Proposing Evaluation as Interface for world-wide Academic Assessment and Computer-based Learning Systems: The Engineering Aspect

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Abstract *Educational systems are commonly organized in a kind of modules the student has to pass to get final academic grades like under graduate, graduate, doctor, etc. With the advent of globalisation and technological progress, interchanging of academic staff saw an impressing increase. This is typical in our fields of engineering and computer science, especially when mathematics and physics are concerned, as they use world-wide accepted formal languages for information interchanges and as methods for problem solving. The described situation evokes three principal problems for educational institutions and students themselves. The first problem occurs when students change from an inferior module to a superior one. Here it is of essential importance to heed that the higher module is shaped in a way, that the student has facility to start on the one hand and the professors can presuppose certain bases on the other hand. The second problem describes similar interfacial problems caused by different countries and educational systems. Third, the modules described above are essentially time-oriented and not performance-oriented and do not take into account different speeds in learning. This paper presents our first investigations on these problems and demonstrates that some mismatches can be reduced if we consider evaluation as a well-defined interface for gaps between modules. In our investigations, we use Brazil and Germany as case study, but also including interesting point of other known educational system in our consideration. We describe some hypotheses for this approach considering evaluation as main point based on our experiences on the mentioned problems above. We take the first step to an epistemology of evaluation aimed to use this formulation in automated and computer-based evaluation systems.*

Keywords *Interface, Evaluation, Computer, Brazil, Germany*

1. INTRODUCTION

A countries' educational system is composed by the formal institutions, agencies, and organizations that transmit knowledge and cultural heritage. The educational system influences the social and intellectual growth of the individual and, thus, presents itself in such a way as an important base of society. The Government has to take this importance into account and, so, offer a good education system. This generally includes legislation and policy making, administration, facility maintenance, curriculum planning, and professor's preparation and selection. A country's educational system typically is influenced by a variety of factors. Racial and ethnic attitudes, for example, can play an important role in policy formation and school administration. Language is a significant factor as well, especially in countries like India that have more than one official language. Political and religious ideologies also are potent influences on educational objectives and content. China's is an example of an educational system controlled by a single political party or ideological group, while religious influences are strong in Spain, Ireland, and Pakistan. Most countries have a centralized governmental agency that organizes, administers, finances, and controls the formal and cultural aspects of education. The laws, curricula, personnel, and materials and methods of instruction generally are determined in the central office. Examples of countries with centralized systems are France, Italy, Denmark, Sweden, Norway, Belgium, The Netherlands, Greece, Argentina, Brazil, and El Salvador. Decentralized educational systems are found in such countries as Switzerland, the United States, Germany, India, Canada, and Australia. Local administration generally is found in countries where public schooling originated in grassroots or separatist movements or where political unity was achieved through the confederation of sovereign states. Decentralized systems are characterized by the limited participation of central authorities in policy making, largely locally derived funding for education, and administrative power lodged in local boards of education. Countries such as Canada, Germany, and Australia have appointed state ministries of education and state systems of inspection. In the United States, individual states are responsible for providing education and, in the delegation of power, states may tend toward either centralization or decentralization. Most state school boards disburse funds, certify professors, recommend curricula, and supervise the building and maintenance of schools. Actual administration, however, usually is carried out by local school boards. Members of these boards usually are elected officials who carry out the wishes of the community in formulating policy and drawing up budgets. A third type of system is a hybrid of the other two: administration and control are shared by national and local authorities. Such is the case in England, where education laws originate in Parliament but actual administration is in the hands of local government. The Japanese system also is jointly controlled, though it differs considerably from the English system. In some cases, private schools and other educational facilities may be controlled but not financed by the central authority, while in others they may receive full or partial subsidies with varying degrees of autonomy. Two factors increasingly have challenged educational systems during the 20th century: industrialization and population growth. The spread of industrialization and of technological advancement in many parts of the world has required a more complicated division of labour and more extensive formal educational preparation than in the past. Concurrently, worldwide population levels have risen dramatically, especially since 1950, and it has been necessary to allocate more resources in order to maintain or increase levels of educational attainment. The more industrially developed nations generally have been able to meet this twofold challenge, but the developing countries of Africa, Asia, and Latin America - where population growth has been the greatest

and educational resources less plentiful - often have encountered great difficulty raising literacy and skills levels.

