Vocational Training and University Education - Is There a Difference?

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1. Some preliminary observations

Vocational training in statistics, taken broadly to mean statistical courses aimed at professional staff rather than at university students, comes in a number of forms. Their levels range from virtually no prior knowledge in statistics to one or more years of university statistics. The organisational form differs from ad hoc courses within a firm to recurrent courses offered by, for example, a university.

In this article, the specific form of vocational training under consideration is the training provided by a government statistical office for its own staff and for users of statistics. The illustrations are based on experience from Statistics Sweden.

It appears that university education is often used as some kind of model for training courses in statistics. The reason may be that teachers at vocational courses have experience of university education, either as university teachers or as students. They may thus feel that there is no real alternative to copying university courses as closely as possible.

However, the basic situations at a university department and a centre for vocational training are quite different. A vocational teacher who does not take these differences into account when planning and executing his course will not do a good job.

(i) *A difference in goals:* If we first examine the differences in goals, we find that the university course has perforce a relatively vague goal. The reason for this is obviously that the student may elect to finish his studies after the course, or continue at a higher level. A university course at the lower levels thus has to provide both a self-contained body of statistical knowledge and a sound basis for further studies.

As a consequence, university courses tend to form rather solid pyramids. At the lowest level, a broad spectrum of statistical topics is covered in an elementary way. At the next level, some topics like descriptive statistics are more or less left out, while

others like probability, inference, etc. are covered in a deeper and/or broader way. As the building process continues, each level has to be built so solidly as to support all the levels above it.

In vocational training, the goals of a given course are much more distinct. They may be stated as "Giving EDP specialists an orientation on statistical principles" or "Training laboratory personnel to use basic methods of descriptive statistics". The point here of course is not that it is easier to define a goal for a shorter course - which is not necessarily true - but that there is no need to bother about the next level. In general, there is no next level!

The building that the vocational trainer erects is thus not a pyramid but rather a light and strong structure stressed for its specific task. Even if formal derivations etc. play a less important part in vocational training, it is important to acknowledge that this does not lead to an "inferior" curriculum.

(ii) *A difference in students' experience:* The students at an elementary university course in statistics have little prior experience of statistics and no common subject-matter experience. By contrast, the students at vocational training often have experiences of using statistical data, even if they do not possess any formal knowledge of statistics. They also have a more or less common field of interest, e.g. city planning. These circumstances give the vocational trainer great opportunities.

To illustrate these opportunities, we may consider the use of examples. At universities, it is generally preferred to begin with very simplified examples. One reason against using realistic examples is that students lack the (common) subject-matter knowledge that is necessary to understand and penetrate the example. Another is that they do not have the general experience needed to tackle complex situations until quite late in their studies.

In vocational training, realistic and complicated examples may very well be used as starting points for the presentation of a method or a principle. The students will not only have the subject-matter expertise needed to be able to distinguish the statistical problem and the general experience to tackle complex situations. They will also judge the statistical method presented on its performance in their actual day-to-day work, so it is as well to start there.

A further aspect of the role of examples that needs no elaboration is that it is imperative to use illustrations and examples from the student's own subject-matter area. City planners are very sensitive about analysing market research data and vice versa!

(iii) *A difference in cost structures:* It is very difficult to compare costs for education and training between firms, departments, etc. because of differences in funding and accounting. In this context, however, only one aspect of the cost structure will be considered, viz the cost of students' time.

How the costs for time spent in training are treated varies from organisation to organisation, but it is clearly a real cost for the organisation. It is equally clear the cost for students' time at a university does not burden the budget of individual departments. In the same way, savings in time spent in education/training bring direct financial benefits in one case but at best get an approving nod in the other case.

To be more specific, consider a ten-hour block of education for 20 students at a university, for simplicity disregarding costs for administration, equipment, etc. If the same increase in statistical knowledge could be achieved in nine hours, the saving for the department would only be the teacher's salary for that hour and perhaps for an extra

hour's reduction in time for preparation. A rough estimate of the gain would be in the magnitude of 1,000 SEK (approximately £100), which should then be the upper cost limit for any efforts to achieve that reduction in time.

In a similar situation in vocational training, the potential saving would be in the region of 10,000 SEK, as the students save one hour each. Obviously, the teacher in this case has much more freedom to introduce learning aids, better equipment, or even a co-teacher, to achieve the reduction.

In practice, this theoretical analysis may not be entirely valid when the very visible costs for new equipment, for example, are weighted against the more illusive gains in more effective training. Even taking this into account, the fact that students' time is not a "free asset" is a strong incentive to improve vocational training procedures.

