SEFI
ANNUAL CONFERENCE

INTERDISCIPLINARITY
IN ENGINEERING EDUCATION

PROCEEDINGS

HELSINKI UNIVERSITY OF TECHNOLOGY

JUNE 29 - JULY 2, 1987

Disciplinarity or/and Interdisciplinarity?

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I believe that interdisciplinarity is much older than disciplinarity. I might even say that first there was interdisciplinarity, and only then came disciplinarity. There is no point in arguing when disciplinarity appeared, but when it did, it seemed for a long time that interdisciplinarity would gradually come to an end.

In those times, shall we say in the 19th century, the progress of both science and education was characterised by a growing number of disciplines which became firmly established. The then still new disciplines, which are called traditional disciplines today, were produced through multiplication. This process, which accelerated in the last century, was necessary, and also in conformity with a law of nature. But it did not mean that the interdisciplinarity had ceased to exist. It was perhaps mentioned less frequently. However, in recent times - shall we say from the 50s - more and more people have spoken up for the development of interdisciplinarity. But their view has not been given a whole-hearted reception. Some of the teachers of the traditional disciplines became anxious about their own disciplines.

And indeed, their anxiety does have a basis too.

Slogans are fraught with danger at times, since they can be misused. Just remember that there was a time when the basic theoretical knowledge of our engineers was found insufficient. So we adopted the even today fashionable slogan: enhance teaching of fundamental sciences. Enhance it uniformly, meaning even there where it was satisfactory. In vain did the teachers of concrete engineering disciplines protest, engineering education deformed. The

stress was excessively shifted to theoretical grounding. To the grounding of nothing: for indeed, a substantial part of the concrete subject-matter of engineering wasted away. Some of the universities trained not engineers, but semi-physicists, who were neither genuine physicists nor genuine engineers.

There was once in Hungary an "epoch of economic efficiency", and there have been other periods, too, such as "labour safety", the "green period", etc. Those were times when, due to the overstressed and fashinable slogans, even mathematicians were obliged to study economics, labour safety, environment protection and the like quite intensively.

It stands to reason that this sort of thing could only be done to the prejudice of the traditional disciplines. For example, recently the slogan "global education", which is somewhat cognate with interdisciplinarity, has gained considerable ground. It would be a nightmare even to think of what might happen if interdisciplinarity should achieve world-wide success and consequently have a monopoly: there would only be "inter" in education, without disciplinarity.

But to be in earnest, let us see what we have to keep in mind when we argue for interdisciplinarity. For interdisciplinarity is a very important thing, even though not all engineers are equally concerned in it.

Bud first we must clarify the concept interdisciplinarity. I know at least three different types, and each one has to be handled differently.

The simplest type is the one which is created from the marriage of two traditional disciplines. There is really not much to say about it. It will suffice to mention words such as bio-engineering, economic engineering, CAD, CAM, etc.

These creations are in fact transitions. For it is not only by bipartition, but by interbreeding of older disciplines that nowadays new disciplines can be multiplied. If the "newborn" proves progenitive, it will first become a new discipline, increasing the number of branches and becoming sooner or later a traditional discipline itself. If the result of interbreeding should be a hybrid, it can be sustained by artificial feeding only for a short time.

In the case of this type of interdisciplinarity there is no need for restructuring the entire engineering curriculum. There is only need for adding a new degree programme to the traditional engineering ones. It usually involves no difficulties, for the traditional disciplines also profit from it because of their possibility to expand.

The other type of interdisciplinarity is when the engineering problem to be solved is a complex one. Under the circumstances, there are teams where the representatives of several disciplines work together. Let us take, for example, the case of a hospital building. There are of course here, too, many partial tasks which do not go beyond the boundaries of different traditional disciplines (e.g. the design of the structure), but a considerable part of the problems requires interdisciplinarity, some of them even need multidisciplinarity. This is mainly characteristic of the work of the "general staff". It is naturally inconceivable that this type of multidisciplinarity could be embodied in a single person only. While on the other hand, the specialists who work in a team on such task must have the necessary aptitude required for cooperation. Such aptitude can only be acquired in practice, still the person must try his hand at it as a student.

It is not easy to introduce such interdisciplinarity or multidisciplinarity into university education. True, one's resistance arises not from the anxiety about one's own discipline. There is a much simpler reason for it. It calls for too much work and effort on the part of the teachers. For it is necessary that the teachers themselves should also be inclined to co-operate. And moreover, the planning, the organising and the implementation of these projects entail meticulous care. Over and above that, some of the students often choose the easier way out, participating in the teamwork only formally.

The third type of interdisciplinarity resembles the one above, with the difference that it requires not only inclination to co-operate, but also a certain amount of knowledge in the field of the "alien", at times "much too alien", disciplines.

It is the lack of such interdisciplinarity that causes the greatest problem for society, while its realisation entails the greatest difficulties. For the fact remains that, on the one hand, we do not know the right way to realisation and that, on the other hand, the intensification of this type of interdisciplinarity is what gives rise to the main worry of the teachers of traditional disciplines. They have got the feeling that any subject-matter outside their own discipline would tend to diminish their authority.