2. DOING A STOCKTAKING IN EDUCATIONAL SYSTEMS

According to a number of sociological surveys, university professors generally rank high in public estimation, comparable to medical doctors, lawyers, owners of large business and industrial establishments, bankers, and officials of national government. In a country with a selective university-preparatory secondary school, such as, for instance, the lycée in France, the grammar school in England, and the Gymnasium in Germany, professors must have the equivalent of a university education and must pass rigorous examinations or selective screening.

In Europe and South America, for example, adolescent students training in normal schools to become primary-school professors are generally addressed, referred to, and treated as children, while their counterparts in university preparatory schools are addressed as adults. In most modern countries, however, where the goal of universal schooling has been extended to the secondary level, distinctions in status between primary- and secondary-school professors have moderated. In such situations, secondary-school teaching has become relatively less selective as additional professors are sought for, at the same time that primary-school professors have increased their training level and, therefore, their salary and status levels. In a growing number of countries, including Germany, England, and the United States, primary-school professors must have as much university-level training as secondary-school professors, and a single salary scale has been established, based on the amount of training and years of experience.

Whatever the status distinctions may be, the teaching profession in general is an important avenue of upward social mobility. Because teaching does not require capital, property, or family connection, it provides a good opportunity for the economic and social advancement of able and ambitious young people. A study of Chicago public-school professors in 1964 indicated that approximately half of them had come from families of skilled, semiskilled, or unskilled workers how HAVIGHURST (1964) explained. A study of the social origins of middle-school professors in Brazil in 1963 showed that approximately half of them had moved up in social class as a result of becoming professors following HAVIGHURST (1969).

With the advent of globalisation and technological progress, interchanging of academic staff saw an impressing increase. This is typical in our fields of engineering and computer science, especially when mathematics and physics are concerned, as they use world-wide accepted formal languages for information interchanges and as methods for problem solving (see **KHYWAJA and PATEL)**.

The described situation evokes three principal problems for educational institutions and students themselves. The first problem occurs when students change from an inferior module to a superior one. The second problem describes similar interfacial problems when students from one country enter in the education of another country. Third, the educational modules are essentially time-oriented and not performance-oriented and do not take different speeds in learning into account.

2.1 Educational System: Case Study Brazil

Since the Brazilian educational system offers a simplify college structure with its “Ensino Fundamental” and “Ensino Medio” that all students have to pass to have the

possibility to enter the university, the German educational system takes intellectual achievements of its students in account and classify them in three principal collage types: “Hauptschule” for minor intellectual achievements, “Realschule” for middle intellectual achievements and “Gymnasium” for higher intellectual achievements. A graduated “Gymnasium” student principally has all access to university, because he or she passed in the “Abitur” that is equivalent for the Brazilian vestibular, but the “Abitur” is done finishing this college and do not need to be done twice (e.g. for entering two times with different courses in the university).

In Brazil, the educational Situation in higher education can be observed by two principal realities, by public universities and by private universities. At the public universities, in almost all Brazilian states, there are much more students than open places. Normally, students from public schools have to be up against students from private schools, which offer a better educational quality.

The public universities appeared and work against this situation, but with the intention of mix education with capitalism often by reducing the quality of education to accept more students to increase their profit. The most public and private university are processing with their examination like this: They organize the examination and accept as much students as they have open places according to the list of the examination results. In fact, there is no “passed” or “not passed”, there is just a open place or not. This situation become ridiculous when there are much more open places as candidates. Thus, students without any knowledge have the possibility to enter to university.

The characteristics of the students that finished the college and enters to the university can be analyzed respective to the institution where their studied. Students that finished at a private institution, normally enters at a public university. Observing the large number of students, not all students from private institutions are enable to enter in public universities, thus they enters to private universities where there have to face up with the situation that they appears with their extraordinary achievements in respect their good results.

