International Conference on Engineering Education in Sustainable Development
EESD2004
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TECHNOLOGICAL EDUCATION AND PROJECTS IN DEVELOPING COUNTRIES: POSSIBILITIES AND CONSTRAINTS

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Key words: Developing countries, Technology, Participation, Education, Traineeship

Abstract. *The basic choices and activities of the project on arsenic contamination and drinking water in Bangladesh presented at the previous EESD conference are driven by a certain vision on development in general and on the role of technology and engineering in particular. This standpoint has repercussions on the way we perceive and organise the role of Western institutions in the development processes in rural Bangladesh. Consequently, it also influences the way a student educational programme should be structured within this particular development project.*

The purpose of this paper is to describe the consequences of our general vision on development, especially on the technological inputs in the set-up of development projects. As a further consequence we will elaborate on the education component within our own projects as well. Considering that these projects mostly include research components, the link between education and research activities will also be presented in this paper. This paper will build upon the previous paper (Rammelt, 2004) and offers an evaluation of the results of these particular activities.

Our experiences until now suggest strongly that short-term activities, even if seemingly successful, provide absolutely no certainty about their impact on the long run. The activities, carried out over the time span of several years, can therefore provide the needed long-term dedication that individual student internships lack. An evaluation of the respective roles and objectives for each of the components (project, education and research activities) will be presented. It is believed that each participant in the project has its own priorities, may it be educational, developmental, or financial, which influence the activities. For a proper evaluation, previous cases of research, student linkage projects and development activities help to shed light on peopleís expectations, preconditions and learning experiences. From these insights it should be possible to reveal more general ideas about partnerships between North and South on different levels as well as understanding our role as (future) engineers in these partnerships.

INTRODUCTION

During their studies many students have experienced a stay in a developing country and quite a number of them worked for some time within the framework of development programmes. In this paper we will focus especially on the learning experiences that students get from a close participation in development projects at the level of local communities.

Looking back upon our past years experiences in educational stays of students in developing countries a few observations should be made. Firstly, there is a huge gap between the expectations of students about the impact of their activities and their real contribution, and secondly, despite this gap they generally appreciate the learning experience as a great value. Lastly, we cannot deny that our own view on development issues has an important impact as well.

Our own educational goals are linked to a particular vision on development and education, which needs a short clarification1. Development will be seen as a lengthy process that has to come from within. Influences from outside have their effects on this process. Sometimes by facilitating it, but in other cases by working against it and restraining disadvantaged communities in their autonomy to choose their own development path. But nevertheless the dynamics will be strongly influenced by specific local cultural, historical and social factors. In relation to this observation it is important to be realistic about our own impact in such a development project. First of all our involvement comes from the outside and secondly, it is normally of a short-term nature. This creates a natural friction between our own involvements and the development process of others and also creates an educational challenge. Students should approach their task with a more than normal reservation concerning their role towards someone elseís development and do that without loosing enthusiasm.

Considering this view on development and therefore the type of learning experience that we would like to recommend, the paper will present two types of student traineeship. On one hand those where students have the role of observer. Their contribution is a report with useable conclusions or recommendations regarding various projects. On the other hand there are cases where students participate in a project.

Furthermore, on the side of universities, faculties and faculty mentors, educational aspects and constraints are to be considered as well. Our observation of previous internships in Bangladesh suggests that there is a possible tension between development and education objectives and strategies. In this paper we will try to elaborate on the type of frictions that can occur and try to clarify their cause.

[1] More on this can also be found in the previous EESD conference paper (Rammelt, 2004)

BACKGROUND

Since 1993, Technical University Delft (TUD) and a number of Bangladeshi organisations are working together in a co-operation. Work started with Unnayan Shahojogy Team (UST), a non-governmental organisation based in Dhaka with projects in different rural areas. Students were given an opportunity to participate in this programme in order to get them close to operations and processes in development projects. The first topic was an investigation into the effects of the controversial Flood Action Plan project on the local communities in Tangail (a district North of Dhaka).

As expected this joint effort created the chances to come up with appropriate suggestions merely because of the low profile of students and therefore the extra ëroomí they have to operate for their interviews and their field visits. Nevertheless, right from the start it was clear that the main objective was not the possible technical assistance of Delft students, but the expectation that the experience of a direct confrontation with the situation in Bangladesh would have an impact on their decisions to be made in their future profession (Boes, 1996).

