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TEACHING STATISTICS MUST BE ADAPTED TO CHANGING CIRCUMSTANCES: A Case Study from Hungarian Higher Education¹

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Abstract: Teaching statistics can bring up difficulties of various types for the teacher. Some of these are independent of the environment, i.e. they could occur at any place and time; some are specifically conditional on the surrounding circumstances. This paper presents an example for both of these kinds from the practice of two Hungarian teachers.

Keywords: contextual learning; Hungary; statistics education

Adjusting to the drastically changed environment

INTRODUCTION

Higher education in Hungary has been going through a turbulent transition period since many years. Traditionally Hungary had a well-established and successful higher education system³ but in the last decades it had to face new challenges coming from various directions. These challenges include the greatly increased number of students while the human and material capacity of educating institutions has not developed, the adjustment to the new needs of the labour market after the change of the political system in 1989 and adopting the two-cycle higher education system which is an obligation for Hungary by joining the European Union in May 2004. These issues have an over-all impact on the whole higher education system: we have to reconsider what and how we teach.

Probably the problems caused by these challenges are most apparent in business education since the deepest changes are to be observed in this field of life in a transition economy. The market needs a great number of well-qualified business professionals armed with usable practical knowledge but the philosophy of the traditional one-cycle system does not really fit to meet these

¹ *The views expressed in this paper – especially the sometimes sharp statements of the first part about the present situation of Hungarian higher education – are those of the author, and do not necessarily reflect in any sense the views of their institutions.*

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³ It can be certified, for example, by the fact that Hungary, although a small country with respect to its population, had over the course of the 20th century no less than twelve Nobel Laureates.

needs. The subject of statistics is an excellent example to illustrate the problem. As statistics is a very rigorous mathematical theory and at the same time a collection of practical analysing tools as well, it is always a matter of dispute how to weigh theory and practice in the curriculums.

Since I teach Statistics in a Hungarian business college⁴, here I will discuss the above mentioned issues through this particular subject. The paper is organized as follows. Section 1 briefly summarizes the current state of Hungarian higher education and enumerates the most important challenges it has to encounter. Section 2 discusses how these problems are related to the content and way of teaching Statistics, and Section 3 presents some suggestions based on my own experience and the results from a short survey which was carried out among second-year students of Statistics in December 2006. Section 4 summarizes the key findings.

1. CHALLENGES AND THE CHANGING ENVIRONMENT

Emerging mass education

The most characteristic feature of the Hungarian higher education was a dramatic increase in the number of students. Table 1 shows that between 1992 and 2003 the number of students more than tripled. At the same time the number of full time lecturers has just slightly increased after a significant fall in the middle 1990s. Comparing these two data it is apparent that the number of students per lecturer has increased from 7.3 to 21.9.⁵ It is also apparent that the budgetary support of higher education relative to GDP has not increased either, and it represents a quite low GDP proportion. This means that governmental support can be described with largely decreasing per capita value in real terms. One can summarize the last 15 years of the Hungarian higher education by *moving from a mostly elite-type education to a mass education*, which has far-reaching implications for the whole system.

Table 1: *Some characteristics of the Hungarian higher education, 1992-2003*

Year	Total number of students	Total number of full-time lecturers	Budgetary expenditures on higher education (per cent of GDP)
1992	117 460	16 157	1.12
1995	179 565	14 975	1.01
2000	295 040	15 649	1.15
2003	366 947	16 771	1.17

Source: CSO (2004)

Corresponding to market demand

Hungary has undergone fundamental structural transformation since the system-change which has also affected her labour market to a great extent. For example, traditionally we have had high proportion of students in engineering and in teacher's training. Owing to the emerging new economy, recently business and management studies are very popular: the market economy

⁴ The exact meaning of 'college' in the Hungarian higher education system will be given later in this paper.

