Is the definition of mathematics as used in the PISA Assessment Framework applicable to the HarmoS Project?

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Abstract: The project known as the “Harmonisation of the Obligatory School”, or in its shortened form as “HarmoS”, has a high priority for Switzerland’s educational policy in the coming years. Its purpose is to determine levels of competency, valid throughout Switzerland, for specific areas of study and including the subject of mathematics. The general theoretical basis of the overall HarmoS Project is constituted by the expertise written under the direction of Eckhard Klieme and entitled “Zur Entwicklung der nationalen Bildungsstandards” (Klieme 2003) [i.e. "On the Development of National Education Standards"]. The proposal announcing the HarmoS partial project devoted to Mathematics includes references to the results and subsequent analysis of PISA 2003. It thus seems appropriate for us to begin our work on HarmoS with a critical consideration of the definition of mathematics and mathematical literacy as they are used in the PISA Study. In a first part, we want to describe the core ideas of HarmoS. In a second part, we will address the meaning of general educational goals for the development of competency models and education standards to the extent that it is necessary to properly locate our problem. In a third part we will analyse the concept of mathematics which is at the basis of the PISA Study (OECD 2004) and more precisely defined in the publication “Assessment Framework” (OECD 2003) In the fourth and last part, we will try to provide a differentiated answer to the question posed in the title of this paper.


1. HarmoS

"HarmoS" is an abbreviated form of “Harmonisation of the Obligatory School” and with it that which should finally be achieved with the HarmoS Project, or at least an initial and rough outline: it refers to a long-term harmonisation of the obligatory school in Switzerland. The necessity for harmonisation has been justified by the Swiss Conference of Cantonal Directors of Education (EDK) – a body corresponding to the Committee of the Ministers of Education and the Arts in Germany – in its policy paper on the objectives and conception of HarmoS as follows:

“A growing mobility of the population, the permeability on the tertiary level, the organisation of education on the secondary level II (general education and vocational training) through basic curricula valid throughout Switzerland, the raised scholastic standards, requirements of parents as well as expectations from educational circles and from industry today necessitate a more precise statement and harmonisation of learning results. From this political background, an effective and binding intensification of the harmonisation efforts in the obligatory school provides an answer to the expectations of society for an improvement in the quality of the schools.” (EDK 2004a, p.2)

This means, first of all, that the harmonisation and with it the anticipated precision should do justice to the standards, the requirements, and expectations which students, educational and training institutions, parents and industry place on the obligatory school education and, secondly, that it should contribute to an improvement of the quality of the schools.

This long-term and ambitious goal, which denotes the HarmoS Project, is opposed to a much more modest goal that actually characterises HarmoS: the determination of competency levels effective throughout Switzerland. This goal is to be achieved through a co-ordination between science and political policy.

“The HarmoS Project intends to establish comprehensive competency levels in specific core areas for the obligatory schools in Switzerland. The necessary work in this respect is being accomplished on two levels:

- The pedagogic-didactic level includes the development of competency models. This makes it possible to determine exactly which levels of competency can be expected at a specific time in the obligatory school (2nd, 6th, and 9th school years).
- The juridical level relates to the conclusion of an inter-cantonal agreement on the harmonisation of the obligatory school. It constitutes an extension of the school concordat of 29 October 1970 and guarantees a binding character for the competency levels that have been stipulated.” (EDK 2004a, p.1)

Therefore the course of the project, as planned, can be roughly divided into two phases:

- a scientific phase in which competency models are elaborated, empirically examined, and validated by practical experience in the school, and
- a political phase in which, on the basis of these models, a “specification of anticipated minimum competencies for all students for that particular school year” (EDK 2004b, p.12) is enacted in an inter-cantonal agreement”.
This procedure in which the tasks are divided between scientific and political levels, or authorities, results in good part from the intent of providing adequate legitimacy for the competency levels that have been determined and thus for the greatest possible acceptance. According to this procedure, the determination of competency levels is neither a merely academic act nor a merely democratic act but rather an interaction of both. On the basis of scientifically substantiated competency models and empirical tests, the group responsible for a particular subject formulates a recommendation for competency levels which, in a second phase, is then subject to a democratic process (discussions in the cantonal parliaments, hearings, a motion if necessary, etc) and finally enacted – possibly in a revised form.