The idea was triggered by the mutual recognition that in many cases Northern technology played an adverse role in the development of rural Bangladesh (Boes, 1996). This paper will clarify and build on this particular concept, which formed a basic premise of the programme. It will pull out a number of examples from an evaluation of five years of student traineeships in Bangladesh (Rammelt, 2001). The mentioned confrontation and resulting learning experience for the participating students is unique considering that such initiatives are rare in engineering education in Delft. With its open-ended character and learning objectives, the programme sidetracks from mainstream education that normally favours concrete and measurable educational goals.

CONVENTIONAL AND ALTERNATIVE EDUCATIONAL PROGRAMMES

It might be an exaggeration but observing university educational programme one can nearly escape from the conclusion that they have a tendency to lead engineering students into a path where technology is the starting point, the end goal, as well as the way to get there. There is a ìsimpleî equation to be resolved whereby each problem has a given technological answer that just needs to be generated. An effect of such a format is that students feel they should have an answer to everything. This can hardly be blamed on the students themselves but much more on the type of goals that have been set in conventional education programmes (see box 1).

The real world functions in an entirely different way and although purely technological solutions can be extremely relevant and complicated; they exist for a specific type of clear-cut problems. Thinking there is a technological solution for everything is absurd, it is a way to close ones eyes to many very important problems. On the whole, these are complex and require an approach different to the mainstream methods and approaches taught at universities.

In the past a number of Civil Engineering (CE) and Technology, Policy and Management (TPM) students participated in the programme. According to the policies of their faculties, a student project has to concentrate on a technical design in one specific field and students have to gain insight in the systematic application of methods and techniques for solving a problem. Apparently, students are urged towards technical problem solving. The incorporation of social elements, even if directly in relation to technology, is to say the least not automatic. Nevertheless the studies in the student programme require

incorporation of non-technical issues; a conclusion that has eventually been reached by all participating students.

Box 1: Goals of education programmes

However, taking that road is ënot doneí since alternative ways of looking at things are very often considered as unscientific and soft. That this is nonetheless necessary becomes obvious during some of the more uncommon courses[2] where engineering students are asked to look closer into implementation issues and social conditions relevant for new technology and less at the technical design itself. So without undermining the importance of purely technical courses, it is in those sporadic educational programmes that students are confronted with the limits of a downright engineering approach to many of the complex real-life challenges.

Unfortunately, still too often it is easy for them to feel lost because there is no direct solution to the problems exposed. And because students are mainly trained to generate solutions for immediate problems, these are logically oriented towards the short-term and not that much towards long-term approaches. When confronted with more complex topics, they fall back on breaking the problem down into workable parts. This unfortunately leads to fragmentation and losing sight of the larger perspective, which is something universities are not sufficiently dealing with. (See box 2)

Two examples illustrate that it is not easy for students to think out of the box and apply their knowledge in a flexible way. CE students sometimes tended towards technological feasibility studies even if not visible in their initial proposals this became visible in their final reports. However, the relevance of such studies on the long-term is uncertain for the Bangladeshi counterpart organisations. TPM students usually incorporated curriculum methods in their set-up, which are often less suited to analyse the informal institutional arrangements common in Bangladesh.

With the freedom they were offered within the programme, students often stepped away from the constraints of the curriculum but radical adjustments remain difficult to make. The conducted interviews with students revealed that this is partly due to their expectations. There is an understandable drive for students to contribute in the projects and there has been in some cases a disillusion about the possibility to come up with tangible results. The truth is that development processes are very slow and the effects of such a short period in the field are minimal. On the other hand, the effect that this has had on the students is most probably much more significant.

Box 2: Studentsí focus

DEVELOPMENT TOPICS IN EDUCATIONAL PROGRAMMES

An analysis of development and poverty issues can well be used to illustrate to students the limits of the ëconventionalí approaches. First, we can say that the choices and orientation of curricula in the North hardly reflect the priorities of the Worldís poor. Most of the fields of study are irrelevant for the average farmer of labourer from the South. This statement is not yet another proclamation of ethical principles or idealistic higher moral grounds but it is a plain observation, which the students involved in this topic also make sooner or later (see box 3). We can order our weekly groceries through the Internet but poor people cannot eat a computer. For them it is more a question of how to stay alive and how to feed their family today and maybe tomorrow, which belongs to a quite different rationality then ours.

[2] Courses such as sustainability modules or internships in developing countries with different social and economic contexts.

Then, supposing technology development is oriented towards addressing human needs, with the larger part of the world population living in poverty, it would be merely common sense and statistically accurate to redirect a larger part of our research and education to the needs of this majority, or at least to make a proper distinction. Instead, the focus usually comes down to our own market needs.

