I am in the water with him. He gains from my experience in how to tackle things afresh, and I profit from his new approach to the problem. There is no authoritarianism or conflict. We share the problem and I can show my partner that he has qualities that I can respect.

5. In doing the project the pupil experiences all the joys and despondencies involved in gathering material together and trying to get it to work. As this is probably the first time he feels these ups and downs, they will be the more intense, and he will need help. It means listening and a genuine sharing in a success and it requires foresight to predict a period of depression, so that one has the means to give support and hope. This can be either a visit to industry or university or the arrival of a knowledgeable visitor or of some needed raw material. Despair can be set in when the momentum of a project, which is its rate of achievement is, seen to flag.

6. I look for a supervisor from outside the school who may be from local industry, university or retired. I encourage the pupil to go to this person for advice and support and I take as much of a back seat in the new relationship as appropriate. The project thus tends to become, not school work, but to do with life in general and this helps the pupil to get it into a wider perspective. The supervisor also protects the pupil against my own lack of expertise and I too gain the benefit from another viewpoint.

7. My task when a pupil has a project is to be available to him as a friend who listens rather than a teacher who tells. I am usually required just when I wish to do something else. Then I must drop that thing and attend to the pupil. If I ever cannot deal with the problem, then I must make a firm time with the pupil to see to the problem, and this time

must not be postponed for another reason. I think pupils do want to know, often subconsciously, how important the project is to their teacher (and thus how important they are which is the real thing). If one does not take them very seriously whenever they want help, they will quickly lose confidence and the main purpose of the project, which is the one of character development, will be put at risk.

8. I am very interested in the occupations of the parents. How many children really talk with their parents about what they do for a living? I often set a pupil a project involving his parent skills and knowledge and once did so that a pupil would begin really talking with his father.

9. In general pupils are good starters, but very poor finishers. They need an aiming point and competitions and examinations provide this. It is very good experience to prepare work for display and to stand by it and answer for it to informed people. I have always found the judges comments to be surprisingly sympathetic, accurate and useful. They tell me much about how I could improve my stage-management for the pupil. Some of their comments I may not like and therefore need to know.

10. Regulations are usually designed for those of a minimum of common sense, motivation and responsibility. They can quickly dampen the spirits of young people. One must be able to get round bureaucracy when necessary. Safety is a result of acquiring good habits and these have to be shown to be reasonable and desirable, and then enforced.

11. If a pupil is given the right task at the right time in his life, then his subsequent progress can be a joy to see. He is given purpose. He walks with a firmer step and his head is held higher and any sense of inadequacy is pushed aside by the faith in him demonstrated by those who thought him worthy of the particular project. He will gain those qualities of mind and character as they are required to accomplish the tasks he faces. It is extraordinary how quickly fine qualities can appear and establish themselves in a person when he is given the requirement to have them by something he believes in.

It is amazing how quickly young people can master things when fully motivated. The need for repetition and tests is eliminated and these take at least half a schoolteacher's time. They really want to know and will not stop thinking away at something until it is mastered. With this intense and directed effort, they rapidly conquer things that they would otherwise think too difficult.

12. An argument often used against project work is that it will take up too much time, and, accordingly, academic work should suffer. So much is this the reverse from my experience that I encourage project work as a remedy for dull academic performance, and have been rewarded with better grades than predicted.

An example may help. A prospective doctor at school finds his physics and chemistry dull, as he really wishes to study medicine. A project involving

these two subjects in a medical investigation will make him feel he is doing medicine and he will release enthusiasm into the work that would otherwise be withheld. He now sees, and more significantly perhaps, feels, the relevance of his studies with inevitable beneficial results.

Even if the project is not on a topic relevant to the pupil's career, he will benefit for the following reasons:—

a) In doing the project, the pupil, often for the first time in his life, gets to know something very well. He knows it deeply, both by experience, as well as in theory. Having acquired these standards he will be dissatisfied with a purely superficial knowledge when he comes to study other things. In competitions the pupil must explain his work to intelligent and informed people who will seize upon illogicalities and irrelevancies and who are not impressed by waffle and woolley thinking.

b) In writing the report of the work, the pupil must go over what he has written many times to perfect its meaning. There is often no time for this in ordinary school work, so a pupil rarely gets the chance to polish his work in this way before considering the next topic. In exhibitions, the pupil must produce an easily understood display that will attract and hold the interest of a passing visitor and send him away accurately and well informed.