Students from public schools principally are not prepared for the university, although they often attend in Vestibular Preparation curses. Because of financial reasons these students had to visit public school and generally will have skills to enter to public universities, but they will not have financial possibilities. Also, they often demand too much of them.

The private universities carry out the problem of working for earning money. Students that have this necessity are working and waste the most of their diary attention and time on their work. It rises up the question, if the student is still able to pay attention to the professor as he or she should. In the described situation, the professor has to hold their attention in a more intelligent way.

We conclude, that the public university selects the best students that its normally the students that can pay for it and paid for college while the private university has two missions: (a) complete the student’s college skills and (b) offer a graduation on higher education.

2.2 Student changes Educational System (Brazil – Germany)

In the Erasmus program for the exchange of students between EU nations, Britain was the most popular recipient country, with 19,600 candidates from other European nations. France was second with 14,086 exchange students, and Germany third with 9,700. Among EU countries Germany provided the greatest number of exchange students, 13,000.

Intercontinental student exchanges are also increasing. Asking the question why statistical analyses shows that intercontinental student exchanges are increasing much more slowly and we as e.g. the Erasmus program do, we concluded that national educational systems are often not open for integrate a foreign student. Especially the Brazilian educational

system does not show a consistence interface for foreigners from Germany. The Brazilian grade "Mestrado" is accepted in Germany as "Diplom", while the German "Diplom" is accepted in Brazil as "Graduacao", an inferior academic grade. As "Mestrado", it is possible to make the doctor grade, as in Germany as in Brazil. The German "Diplom" grade also allows this in Germany, but not in Brazil. Our investigations shows that there is another leak: For example, it is possible to recognize the German "Diplom" as the American "Master of Science" Degree (in the case of engineering and computer science), and a "Master of Science" Degree will be accepted as a "Mestrado" in Brazil.

Our investigation showed that there is no official Brazilian study about classifying foreign academic grades, in contrary it shows to be extreme dogmatically.

2.3 Time-oriented vs. Performance-oriented Educational System

Primary-School and Secondary-School are planed in years by the government in almost all countries. This fact has the assumption that students are learning with the same learning speed and it ignores the real situation that students can learn faster than others. This planning was done in this matter, because there were no rational alternative. For more than 2000 years we are using the same educational idea. But nowadays, technological advancement gives more possibilities in our hands.

This situation causes that some students are delayed in their intellectual development and that other students do not have time to create intellect and do store knowledge in them. How we already sow, this situation turns worse when students are enter in university where a lot of student from different schools put together.

Researches are generally done by individuals are groups with few persons and principally done autonomy. This leads to an interesting situation: A person has to be become a researcher before he or she can develop himself or herself in his adequate learning-speed.

3. EVALUATION AS INTERFACE AND THE EVALUATION SPACE

Avoiding the problems mentioned above, education should become a more global issue. Our investigations showed that evaluation is the central point of educational mismatching and misunderstanding. There is nothing new in the idea of evaluating in school and universities, but there is no epistemology for evaluation, thus, there is no scientific base. Our first step in finding an epistemology for evaluation is described below. Our hypothesis is, that an epistemology for evaluation what give the possibility to evaluate objectively in the sense of this epistemology intellectual achievements and opens ways to avoid inconsistence of several educational systems how described in section II. Furthermore, we believe that these results influence the automation of evaluation systems, how e.g. Computer-based evaluation systems.

Since evaluation goes on inevitably, it is of vital importance that its principles, techniques, and uses be understood. Evaluation and measurement are terms often used with a little regard for their meanings. Measurement refers to observations that can be expressed quantitatively and answers the questions "how much". Evaluation goes beyond the statement of how much, to concern itself with the question "what value". It seeks to answer the student's and professor's question, "What progress am I making?" Evaluation, therefore, presupposes a definition of goals to be reached – objectives that have been set forth.

In the development of objectives, certain principles are important:

1. Objectives must be twofold. That is, they should set forth what the institution is trying to accomplish and what the students should attain or work toward.