⁵ It must be mentioned that part time lecturing has become more widespread that is many teachers have part-time jobs besides his full-time job.

needs professionals in the field of marketing, corporate finance, production management, human resource management, etc. Although the aim is obviously to *establish a course structure that will respond to the changing demands of the labour market*, very often it is mainly reflected only in the names of subjects. Management and business sciences is a quite new field of education in Hungary and sometimes the heritage of the past is more dominant in these programs than the orientation to *conveying practical knowledge which is required by the labour market*. The introduction of a two-cycle education system, which will be discussed in more details in the next paragraphs, may help to overcome some of these difficulties by clearly separating study programs qualifying to the labour market from those giving a more advanced and more theoretical education.

From one-cycle to two-cycle system

Traditionally Hungary had a binary higher education system provided by colleges (*főiskola*) and universities (*egyetem*), and both parts of this dual education system offered one-cycle programs. Traditional-style universities offered “long” four- to five-year degrees in arts and sciences, law, social sciences, economics and education. Colleges offered three- to four-year, professional-oriented programs in areas such as technology, business administration, health services and teacher training. Universities generally followed a one-tier system leading to an integrated master-level degree (*Egyetemi Oklevél*) that required a total of five years of study (six years for medicine). The system was one-cycle in the sense that colleges offered bachelor-level degrees (*Főiskolai Oklevél*) but hardly was it possible after graduation to continue on for a master’s at university nor was it a prerequisite to go to university and obtain a master-level degree. The conception behind this system was that one should decide whether she/he wants a bachelor or master-level degree at the beginning of their higher education and should enrol to the appropriate institution.

By joining the European Union, Hungary engaged herself that *the then existing dual education system would be gradually dissolved and a sequence of bachelor and master’s degrees built on each other would be created*. The shift to the two-cycle system took place in this academic year, so in September 2006 only the new, bachelor’s-level programs were launched at Hungarian institutions of higher education and the long, integrated programs were phased out. The shift, however, was not easy and painless, and over-many questions still remain open, for example about the curriculums. Hitherto both college and university curriculums were designed to make up a whole on their own, that is they knew what they could build on and there was no need to take into account what could be built on them. Evidently this autonomy no longer exists with the introduction of the two-cycle system, so *we should have redefined the place of each subject in the schedule*. This still ongoing process is very effortful mainly due to the institutional and personal inertia that can be experienced in higher education: no one likes changing what and how they teach.

2. TEACHING STATISTICS IN THE NEW ENVIRONMENT

Teaching the subject of Statistics had been always present in the modern, 20th century higher education in Hungary. Having a long tradition is definitely a valuable thing but *this honourable*

history also makes it more difficult to adjust to the new environment described shortly in the previous section.

When enumerating some of the troubles specifically related to teaching Statistics I will try to follow the same structure as before; thus I will categorize the arising problems in terms of whether it comes from mass education, from the changing demand of labour market or from the introduction of two-cycle higher education. Obviously these issues are not independent from each other, and this kind of grouping is arbitrary. My aim is only to give some framework of thinking, even for me myself.

Challenges to teachers of Statistics arising from the sudden shift to mass education

With moving from an elite-type higher education to mass education it is inevitable *that we face a descending average standard of students*. Ten or twenty years ago usually talented students from good secondary schools went to universities, so they had quite good basics which could be built on. Nowadays a much wider range of adolescents with very divergent backgrounds go on to higher education, so there is no firm common knowledge which can be taken for granted. It has far-reaching consequences on teaching Statistics. The most apparent is *the lack of ability to cope with formal mathematical arguments*, which would be essential to understand the theoretical side of the discipline.

Conventionally, the curricula of Statistics at universities and colleges used to lay special emphasis on the mathematical grounding. Students were not just provided with the appropriate formulas to use but they saw rigorous proofs and derivations resulting in those formulas. The typical student of now simply does not have the necessary preliminary training and, in my opinion, not even the intellectual capacity to accommodate such theoretical reasoning. The very important question of whether it is needful at all will be discussed later.

The multiplied number of students makes the teacher-student relationship much looser, too. In case of mass education practically there is no room for individual balancing, no room for handling personal problems. Uniform conditions and requirements are needed not only among students in the same study group but among lecturers of the same subject, as well. This means that *teachers' autonomy is away*. For me it causes the most inconvenience when compiling the tests. I think every teacher should have the right to weigh the parts of the curriculum to some extent, that is to emphasize stronger the methods he considers the most important and to talk a bit less about parts that does not seem to be of crucial importance. Obviously it is impossible if all the students have to take the same exam. In that case *I have to teach them what they will be asked in the centrally compiled test and not what I think they should know*.