Consequently, the pupil learns what it is to know and describe something to a high standard. When the rest of his academic studies are influenced by this, he will inevitably do better in formal examinations.

13. More important than a pupil's scholastic achievements are those in his character and self-knowledge. A project well done will have the following benefits:—

a) The participant will have begun to understand himself. He will have a fair knowledge of his merits and defects and thus the tasks he could tackle with fair promise of success and those he should leave alone. He will be meek in the Biblical sense of the word, which is to me 'knowing one's true worth'. By this I mean knowing one's defects and being able to accept them and also one's abilities and being able to recognise that others have them too.

b) When given another problem, he will have a realistic idea, even if he does not know how he would actually tackle it, whether he could succeed with it. Knowing his limitations better he will be able to pick team members to compliment these and how to work with them in harmony and get the best out of them.

c) He will be less swayed by over pessimistic or optimistic attitudes because he will have become more self-reliant. He will subject more of what he is required to learn to careful scrutiny before acceptance. He will have developed a feel for what is essential and an appreciation of true worth.

d) If his work has attracted the interest and involvement of others, he will be given respect for his achievement and thus attain a measure of

influence. He will be looked up to as a leader in a deeper sense than those otherwise promoted. He will have attained the self confidence to enable him to live up to his responsibilities.

e) In an age of increasing unemployment, more and more people will have to create jobs for themselves and project work is excellent training for this.

Bryanston School Record of Successes in Competitions

1976 A project on an electronic altimeter was written up in the National Schools Technology Magazine.

1977 A project on a 6" x 6" working section wind tunnel won 3rd prize in the Southern Science and Technology Forum (SSTF) competition and also won the E. Gray memorial prize and trophy. (E. Gray was the principal designer of the BAC 111 aircraft).

1978 A project on an electronic Bee counter and another on an electronic door lock both won a highly commended at the SSTF competition. Another project on an acoustical system got into the Finals of the Young Engineer for Britain competition (YEB).

1979. A project on a new method of testing the accuracy of paraboloid telescope mirrors won the SSTF competition and another on a solar tracking system came 3rd in the senior section. A project involving the construction of a 1ft x 1ft working section wind tunnel, which was 20ft long, won the E. Gray memorial prize and trophy and went on to win the Regional Finals and came 2nd in the finals of the YEB competition in the 17 & 18 year old individual entry group. Another project on an environmental control unit won a certificate of merit at this competition. A project on an 8" diameter astronomical telescope to a new topical design was filmed by a BBC for the Young Scientists of the Year competition, but not broadcast.

1980 At the SSTF competition a project on a wave tank and on an environmental control unit for the disabled each won a 1st prize. Three projects, on an electronic touch switch, an electronic door lock and an electrolysis apparatus for hydrogen generation for alternative technology each gained 2nd prizes. Third prizes were won by two more environmental control units and by a simple aluminium casting facility. Six projects were entered for the Regional Finals of the YEB and three for the Schools Design prize.

1981 At the SSTF competition, an electronic door lock won a 1st prize in the senior handicapped section and an investigation into the removal of nickel from the effluent of an electroplating works* won a 1st prize in the conservation section. A small scale water turbine won a 1st prize in the energy section and went on to win a 1st prize in the schools individual (18-20 year old) section of the regional final of the YEB competition. It was selected for

the National Finals and came 3rd in the 18-20 year old individual entry section. Another project on an off-axis Astronomical Telescope, made to a new optical design and the subject of two patent applications, won a 1st prize at the SSTF. It also won prizes for the best entry in its class, the best team exhibit and the best school exhibit at the Regional Finals of the YEB. It was selected for the National Finals. An Electronic Environmental control unit* for a disabled person came 2nd in its group and won the prize for the best presented exhibit at the Regional Finals of the YEB.

* These projects, together with one on the making of a Ramsden eyepiece for the Telescope were part of an exhibit at Southampton University.