2. Objectives should generally be developed cooperatively. If the administration alone attempts to establish the objectives and the role of the professors is merely to carry out its directives, the results are often questionable. Such a policy tends to breed resentment and dissatisfaction.
3. Objectives should be broad and general. However, these broad objectives must be so stated that they are subject to specific implementation.
4. Further objectives should grow out of the task a appraising students' performance.

Methods must be developed for obtaining evidence as to how closely the school is realizing its objectives, and sources of this evidence must be identified. We must also interpret the results in the light of our objectives.

These processes of evaluation are wasted effort unless the discovered weaknesses are corrected. Who should correct them? The student's must correct the weaknesses revealed in themselves, and the faculty must correct deficiencies revealed in the educational program. In Summery, we evaluate because we must always be concerned with whether we are reaching the goals of our teaching efforts. By analysing methods and results we hope to find ways of improving them.

Planning evaluation raises at least five basic interlocking questions: What is to be evaluated? What are the purposes of evaluation? What do we use? Can we do it ourselves? What are these scores about?

What is to be evaluated?

First it is necessary to consider the areas in which evaluation of student's growth and development may be made. We can group these areas in general as intelligence, interest, achievement, physical, and emotional. The task of deciding what areas are to be evaluated is far from an easy one. In how many areas should we attempt evaluation? What specific types of evaluation should we make? The decisions - a cooperative enterprise on the part of administrators, professors, students, and parents - should be made in keeping with the purposes of evaluation and the objectives of education (see WRIGHTSTONE (1956)).

What are the purposes of evaluation?

How am I doing? Is this a good school for children? Are the schools accomplishing what they are supposed to accomplish? These are but a few of the many questions that every educator should be able to answer for his individual unit, whether this unit is the entire school system, a single school, a single class, or an individual student.

One of the most important purposes of evaluation is to adapt instruction to the differing needs of individual students. Evaluative techniques lead to identification of students needing specialized work and to the kind of specialization required. Without these techniques professors may overestimate or underestimate the extent to which they should differentiate their treatment of students. All professors make some adaptations to individual differences. Although the influence of evaluation may not result in different types of activities, it can lead to better-directed and more effective methods of carrying on activities.

Another use of evaluation is in educational guidance. Evaluation leads to information revealing how much aptitude a student possesses for scholastic work in general, as well as the broad areas of scholastic work in which he is most likely to succeed. It provides a basis for long-range counseling, placement, and follow-up work as well as assistance in dealing with the many immediate problems of students following WRIGHTSTONE (1954).

In personal guidance, evaluation is used to identify the most troublesome problems - educational, vocational, social, or emotional - that students face.

In addition to purposes pointed directly toward student needs, student evaluation is important in the overall appraisal of the total school program. It reveals specific strengths and weaknesses in the program. It provides bases upon which to compare one school's program with another's. It makes possible a study of the progress of a program between different dates, the development of school standards and school norms, and the nature of needs in curriculum improvement.

Student evaluation may also be used as a basis, through reports to parents and school patrons, for the improvement of public relations and the mobilization of public opinion.

What do we use?

A third consideration basic to evaluation is the selection of appropriate methods and instruments of evaluation. We could use several different techniques to get the same type of information. For example, we could estimate a student's vocational interest by an interview, by his responses to single items on a questionnaire, by an analysis of his hobbies or out-of-school activities, by his scores on an interest test, and so forth. Which of these techniques is best? Should we use all of them? Is this unnecessary duplication? Couldn't we get all the answers from a comprehensive testing program? From the viewpoint of economy, it is clear that we should select the methods and instruments which yield information especially valid for the specific purposes set forth.

Can we do it ourselves?

For one reason or another, the Mea has developed that only individuals who have been specially trained in techniques of guidance and psychometric methods are capable of using evaluative "instruments. It is true, of course, that the results of tests and inventories are worse than meaningless if there have been errors in administering and scoring them, or if there has been inaccurate recording of results. However, nearly all professors can become good examiners and scorers with a little help from manuals and trained counselors.