Challenges to teachers of Statistics when trying to meet the needs of the labour market

In the past the main objective of the Hungarian higher education was not to give directly usable practical knowledge, but rather to provide the students with extensive general knowledge – or to be more elevated, a ‘view of the world’ – on their widely interpreted field which they could use as a basis and they could develop themselves building on that ground. With the rapid change in the structure of society and economy *this role cannot be sustained any longer. The labour market*

does not need ‘little scientists’ who can learn anything if they have enough time. It *longs for ‘professional specialists’* who are armed with all the practical knowledge of their specific narrow field, everything they need to start work (and make profit) immediately.

I would illustrate this point with the following example from the field of Statistics. A company does not want its new marketing assistant to understand how two sample t-test actually works. It wants him to know what it is good for and to be able to perform a t-test on a computer using an adequate program. It has the consequence, again, that *our emphasis should shift from theory towards practice*. It is more important for graduates to be able to run a regression, for instance, with MS-Excel than to be aware of the theoretical stuff with all those uncorrelated, standard normally distributed error terms.

In my view, *teaching Statistics in Hungary has gotten stuck somewhere in the middle of the way from the old concept to the new, market-oriented one*. Most institutions realized that due to the increasing number of students and falling standard they cannot expect as much theory as before, so they reduced the requirements. But, concurrently, almost nothing happened in order to rationalize the curricula and to adjust them to market demand; that is to increase the number of real-life examples and computer-aided seminars or to skip parts that are not really important from a practical point of view.

Challenges to teachers of Statistics arising from the new two-cycle higher education

Perhaps some of the dilemmas mentioned earlier will be solved by the introduction of the two-cycle higher education system. Many of the current problems arise from the fact that we are in trouble when defining the role of higher education: Is it mainly a ‘scientific workshop’ giving theoretical education no matter what practical skills the labour market requires (close to the old view) or is it a ‘conveyor belt’ producing good professionals with immediately usable knowledge but not really wide-ranging thinking. The system of the two-cycle higher education may reconcile these two somewhat opposite views. *The bachelor’s programs, as the stage of mass education, could provide the market with the labour force it needs and the master’s programs could place much more emphasis on the theoretical grounding*.

In my esteem, this division is also inevitable when talking about Statistics. To describe the present situation I would use the proverb ‘too much is as bad as none at all’. *At the moment we try to teach a lot*, from the basic concepts through hypothesis testing and multiple regressions to time series analysis, and all these rather deeply.⁶ Given the available time and the preliminary training of students it is just too much to cover. I am convinced that *some of the topics should be allocated into the master’s program*, and those remaining should be backed up with more real-life and practical examples.

Another important question is *the place of probability theoretical grounding of Statistics*. As I have already mentioned, traditionally Hungarian institutions of business and economic higher education gave a very serious mathematical grounding. They offered at least one semester of Calculus, one semester of Linear Algebra and Linear Programming and one semester of

⁶ The list is quite similar at universities too, the difference is that later they offer more advanced courses based on Basic Statistics such as Econometrics, Multivariable Statistics or Time Series Analysis.

Probability Theory.⁷ The main point is that Probability Theory was a standalone course, so the students were familiar with the basic mathematical concepts (for example random variable, density function, central limit theorem, etc.) used in Statistics. Probably in a short and practice-oriented bachelor's program Probability Theory cannot claim an own semester for itself, so *the introduction of basic concepts will devolve upon Statistics*. I guess it would also have some advantages. For instance, probability theoretical grounding could be more goal-oriented, namely we could avoid such topics which are irrelevant for our purposes.