Perhaps it would be worth discussing the background of this interdisciplinarity a little more in detail.[1]

While engineers have never enjoyed a social status commensurate with their social utility and importance, and while explicit anti-technological sentiment has existed since at least the Industrial Revolution[2], the situation has recently taken a quantum jump for the worse. Antitechnological lit-

erature and pronouncements have proliferated since the late sixties[3], and the engineering profession has fallen into a state of disrepute, evidenced by the sharp decline in enrollments at colleges of engineering[4]. What is the source of this widespread disenchantment with engineering?

Engineers have a credibility gap. The engineering community developed notions of social responsibility during its professionalisation. The notion has led many engineers to seek a role in directing the power that they help create. The credibility gap results from such engineers making their claims about technological right and wrong as engineers, rather than as concerned citizens. The notion that engineers have some special aptitude for the judgment of social issues damages public confidence in the integrity of engineering.

The engineers' credibility gap comes from their behaviour in the public arema. Many engineers have overstepped the limits of their expertise at two different points. First, they have confused technical know-how with social insight. Second, they have forgotten that the perspective of a particular engineering specialty is very restrictive, and have consequently confused technical know-how about parts of real problems with comprehensive solutions to these problems. In other words, many engineers have fallen into the bad habit of believing their specialties are sufficient for taking successful action in the world. As a consequence, such engineers make conflicting claims about the desirability and technical adaquacy of technological programmes.

The other source of disenchantment is society's misunderestanding of the progress it has made through engineering.

I will not go into the details of this aspect.

One way of eliminating the sources of disenchantment is to bring both engineers and non-engineers into interdisciplinary experiences with each other.

The engineers' credibility gap ultimately results from their overstepping the limits of their expertise. They have been trained as though their specialties were self-sufficient in solving real-world problems. This confusion cannot be made by an engineer who has had an interdisciplinary experience in a group of non-engineers and engineers with different specialties.

From interdisciplinary experiences the non-engineering public can learn that the desirability of a technological innovation is a social issue,

and undesirable side-effects can be avoided only if society makes this a part of the engineers' problem and adopts a decision process that incorporates both social and technical considerations. Hopefully, the public will stop blaming engineers once it learns this lesson.

The lessons to be learned from interdisciplinary experiences are important enough to be included in formal college and university education. Many institutions have attempted to do this with far-ranging curricular innovations.[5] They have either radically restructured the entire engineering curriculum or added an interdisciplinary degree programme to their traditional engineering ones. Many institutions have introduced individual courses that are intended to provide interdisciplinary culture.

I believe it is no small problem to decide the number of programmes, courses and subjects that should be offered, nor is it easy to decide their content. There are, after all, so many "alien" disciplines.

It is also obvious that some of the engineers (the majority perhaps?) solve throughout their whole life the kind of tasks which require the knowledge - a very thorough knowledge - of but a single discipline. Take, for example, the engineer who is engaged in bridge construction. The question immediately arises whether he knew as a student that he would design the structure of the bridge or rather designate its location. The first case requires the knowledge of a single discipline, whereas the second involves multidisciplinarity.

Thus we are faced with the issue of whether can the student be made to study interdisciplinary courses, and if so, then how many should he study. If the student is made to study many interdisciplinary courses, many subjects which belong to "alien" disciplines, he will have less time for the traditional disciplines. Here there is a possibility of clash with the traditional disciplines.

The importance of this question naturally differs in different countries. The reason why I sense its importance is that in Hungary considerable pressure is often applied to the university in connection with the elaboration of the curricula. In some instances the government specifies certain compulsory subjects (e.g. law, labour safety, sociology, etc.) that every engineering student must study. But the period of education cannot be extended, so the essential engineering subjects must be reduced. Where, then, is the reasonable limit?

The answer is all the more difficult because quite often it is not easy to separate this type of multidisciplinarity from what is known as gen-

eral culture. The level of the ganaral culture varies according to different countries and considerably depends on the efficiency of the primary and secondary education, even on the programmes of the mass media such as, for example, the TV.

Alas, if the zealous prophets of interdisciplinarity succeed in bringing public sentiment over to their side, then the pressure put on the university may distort the teaching of the basic disciplines, and the creature leaving the university might be able to run, swim, fly and sing, but he will not run as a rabbit, swim as a fish, fly as an eagle or sing as a blackbird. This is the goose.

We do need of course the goose, too. I, for example, am very fond of its liver. But we also need such "specialists" as the rabbit, the fish, the eagle and the rabbit.

That is why I must request all those persons who speak in support of this third type of interdisciplinarity to act with a sense of responsibility when they word their slogans.

References

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3. Two of the more strident are Marine, Gene, America the Raped, Avon Books, 1969.

4. Time reports this drop as 20 percent from 1971-1974. See "Return of the Campus Recruiter," Time, May 6, 1974.

5. Coddington, P. L., et al., "Final Report: College of Arts and Science/Socio-Engineering Task Force,", Vanderbilt University, April 9, 1974.