It is a fact that an engineer will generally not be a sociologist (or the other way around). However, considering the amount of narrow sighted large-scale projects that have failed in Bangladesh, for engineering this means that social aspects have to be taken into account during early phases of development of a technology. Comparing local practices with the way western top-down projects are being implemented will help students to critically review their own activities in their future professions. Social aspects will not anymore depend on an external input but will be inherent to the engineering activities; at the least it will allow a better communication between the two disciplines.

Box 3: Broader engineering

On a less statistical and more principled note we can say that our needs are probably less stringent than the basic needs of deprived communities in developing countries. But even then, we should realise that our priorities are biased and that they are imposed on others through one-sided technology transfer processes and development assistance (Nerfin, 1977). The fact is that the technologies that we develop address the demand in our own society.

Our future engineers are supposed to learn to base their conclusions on a set of experiments that are representative for a given population. It can be argued that their technological education is either very arrogant or not very scientific because it assumes that the main concerns and solutions of a wealthy minority should be a model for the rest of the world living in extremely different circumstances with many diverse cultural values.

The computer example might be oversimplified but the trouble nowadays is that such notions are incorrectly and insufficiently represented in university curricula.

One reason for this is that we have come to believe that there is a single development path for all countries to follow. The benefits of what we have learned from our mistakes and the technologies that we have developed will ultimately be beneficial to the rest of the world (see box 4). But have we really learned from our mistakes or are we yet to recognise them? And are we really answering to genuine needs in our own society with the technologies that we develop? Or are we creating a snowball where we generate more social problems than we can handle?

Most TUD mentors emphasise firmly the importance to contribute something during traineeships in general, in the form of a tangible result or a project evaluation or description. This need for a contribution seems to be emphasized even more in case of training in a developing country. The feeling is by far weaker when the student is involved in a Western company.

In the particular case of the student programme, for Bengali counterpart organisations this raised the question whether their own abilities are undermined. A tangible result or something that could be directly implemented was never a request. On the contrary, training starts and ends with learning, a contribution from the students is simply seen as a bonus. While this is not a requisite from the perspective of the counterpart, cross-cultural development of both parties is. Eventually, it is hoped that an open dialogue about North/South relations should have its consequences in both directions as well as on the relation itself (Boes, 1996).

Box 4: Idealistic wish to ëhelpí

Apart for these, what could be considered as ìsoftî meta-questions, there are a number of very down-to-earth issues to consider as well. The above-mentioned snowball is probably caused by a so-called technological lock-in but the actual roots lie much deeper. Earlier we posed the generalised question whether technology development is meeting a genuine need. A viewpoint is that the ëthingí that engineers are taught to address is perhaps not so much a human need but it seems to be more inclined towards a need defined by our economic and political system (Galtung, 1999).

It is becoming more and more obvious that whatever technology we develop, we develop it in order to support economic growth. Products are obsolete after just a few months, almost forcing us to consume more, to support our growth-oriented production system, and thus to support the increase of our GDP.

FAILURE OF THE CONVENTIONAL EDUCATIONAL PROGRAMMES

Today, claiming that development should contain much more than an increasing GDP is perhaps a clichÈ, but it is definitely not self-evident in our political circles, and thus eventually in the way we have organised our education and research, which is more and more influenced by the wishes of industry and business where profit-making is very logically an undeniable ultimate end. And so current economic incentives of growth have shaped the direction of engineering.

A repercussion of this ideology is that the social and poverty dimension of technology development are insufficiently represented in our engineering curricula. There is little money to be made in this ëunexcitingí subject and moreover, the discussions about needs and local organisations are not particularly trendy. But it does not imply that these discussions and observations, going back to the 60ís and 70ís with for instance the appropriate technology movement (Reddy, 1975), are less relevant today.

Doubts regarding the actual significance of modern technology in attending to genuine needs in the North strengthen the argument that in its current form it might be even more unsuited to properly answer the basic needs of the South. While it is true that our own solutions should not be entirely discarded to address problems in another context, they do however carry within them a certain ëgenetic codeí that reflects the cultural and social values of the country from where it was originated. Technology transfer has disturbed many of the more traditional practices in developing countries and reinforced lines of dependencies between owners of land and capital and cheap landless labourers. Western technology is based on certain Western institutional arrangements that often simply do not exist in the so-called developing world.

Decennia of development assistance did not have the results hoped for. Global economic growth has increased, but inequity is also still increasing[3]. This has disillusioned many, and for them it was often easy to blame modern technology for the social inequality or dualism it created (see box 5).