By and large, this summarises the HarmoS Project. If the role that is attributed to the scientific side of this project is more closely examined, two difficulties can be recognised that are systematic in character and linked to each other. The first relates to the criteria to be applied in choosing those mathematical themes, from the many partial components of the subject, that should be elaborated for the various grade levels. But even if, in a mathematical sense, it involves only finitely many partial components at one particular moment, the budget for HarmoS is too limited, in terms of finances and time, to investigate all of them. The second difficulty concerns the question as to which criteria, based on an elaborated competency model, should be chosen as a recommendation for the determination of minimum standards. In both cases, of course, it cannot simply be a matter of proposing just any criterion but rather of indicating criteria that can be satisfactorily legitimised. Although both problems were not given special attention in the EDK report on HarmoS, there are nevertheless certain references to them in the already-cited expertise "Zur Entwicklung nationaler Bildungsstandards" – an expertise on which the HarmoS Project should be focused as much as possible. We would like to address this in the second section that follows.

2. The Role of Educational Goals

In view of the allocation of tasks associated with HarmoS to a scientific and a political level and a corresponding division of the project into scientific and political phases in terms of time, the misunderstanding could arise that a scientific elaboration of competency levels could be achieved in a value-free way in the first phase, and that the normative part of the determination of minimum standards could be postponed to the second phase.

Let us first consider this in relationship to the first phase. Not only the economic argument mentioned above speaks against the opinion that the choice of partial dimensions could result independently of normative decisions, and especially of educational goals in general, but also the fact that only when we relate general educational goals to a subject or to an area of learning, the contours of this subject or of this area and its importance for the students usually become clear. The expertise of Klieme includes the following statement:

"Educational goals are usually tied to a certain understanding for the importance that a subject or area of learning has with regard to personal development and wherein its social function exists. Is the learning of foreign languages aimed at communicative behaviour, or rather at a systematic introduction to a language and culture? Does mathematical training consist in the recognition of patterns for problem solving and the mastering of processes or rather in the capacity for modelling situations?" (Klieme 2003, p.20)

It is clarified by the following quotation from the PISA 2003 report that concerns an attempt to justify the poor results of students in individual partial dimensions:

"In schools, mathematical content is often taught and assessed in ways that are removed from authentic contexts – e.g., students are taught the techniques of arithmetic, then given an arithmetic computation to complete; they are shown how to solve particular types of equations, then given further similar equations to solve; they are taught about geometric properties and relationships, then given a theorem to prove. Having learned the relevant concepts, skills and techniques, students are typically given contrived mathematical problems that call for the application of that knowledge. The mathematics required is usually obvious. Students have either mastered the techniques needed, or they have not. The usefulness of mathematics in the real world may be given little attention." (OECD 2004, p.38)

In fact, it is not only occasionally that mathematical contents are taught and evaluated in this way. Criticism also pertains in a similar manner to certain curricula and teaching materials that are still in use in Switzerland and that allow this kind of instruction. Although a synopsis and analysis of the curricula presently valid in Switzerland is an important basis for the work being done on HarmoS, a harmonisation simply concentrating on a levelling of status quo requirements, would fall short. In fact, it is not a matter of merely harmonising the existing curricula nor one of a paradigmatical change from a system orientated on input and average performance to a system orientated on output and on minimum competency etc. Concealed or exposed, it is a matter of reflecting on the educational goals in general.

It follows from this that, as an initial requirement for the HarmoS Project, it must become transparent, that already the first – scientific – phase is subject to general educational goals as normative conditions, be it that such goals are explicitly formulated, be it that they are implicitly present within the concrete curricula. These goals as such are not the result of scientific research. At most, one or the other deviation of concrete goals from general goals reveals that they are in contradiction to other equally inerfab goals, that they conflict with the basic understanding of the subject matter and its didactics or that it is unlikely that they will be attained by almost all of the students. A second requirement ensues from the latter. One may not simply separate this normative part from the scientific phase because the intimated contradictions, discrepancies and unrealistic notions of objectives must be capable of being pointed out and criticised. In referring to the concrete work on HarmoS, we believe it is important for the normative parts of the scientific phase to be recognised as such and not suppressed or dismissed, and that there is a critical examination of alternative notions of mathematics and of alternative objectives of mathematics education and mathematics classes – specifically, a critical examination of the definition of...