In most schools, classroom professors can and should administer tests designed for groups of students. By reason of specialized training, a counselor is ordinarily in the best position to administer tests that can be given to only one student at a time. Sometimes, however, classroom professors may be able to do a better job than the counselor in administering a particular type of test to a certain individual. This is likely to be the case if the counselor has already failed in an attempt to establish rapport with the student. In the same way, should the professors make his own tests or use those that he can buy from test publishers? For some purposes, as we shall see, his own tests will probably be best, but in other cases he will have to use standardized, commercially published tests.

What are these scores about?

The fifth consideration involves interpretation of the scores or results of evaluations. Interpreting the results provides answers to the first two questions - what is to be evaluated and what are the purposes of evaluation. Interpretation applies the information obtained from the methods and instruments of evaluation to problems in education. It provides a reason for careful consideration of details in test administration. The methods by which data from evaluative instruments are interpreted and used give meaning to the entire program and translate the results into practical application.

Evaluation and good teaching go hand-in-hand. In fact, a description of the processes a good professor tries to follow shows that evaluation is present throughout. Good teaching follows these five steps:

1. The professor analyzes the individual student's capacities, knowledge, past experience, interests, and needs.
2. The professor analyzes the student's goals and helps and encourages him to revise his goals in accordance with his capacities.
3. The professor harmonizes the educational process with the student's capacities and goals.
4. The professor evaluates the student's progress in terms of his capacities and goals.
5. The professors and the student, working together, reconsider the revised goals in light of the progress achieved and strive to correct weaknesses which would interfere with the attainment of reasonable goals.

A good professor is evaluating when he takes into consideration the many factors inherent in student growth. These factors include acquiring proper attitudes toward others, safety habits, manipulative skills, knowledge, appreciation, understandings, and so forth. Some of these factors can be measured with rather precise methods and instruments. Others require careful exercise of judgment based on effective observation.

Concretising the idea of creating an epistemology for evaluation, we introduced an evaluation space. An evaluation space consists of the dimensions transitions, epistemologies, entities and extern entities. The used epistemology is the base for an evaluation of the transitions. Extern entities give the possibilities for Interaction. On the other side, transitions embody cognitive concepts like learning theories. We need transition for introducing mathematical or formal concepts in the evaluation space. The knowledge space theory and other statistical learn concepts could be used for different evaluation. Actually we are still developing this theory and making first tests.

4. OTHER INTERFACE ISSUES

4.1 The Languages Issue

In our fields of engineering and computer science, especially when mathematics and physics are concerned, as they use world-wide accepted formal languages for information interchanges and as methods for problem solving, we have a solid base of exchange information und to communicate problem related questions. An important gab are natural language skills. This problem is not new and caused the development of Esperanto. Nowadays, Esperanto is not in use as many people would wish, instead of this, English has been taking the role of Esperanto. More than 80 % of all scientific papers are published in English. Thus, it is seems very clear that is of importance for an academic career, but in Brazil many graduate students or even researchers fail of this demand for expressing their research in English. We think that the role of a foreign language as English is not given enough attention. Changes could be done in university by offering course lessons in English or to request homework done in English. It would be more interesting to undertake this intention already in the collage years to increase research qualities in the university.

4.2 Better School Professors (university degree)

In a country with a selective university-preparatory secondary school, such as, for instance, the lycée in France, the grammar school in England, and the Gymnasium in

Germany, professors must have the equivalent of a university education and must pass rigorous examinations or selective screening. In a growing number of countries, including Germany, England, and the United States, primary-school professors must have as much university-level training as secondary-school professors, and a single salary scale has been established, based on the amount of training and years of experience. We suggest that these facts also could be a motivation for Brazil to increase the quality of the primary-school and secondary-school professors by demand higher qualifications, more examinations or selective screening.