However, the problem should not be reduced to a technical issue. In our view technology is no more than a vehicle, a trigger, or a catalyst for growth. Indeed, in

[3] A lot of evidence presented in yearly World Bank Reports over the past forty years shows that simultaneously to a global economic growth, the gap between rich and poor is constantly widening since the sixties. Therefore, a mere focus on growth does not automatically solve the poverty problem.

development cooperation technological processes often introduce patterns that resemble the growth patterns of the North, and in a way the North thereby imposes its own development path on the South, the path of economic growth.

In the case of the Flood Action Plan Project in Tangail (FAP-20), the large infrastructural plans were designed to protect the inhabitants of a particular area from the negative effects of floods. The complex structure of embankments and sluice gates was designed with a focus on intensive agriculture.
Student work and suggestions were based on interviews with the local communities. Technical issues were studied, such as the potential of canal re-excavation and research in better design of roads, embankments and sluice gates. This was done with attention to the water system and water use as a whole, the role of organic farming, the fisheriesí situation and the effects on adjacent areas. They also tackled land acquisition and water distribution issues. While some teams focussed in depth on smaller areas within the embankments, others focussed on a river system, the project as a whole or even within broader strategies.
As a pilot FAP-20 eventually proved not to be appropriate because of the negative effects for the inhabitants of surrounding areas, and other economic activities within the area such as fisheries and boating. It was not the technology itself that was blamed but the objectives and narrow view behind the choices.

Box 5: Blaming technology

This leads us to the old question about why it worked for us but doesnít always work for others nowadays? For one, the current Western model of an economy is concerned only with ëmarketableí items. As a consequence, in its basic fundaments it is incapable of addressing absolute needs (Max-Neef, 1987).

There is a threshold under which the needs are ultimate for survival. Above this threshold an individual can start trading off needs (a smaller house for a radio for example). Basic needs (food, housing, health, etc) are however not marketable because there is no possible trade off between a minimum clothing and minimum food, both are essential for survival. Nevertheless, the large development organisations strongly advise towards market liberalisation and privatisation. In the past the colonial rulers would have never imposed on themselves the kind of rules they impose nowadays on developing countries in trade relations for example (Stiglitz, 2002).

The practice of engineering with proper attention to these questions is extremely complex and therefore quickly and often too easily discarded as soft or far from the practice of engineering. But if we agree on the premise that engineering is about human needs, then an immersion in such issues is essential. For students and teachers alike a period in a developing country is therefore a valuable confrontation. It transparently presents the essence of the problem: there isnít always a social, organisational or financial support for the type of technologies that are at hand in our books and manuals. Training programmes in developing countries can help to plainly demonstrate that a technology-oriented approach often fails for that reason. There are numerous cases at hand to illustrate this point (see box 6).

Once this has been acknowledged it can only lead to one conclusion: it is not the technology itself but a proper understanding and study of the needs and context for implementation that should come first. And finally, such a learning experience is also a valuable asset for an engineering career in industrialised countries for deprived and underprivileged groups also exist within our own borders.

Although it is in one of the wettest parts of the world, Bangladesh has always faced problems with the

supply of clean drinking water. In the past decade a new disaster emerged. It turned out that two-thirds of the tube wells installed over the last thirty years ñ roughly 5 million in total ñ contain arsenic concentrations above the permissible levels set by the World Health Organisation (WHO). These wells were installed to contribute to a secure and reliable drinking water supply. They would provide a good alternative to surface water supply with its associated bacteriologic diseases. In itself that goal has been reached. It is therefore a bitter observation that it is this very approach that has led to widespread arsenic poisoning of drinking water. Arsenic is chronically toxic after prolonged low level exposure and can lead to skin lesions, bronchitis, diabetes and eventually tumours and cancers. Roughly 42 million people (more than 30% of the population) have been exposed for many years to arsenic concentrations well above the WHO standard. (Rammelt, 2004)

Box 5: Case of drinking water supplies

ROLES AND OBJECTIVES

Until now the focus of this paper has been on the fundamental considerations regarding technology and past experiences with the student programme. This next part of the paper will enter the discussion about the respective components (such as research, education and project) and their inherent goals. It will focus in particular on drinking water supply projects in relation to the case from the previous box.

In 1998 a first team of students investigated the recently uncovered arsenic issue. The severity of the issue gradually suggested the need to elaborate the partnerships beyond the student programme. Now, the programme is directed towards the following objective: fulfilling the necessary conditions for a successful participation of the local community in a process to mitigate the effects of the contamination. It includes local goals as well as research-oriented goals having a more general significance. The long-term strategy for this collaboration is directed at minimising the risks of existing and future remedies, while incorporating essential institutional requirements for implementation of remedial technologies. This strategy requires research for a better understanding of the hydro-geological situation as well as the local organisational possibilities and restrictions (Rammelt, 2004).