2. PTP : a Swedish example of vocational training in practice

In 1988, the Professional Training Programme (PTP) was instituted at Statistics Sweden as part of a far-reaching reorganisation of vocational training. In the new organisation, PTP was formed as a new section within the Department of Research and Development to take the responsibility of vocational training in statistics, EDP, marketing, and publishing. Managerial training etc. remained with the personnel section.

There were many reasons for this new approach to training. One was the need to give broader and deeper education in statistics at all staff levels. Another was the feeling that in-house training would be an important tool to retain skilled personnel. A third reason was the desire for closer integration between development and training - the parallel with research and teaching at a university department was explicitly made.

PTP received a budget of approximately six million SEK for a test period of two years. A staff of eleven - head(master), six teachers, and four administrators - forms the core of the programme, while experts from the rest of Statistics Sweden (and from universities etc.) are also used as teachers on specific courses. Roughly half of the total teaching is done by PTP's "own" teachers and half by other teachers.

The statistical part of our programme is divided into four parts. *Statistics A* is aimed at staff members without formal education in statistics (and generally without any university education). In a relatively concrete way, it presents the statistical production process from definition of a need for statistical information over data collection and data processing to presentation and analysis. The philosophy behind this 200-hour course is similar to that behind the *Statistics in Action* approach described by Ms Winqvist in another contribution to ICOTS 3.

Statistics B is a corresponding course aimed at staff with university education in statistics. In nine modules, it covers approximately the same subjects as Statistics A, but at a considerably more ambitious level.

While both these courses adopt the perspective of the producer of statistics, *Statistics C* adopts that of the user of statistical information. It is thus suitable both for those who work with presentation of statistical results and for students from outside Statistics Sweden. Generally, the modules of this course are on a fairly advanced level.

The three courses, A, B, and C are supplemented by *Other statistical courses.* This heading covers a wide field from specialised courses in simulation techniques to elementary courses in descriptive statistics.

In general, there is no course fee for students from Statistics Sweden. Exceptions exist, for example, costs for books that the students keep after the course.

In addition to its main purpose of training the staff of Statistics Sweden, PTP offers courses for students from other government offices, regional offices, organisations, etc. Students from developing countries are trained in cooperation with the International Consulting Office (ICO) at Statistics Sweden.

Training for "external students" is provided in two ways. They will either follow the ordinary courses, or attend a course especially designed for them. In either case, the student pays a fee for the course. The courses offered entirely for external students are the most interesting in this context.

One group of such courses deals with specific subjects from the user's point of view, i.e. where to find the figures, how to use them, and how to avoid possible pitfalls. Typical titles are *Using Indexes in Practice* and *Know Your Market Better.* Another group of courses deals more with statistical principles and methods. A theme we call Understanding Statistics may be taken as a case in point. These courses are generally directed towards a specific group of users, with titles such as *Understanding Health Statistics* and *Understanding Statistics in Regional Planning.* These courses aim at teaching *why* rather than *how.* They cover most topics in a first-semester course in statistics, stressing principles and avoiding computations and derivations.

The reason for giving training for students outside Statistics Sweden is not to make money. Instead, we see it as a way to improve the understanding of statistical issues in a very broad sense; it is very useful for a central bureau of statistics that the general level of statistical awareness is high. Courses of this type are also very rewarding for the teachers involved.

3. Some experience from the first two years of PTP

(i) *Use of teacher teams:* By a teacher team we mean two (or occasionally more) teachers who plan and carry out a number of lessons together. Usually, both teachers are present during the whole training session.

The use of teacher teams is of course a comparatively expensive form of training. Our experience is, however, that properly composed and used teacher teams are very cost-efficient in giving students better value for their money (= the cost of their time spent in training).

We have found teacher teams especially efficient in two types of situations. One is the highly integrated course, e.g. combining advanced statistical theory and sophisticated use of EDP. Even in elementary courses this type of situation can arise, a case in point being the course *Statistical Graphics with PC Support* where a statistical/graphical expert co-teaches with an EDP expert. In EDP-intensive training, the use of two teachers is incidentally also often motivated by the volume of assistance needed when students solve smaller or larger exercises.

The other type of situation when we prefer to use teacher teams is when a high tempo is desired. As an example, *Understanding Statistics* and similar courses cover a very wide spectrum of methods and principles. It would be impossible to achieve this without a high tempo, which in this case is assured by the mixing of short theory-oriented lectures with quick group discussions, practical exercises, etc. It would further

be impossible both for one single teacher and for the students to keep the pace *and* the high level of concentration required. With two interchanging teachers, a much quicker progress through the statistical landscape is possible and even enjoyable.

