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THEORY-FREE AND FACT-FREE BUT METHOD-FOCUSED AND TRUST-DRIVEN EDUCATION: INSIGHTS FROM GOOGLE, EXCEL, AND EBAY

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The distinction between patterns and processes is a major methodological and philosophical challenge in science (Jasienski, 1996). The task of modern education is to give students the tools enabling them to critically analyze patterns and infer which processes generate them, whether in natural or in social sciences. In contrast, most of educational effort still goes to fact delivery and force-feeding students with classification schemes which provide only superficial understanding of the world and become quickly obsolete. I advocate a shift in educational philosophy towards building intuitive understanding, heuristic methods of problem solving and powerful fact-finding skills. I provide examples how modern information technology makes such a shift easy to implement.

FREEING EDUCATION FROM THE RULE OF FACTS AND FOCUSING ON CONCEPTS AND METHODS

The user-defined (and thus practically infinite) scope and self-correcting nature make Wikipedia the perfect and free fact provider. Both Google and Wikipedia, by making access to facts instantaneous, allow one to free the educational process from the burden of fact-delivery. However, unstructured access to data is practically (and especially: didactically) not helpful, and can become paralyzing when one becomes aware of the magnitude of the publication flood (Jasienski, 2006). For example, during the first five months of 2006, the average number of publications added daily to the Science Citation Index reached almost 3,300.

Consequently, the PageRank algorithm, based on the analysis of the users' responses, became the backbone of Google's web search philosophy. Science Citation Index (provided by Thomson Scientific) and Scholar Google provide tools for managing the publication flood, by using the criteria of quality based on quantitative analysis of citations, co-authorships, and journal impact factors (Jasienski, 1991). Importantly, the ranking lists of journals (used frequently as basis for selecting the journals to submit manuscripts) are based on explicit, quantitative and "democratic" criteria, freed from the traditional, celebrity-based considerations.

Educational curricula too often repeat the fallacy of providing the hungry with the fish rather than the fishing rod. Even teaching theories, as done in most schools and universities, is not more noble or sophisticated than teaching about facts. The theories become themselves facts to be classified, memorized and regurgitated during quizes. In contrast, technology-driven methods redirect the educational process from fact-delivery to focus on methods and concepts. They reduce the necessity of formal, mathematical reasoning leading to understanding scientific concepts, and allow replacing such reasoning with numerical (computer-intensive) approach (Efron & Tibshirani, 1991).

For example, spreadsheets (e.g. Excel) and resampling software (e.g. Resampling Statistics) enable focusing on fundamental concepts in statistics, by removing the barrier of calculus. The central limit theorem can now be explained from first principles, in addition giving the students an intuitive grasp of the concepts of sampling distribution and of the, notoriously confusing, difference between standard deviations and standard errors. The student can observe and control the process of drawing multiple samples from a larger dataset, of computing means and standard deviations for each sample, of creating a distribution of means of all samples, and of computing the standard deviation for such a distibution. A mythical notion of 'the standard error as the standard deviation of a sampling distribution' becomes clear when the students know where that distribution came from (because they have just generated it themselves).

The teaching of probability and stochastic phenomena, such as genetic drift in a highly mathematical field of population genetics, can also be greatly facilitated by theory-free, simulation-based, exercises and demonstrations (Jasienski, 2002). Further, mathematical phenomena arising e.g. in the process of computing ratios and other indices, can easily be explored by relatively inexperienced and mathematically-naïve researchers or students with simple spreadsheets (see e.g. Jasienski & Bazzaz, 1999). The educational power of such user-friendly, but technologically advanced, tools is truly revolutionary.

DEVELOPING INDICATORS OF TEACHER'S TRUSTWORTHINESS

Both on-line and traditional education must look at eBay on-line auction system for inspiration on how to manage trust-building information. Indicators (badges) of trustworthiness, which are accumulated by both sellers and buyers, provide the foundation on which all transactions are based. Likewise, the transactional nature of the educational process, requires implementation of a data-driven indicator system. Modern information technology makes accumulation of such data feasible. Axelrod (1984) suggested that badges, identifying individuals as possessing certain characteristics or belonging to a certain social group, are important factors promoting the evolution of cooperation among people.

The students already wear badges of their grade averages, which are used by many teachers as additional criteria in their grade assignments. Students with high GPA scores are often more likely to be graded favorably than those with low scores. A system of individual indicators (more detailed than typical course evaluation catalogues provide) should now be developed for teachers

themselves, if we are to create a trust-based system of education. Somehow, the teachers have been shielded from precise characterization of their didactic profiles. I see no reason why teachers should not be subjected to an equally detailed system as that developed for baseball players. The former, after all, deal with the most delicate and important matter, i.e. education of the next generation.

Importantly, however, like baseball statistics, one should not attempt to collapse all descriptive statistics into one number. A badge of trustworthiness accumulated by teachers could be based on several indices, since there may be several dimensions of trust in student-teacher interactions. There could be trust with respect to personal issues (measured e.g. by the question "How likely would you be to invite him/her to your birthday party?" or "Have you ever had conversations with this teacher about topics other than academic?") or trust with respect to professional issues (measured e.g. by the question "Would you trust your teacher/adviser not to take credit for your work in your academic collaboration with him/her?" or simply "Would you ask your teacher for a letter of recommendation?").

The indices could also be composites of the following quantitative criteria, such as: the variance of grades among the teacher's students, the percentage of students taught by a given teacher who graduated on time or have been accepted to college, a correlation between the ranking of students' grades given by the teacher and the overall ranking of students based on all courses, a correlation between the ranking of grades given by the teacher and the students' SAT scores etc. Finally, I would not attempt at this stage to specify how such composite indeces should be formed, since there are important methodological decisions to be made. One must, for example, decide how the components of the index should be weighed with respect to each other and how the scores given to the teacher by the individual students should be weighed (by the student's GPA, by the SAT scores, by the grade received from that teacher, by the average score given by that student to all teachers etc.).

CONCLUSIONS

The ubiquity of information technology opens two important possibilities for revolutionizing and, paradoxically, humanizing education. First, when the cost of access to databases of any conceivable facts declines (Kelly, 1998), schools should no longer serve as distributors of facts. Their functions shifts to developing in students heuristic approaches to understanding the processes generating the phenomena observed in everyday life (Gigerenzer, Todd, & The ABC Research Group, 1999). Information technology, in the form of general-use software (such as Excel), may help build skills of supporting such intuitions with quantitative skills, allowing students to capture the shapes of relationships between phenomena and quantify their magnitudes.

Second, the notion of a "global village" carries with it an implication of a return to a traditional, small-scale, dimension of human social life. It was characterized e.g. by efficient data transfer about irrelevant or important details through gossip spread via individual interactions (Dunbar, 1998). On-

line educational systems must recognize basic human needs with respect to face-to-face social behavior, with particular reference to cooperation, and implement efficient on-line substitutes. Only then would human distance disappear from distance learning.

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