Obviously there is an irreplaceable role to be fulfilled by the local NGOs in the partnership. They are responsible for the social mobilisation and the implementation part. This requires a proper understanding of local social environment, which for foreigners is often prevented when the informal familial, gender, professional arrangements cannot be openly shared. The actual decisions are often taken behind the scenes out of our own perception. In Bangladesh in particular, working with NGOs will improve the chances to come up with systems of drinking water supplies that are more appropriate, simply because they find their origin in the local situation.

Students and researchers might however play a facilitating role in the social process, even if it is just an eye-catcher for local communities to get involved. But even if their involvement seems to be successful on the short term it provides no certainty about their relevance on the long run. Therefore we should be aware that our involvement is very short compared to the kind of processes that we deal with. This has a strong bearing on how we ought to perceive our own role.

On a more general level, such questions constitute a key criticism to many of participatory approaches in development projects. Groups are formed within the local community in order to meet predetermined objectives, or at best they might participate in joint analysis. The relations are based on what some call pseudo-participation because they are oriented towards concerns that are externally defined. In this way

participation is used to legitimise outside strategies and objectives (see box 6) (Pretty, 1995).

Regarding the case at hand, the arsenic issue might not be as urgent to the average Bangladeshi as we imagine. Other issues might have first priority seeing that the ëincubationí time of the effects of the contamination could take several years whereas other problems have to do with survival on a day-to-day basis. As a result, short-term success does not automatically endure and cannot be taken as proof for similar success on the long-term.

Box 6: Whose objectives count?

The education element is still believed to be a valuable component and its low-profile characteristics havenít changed much but the basic choices and activities of the arsenic project have repercussions on the way we perceive and organise the role of Western institutions in the development processes in rural Bangladesh. Consequently, it also influences the way a student educational programme should be structured within this particular project.

The main risk in the student programme was that the study results from each group separately might, in certain cases, be of less influence and interest to the counterparts. Considering the urgency of the arsenic issue, a more co-ordinated and linked scheme of training periods could improve the quality of the results on a long term. The proposed research within the project might provide the needed glue in a sequence of student traineeships. On the other hand, it could also mean less freedom for the students and a lower personal initiative (Rammelt, 2001).

Idealistically, it is perhaps more the researcher, the donor, or the project manager that in fact should participate by renouncing a certain amount of the control their position has permitted them to have. But this should be done realistically, which means one can not go around the local communities that take initiatives independently; their participation is actually self-mobilisation leading to the formation of new local institutions that will eventually take over control of local decision-making.

Here arises a tension between our own objectives as students, researchers or donors, and the objectives of the local communities in developing countries. Lines of dependencies have been created a long time ago and are not easily changed because there is no apparent reason why many foreign organisations would want to change them, nor why villagers would want take leave of a serviceable benefactor.

CONCLUSIONS

The purpose of this paper was to describe a general vision on development and technology and to look into the consequences of this on the set-up of projects with educational components. As seen, the student programme has evolved into a broader one with research and project components as well. This has provided us with experience with two types of student traineeships: the observing type and the participating type. Both have brought to light certain tensions between project and educational goals.

In the original type of traineeship, the focus is on interviews, field visits and writing recommendations or project descriptions. Looking at the educational impact a tension could be observed when students wished to ëgiveí or contribute instead of ëreceivingí a valuable experience.

In the later type of traineeships, particularly within the framework of the arsenic

project, the same kind of tension is recognisable. An additional and related conflict arises when students are participating for a short time in a project with long-term characteristics. Mostly their own educational goals framed by a set of faculty rules lacks any real influence of the priorities related to the development process. In most universities there is no much room for these priorities.

Sometimes this creates tensions within the partnership itself and is not always obvious to everyone. Normally universities lack the proper educational means to perceive this type of situation with the consequence that these tensions are deepened. The type of problems and the required adjustments in way of thinking (holistic and long-term) has to be pushed much more by universities than happening now. We have observed that students are confronted to this type of thinking for the first time during their training, and that it happens only very late in their studies. The impact will be much stronger when students are confronted with this type of thinking more often and earlier in their curriculum.

We have a dream that some day in the near future university boards would decide that they themselves, and all the management and scientific staff should have a compulsory stay of at least three month in a development country and at least half of that time at the local village level.

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