Before leaving the subject of teacher teams, we may observe that it is imperative that the members of the team are in some sense evenly matched and that they are really willing to coordinate their teaching effort. Planning and keeping of plans - you must be able to rely on your partner to give you your allocated time - are of course most important for teacher teams.

(ii) *The choice of perspective:* As far as possible we try to adopt the student's perspective in our courses. This often leads to a conflict with the "logical" sequencing of material for the course. As examples of a non-statistical nature, we may take those parts of our curriculum that deal with legal aspects of the production and use of statistics.

These parts must, of course, be planned in close collaboration with legal experts, and their initial approach was very straightforward: "Tell us how much time we have. We will review earlier legislation and then cover present laws in some detail. We will round this off with a few actual cases." They were quite distressed to find not only that they were supposed to teach together with a laywoman, but that she wanted to change the order of presentation. In the end, the course very successfully adopted the perspective of a statistician trying to follow the law when carrying out surveys and presenting results, rather than that of a lawyer.

The importance of a well-reasoned ordering of the material in a vocational course should be stressed in this context. A good rule in any educational situation is to begin with the whole, then treat the parts, and finally return to the whole. As an example, we may take the teaching of statistical packages like SPSS or SAS.

Our SAS courses initially started very logically with the preparation of a SAS data set, continued with the SAS syntax, and ended with examples of how to use SAS in different situations. This order has been more or less reversed so that the course now begins with a demonstration of the scope and philosophy of the package, using teacher-prepared data sets. Students find it much easier to learn the relatively complicated process of making their own data sets when this item appears later in the course.

As a final aspect of the choice of perspective, we may return to the role of examples. The general approach to adopt students' perspectives and start with the whole rather than with the parts - which is more pronounced at elementary levels - naturally goes well together with the use of realistic examples.

This practice is, however, not quite unproblematic. The teacher must be prepared to allow side issues to be introduced by students, and know how to treat such cases. The students must be prepared to accept that there is not always one truth and one solution.

(iii) *Vocational training and organisational policy:* Most people engaged in vocational training within an organisation would probably agree that it forms an important and integral part of organisational policy. As an example, training must reflect and support the EDP policy of the organisation. Further, the role of training must be considered early when new methods, software, etc. are considered. As an example, the course in statistical graphics already mentioned was the outcome of a project for choosing a recommended graphical package for Statistics Sweden.

Another aspect of organisational policy is that of priorities with regard to training. While the policy of Statistics Sweden is quite clear in giving training a high

priority, in practice, a middle-level manager will be reluctant to send key personnel to training if there is a chance that their regular work will be delayed. The theoretical remedy is simply better planning, but in reality this sometimes proves difficult.

An area where we find that there is a lot of work to be done is assessment of the demand for training. Our present approach is that all sections at Statistics Sweden are required to plan for their training next (fiscal) year as part of their general budgetary work. As a basis for this work, they may use the current year's supply of courses as well as a short list of new courses proposed by us. They are, of course, also free to suggest their own new courses.

This process gives reasonable results, but may lead to a somewhat static reporting of needs. We thus give the development of a better model some priority and in the meantime try to improve the situation by stressing the need for heads of sections to have a continuous dialogue with their staff and to give us well-founded reports.

On a more optimistic note, our students' high motivation must be mentioned. This is of course a prerequisite for many of the approaches mentioned, e.g. the use of more complicated examples and of a higher tempo.

The creation of PTP and the accompaniment of top-level commitment has definitely given training a fresh impetus at Statistics Sweden. At the same time, it is important to keep motivation high by a close integration between day-to-day work and on-the-job training on the one hand, and formal training courses on the other. EDP training is the prime example: the student who learns SAS and has no chance to practice it in close connection to the course will largely have wasted their time.

4. A brief conclusion

The author advocates that there is a substantial difference between university education in statistics and vocational training performed by, for example, a government office of statistics. The most important differences are in goals and in prior experience of the respective student groups, and in costs for students' time.

In order to achieve an efficient vocational training, one must use the possibilities that these differences offer: the possibility of investing more resources in each classroom hour, the possibility of connecting examples to the students' common background, and the possibility of concentrating on relevant content at a relevant level. The training should further adopt a holistic view of the methods and principles treated.

Vocational training should, like any education, be treated as an investment in knowledge. However, even if decision-makers in an organisation accept this statement, there are, in practice, considerable difficulties in getting them to accept its consequences.

Finally, it should be admitted that the degree of difference between university education and vocational training in statistics varies with topic and level. In general, the differences seem to be larger in elementary courses. Still, the author thinks that in the same way that the vocational trainer takes a few leaves out of the university teacher's book, universities could well adopt some of the approaches sketched above, e.g. the use of teacher teams.