3. SOME PROPOSALS WHICH MAY HELP TO OVERCOME THE DIFFICULTIES

In this section I will try to draw some conclusions and phrase some short suggestions concerning teaching Statistics in Hungary in the future. These directions of development are crucial if we want to fulfil the requirements placed on us by the mass education, the labour market and the transformation process of Hungarian higher education. In doing so, I will rely on two sources of thought. As being a teacher of Statistics myself at a college, *I have my own ideas about what should we do in a different way*, indeed. These ideas have emerged during the years of teaching and are based on direct experience. But *I was also interested in the opinion of the other side of the classroom, namely that of the students*. Therefore I carried out a 'little survey research' with 72 participating second-year college students studying Statistics II⁸ in the first semester of the 2006/2007 academic year. I asked them to fill out *a short questionnaire consisting of four open-ended questions*. Answering was fully voluntary and anonymous. The questions were the following:

- According to your opinion, will you make any use of statistical knowledge in the future? It is important that the question is not how bad or good the present education is, but that if it makes any sense, in general, to teach Statistics at the collage.
- Which parts of the curriculum do you think should be discussed more thoroughly, and on which parts should be placed less emphasis?
- What alterations would you carry out concerning the methods of education?
- Any other opinions, advices, experiences that can be useful for us to make teaching Statistics better.

Since the answers to these questions cannot be analyzed numerically, I will not present any descriptive statistics or figures from this survey. Instead, in the following reasoning I will refer to reactions and judgements that steadily emerged from the answers. It is important to note that all my statements and suggestions apply to the bachelor's level programs, i.e. the level on which I teach.

1. Minimizing the amount of mathematical proofs and derivations, concentrating on the methods: what they are good for, when they can be applied.

⁷ I must emphasize that these really represent a minimum; a lot of universities have more semesters of the listed courses, and also Operational Research in the first two years.

⁸ Statistics II is the second semester of Basic Statistics covering methods of statistical induction (inferential statistics).

It is very difficult for me, as well, to talk about e.g. linear regression without correctly deriving the general formulas by ordinary least squares, but I had to accept that most students are just not enough into probability theory and matrix algebra so that they could make any use of my eager manipulations at the blackboard. Students' answers confirmed my impression, as almost 70 per cent of them considered Statistics a useful subject, but said that they saw no sense in dealing with the theory and neither did they understand it.

2. Much more emphasis on computer-aided seminars. Using at least MS-Excel, but rather SPSS.⁹

I emphasized several times how strong is the pressure from the market that our students be familiar with the most important software packages, and how much we fall behind to meet this requirement. The students are also aware of this deficiency, since about half of them indicated explicitly that they wanted more software-aided demonstrations. This would contribute to improve their routine more than doing the calculations 'by hand'.

3. Real-life data and problems to persuade students that Statistics is useful and really can answer practical questions.

This point is closely related to the previous one. If we would like to motivate our students, we have to persuade them that Statistics is actually relevant to real-life, i.e. it can help in answering actual questions and solving true problems. To this end we have to show them real-size problems with real data and analyze them on a computer. The results of the questionnaire show how important this issue is: almost two-thirds of the students declared that they did not see the connection between the exercises at the seminars and the challenges they will face in their jobs. For me it means that we failed to give them statistical methods as 'tools' to use.

4. Confine ourselves to teaching less on the one hand, but much more carefully and in a practice-oriented way on the other hand.

It is necessary to reconsider the content of the curriculum, and to let some topics into the master's program in order to give narrower but more usable knowledge. Of course, there may be a lot of dispute around the exact breakdown of the topics. As for myself, I would consider leaving the following methods to the master's level: estimation from stratified sample, analysis of variance (ANOVA) and goodness-of-fit test. This would not be a significant loss, as usually hardly anyone understands the essence of these methods on an ordinary course at the college.

4. CONCLUSION

In this paper I summarized the most important changes in the environment of Hungarian higher education which have far-reaching consequences on the role of universities and colleges in the new market economy. I demonstrated how these challenges affect the way Statistics is taught in these institutions. Finally, based on my own experience and on a short research among second-year students at a Hungarian college I submitted some suggestions and directions of possible further development. One thing can be stated for sure: no matter how Hungarian higher

⁹ It is important to note that the students already have a course where they study such software but it is not integrated into Statistics. The point is that computer applications should be parallel to learning the methods.

education will change in the future, this evident mismatch between the current practice and the circumstances cannot be sustained for long.

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