IV. FUTURE WORK AND CONCLUSION

Evaluation, as a human activity conceived from a diversity of epistemologies, is a complex and multidisciplinary process for classifying and giving feedback following to ROSS (1954). Since evaluation is inherent to any learning and teaching initiative, it is of vital importance that its principles, techniques, and uses be understood under an ample basis. From the design point-of-view, we have a growing mismatch between designer and student/parents/government intentions. This situation leads to numerous system-designs that cannot match real needs. Mostly severe is the fact that technological methods play a secondary role in oppose to evaluation assumptions. The diversity of inspiring epistemologies, nevertheless a good research opportunity, is the great source of confusion. Moreover, the introduction of computer-based learning systems in education contributed to enlarge the spectrum of possibilities and raise even more debate.

Avoiding the problems mentioned above, education should become a more global issue. Our investigations showed that evaluation is the central point of educational mismatching and misunderstanding. There is nothing new in the idea of evaluating in school and universities, but there is no epistemology for evaluation, thus, there is no scientific base. Our first step in finding an epistemology for evaluation is described below. Our hypothesis is, that an epistemology for evaluation what give the possibility to evaluate objectively in the sense of this epistemology intellectual achievements and opens ways to avoid inconsistence of several educational systems how described in section II. Furthermore, we believe that these results influence the automation of evaluation systems, how e.g. Computer-based evaluation systems.

The theory provides early basis to investigate design issues and anticipate consequences while conceiving and implementing a computerized evaluation method. An evaluation space consists of ideological entities, epistemologies, and transition systems etc. Furthermore, the evaluation-space-theory permits to devise new evaluation spaces and study interactions among them. Existing evaluation methods can also be qualified, giving the designer the precise differences between evaluation methods.

The theory can have an important impact on all evaluation-directed processes and contribute to computer-based learning system design, but we are still beginning and are still developing the formal language for our transition system in.

If this way leads to success, the evaluation space will answer questions like “What evaluation I have to use for the best and which one for the worst results”.

5. REFERENCES

DEVEDZIC V., RADOVIC D., JERINIC L. **On the Notion of Components for Intelligent Tutoring Systems.** In: 4th International Conference on Intelligent Tutoring Systems (ITS’98) Proceedings, San Antonio, Texas EUA, 1998.

GREENE, H. A., JORGENSON, A. N., AND GERBERICH, J. R., **Measurement and Evaluation in the Secondary School**, New York: Longmans, Green, 1954.

KERRES, M. **Didaktische Konzeption multimedialer und telemedialer Lernumgebungen**, 1999. http://www.edumedia.uni-duisburg.de/.

KHYWAJA, R., PATEL V. **A Model of Tutoring: Based on the Behavior of Effective Human Tutors**, In: 4th International Conference on Intelligent Tutoring Systems (ITS'96) Proceedings, Montreal, Canada, 1996, p. 130-138.

LINDQUIST, E. F. (ED.), **Educational Measurement, Washington:** American Council on Education, 1951.

MALEY, M., HARVEY, J., YU L., SCOTT N. **Drag & Drop Pathology: First experiences with a new computer-based tutorial system in the Faculty of Medicine**, 8th Annual Teaching and Learning Forum Proceedings , Australia, 1999. http://cleo.murdoch.edu.au/asu/pubs/tlf/tlf99/km/maley.html.

PANITZ T., **A Definition of Collaborative vs Cooperative Learning**, 1996. http://www.lgu.ac.uk/deliberations/collab.learning/panitz2.html.

ROBERT J. HAVIGHURST, **The Public Schools of Chicago: A Survey Report**, ch. 16, 1964).

ROBERT J. HAVIGHURST AND APARECIDA J. GOUVEIA, **Brazilian Secondary Education and Socio-Economic Development**, ch. 9, 1969).

ROSS, C. C., AND STANLEY, J. C., **Measurement in Today's Schools, New York**: Prentice-Hall, 3rd ed., 1954, pp. 3-59.

WILBERS K. **E-Learning didaktisch gestalten**, 2001. http://www.karl-wilbers.de/download/wilbers2001.PDF.

WRIGHTSTONE, J. W., **What Tests Can Tell Us About Children, Chicago: Science Research** Associates, 1954.

WRIGHTSTONE, J. W., JUSTMAN, J., AND ROBBINS, I., **Evaluation in Modern Education**, New York: American Book, 1956, pp. 3-13.