Mathematics Goals and Achievements:

The Case of Lebanon

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Abstract: Though the goals of the new mathematics curriculum in Lebanon include the three levels of mathematical abilities (procedural knowledge, conceptual understanding, and problem solving), they are content based and decontextualized. In basic education (ages 6–15), the focus is on mathematical literacy whereas, for college-bound secondary school (ages 16–18), the goals are more specialized and differentiated by scope and level of treatment. Evidence from a national study indicates that the overall achievement of goals is partial and low (mastery level is less than 40%). The achievement index for individual abilities, in descending order, was procedural knowledge, conceptual understanding, and problem solving. Private schools (autonomous, with middle and higher socioeconomic students) had higher achievement indices in each of the three abilities.

One striking peculiarity of education in Lebanon is the predominance, both in size and quality, of private schooling compared to public (or state) education (65% of students are in private schools compared to 35% in public schools). Since the early 19th century when Christian missionaries started to establish schools, private schools have multiplied and developed to include schools belonging to other religious groups or to secular groups or individuals. The private schools, being tuition based, normally attract students from the middle and high socioeconomic classes. On the other hand, public schools, which started much later, have grown at a much slower pace. The public schools are under the direct control of the central Ministry of Education (MOE) whereas the private schools are nominally supervised by the MOE. The three primary tools of government control over private schools are the licensing of the schools, the general structure and content of the curriculum, and the public examination and certification. English or French was the language of instruction of mathematics and sciences in the early missionary schools, and that tradition became a general practice protected by state policies. The issue of the language of instruction is heavily entangled with cultural and political controversies (Jurdak, 1988). The independence of private schools is so valued by the different groups in Lebanon that it was incorporated in the most recent constitutional amendment in 1990.

The year 1993 marked the beginning of a planning process for the rehabilitation of post-war Lebanon. The focus of this process was the rehabilitation of the country's infrastructure, including that of the education sector. These efforts materialized in producing a national curriculum document (CERD, 1997), which was implemented during 1998–2001. The new curriculum introduced structural as well as content changes. The educational ladder was changed from 5 elementary, 4 intermediate, and 3 secondary, to 9 basic and 3 secondary. The basic stage is further divided into three substages: first cycle (Grades 1–3), second cycle (Grades 4–6), and intermediate (Grades 7–9). By the end of basic education, students can go to technical secondary education or to general secondary education (normally college-bound). The tracks in

the general secondary education were changed from three (math, science, philosophy) to four (literature and humanities, sociology and economics, general sciences, life sciences). New subjects were introduced for the first time (informatics, technology, cultural studies, sociology, economics). The contents of existing subjects were updated and detailed in terms of general, special, and instructional objectives. Mathematics was maintained as a common core subject in basic education (Grades 1–9), as well as a required subject, though differentiated in scope and level according to the track, in all three classes of the four tracks in secondary school.

The new curricula were implemented over a period of three years: the new curricula for Grades 1, 4, 7, and 10 in 1998–1999; those for Grades 2, 5, 8, and 11 in 1999–2000; and those for Grades 3, 6, 9, and 12 in 2000–2001.

Mathematics Goals Before 1997

Prior to the last attempt at educational reform in the country in 1997, mathematics goals were not made explicit except in terms of mathematical content. The only change occurred in 1969–1970, and its purpose was to align the mathematical content in the curricula with the then popular "new mathematics" movement. However, it is not difficult to infer the goals of mathematics at that time from the structure and goals of the general curriculum plan then in effect. The predominance of content reflected the value attached to mathematics as a critical subject for academic purposes embodied in successful promotion of students through the school system. The purpose of mathematics in the elementary stage (Grades 6–9) was basically arithmetical literacy, injected after 1970 with a low dose of mathematical literacy. The middle stage (Grades 6–9), including mathematics, was to prepare student for secondary school, which catered primarily to college-bound students.

Mathematics Goals in the New Curricula

The goals of the new mathematics curriculum are different from those of the old ones in many ways (CERD, 1997). First, the mathematics goals are made explicit and include mathematical reasoning, problem solving, connections and applications, mathematical communication, and the valuing of mathematics. Second, specific instructional objectives were formulated and made part of the curriculum documents. Third, standards were defined in the form of competencies. Fourth, mathematical literacy was widened in scope as part of basic education and in depth in terms of preaching the constructing of meaningful learning.

There were many changes in the content of the curriculum. Table 1 gives the distribution of content strands over the cycles. New strands such as statistics and solid geometry were introduced starting from the second cycle. Measurement concepts were given more attention in the first and second cycles. Probability was treated more systematically in the secondary cycle. However, the new math curricula remain within the confines of the traditional paradigm in being content based within a closed system of the concepts and skills of mathematics, decontextualized, and not responsive to the demands of mathematical literacy in the information age.

Table 1

Distribution of Content Strands Across Cycles

Content Strands	First Cycle (Grade 1–3)	Second Cycle (Grade 4–6)	Intermediate (Grade 7–9)	Secondary (Grade 10–12) (all tracks)
Spatial	X	X	X	X
Numerical	X	X	X	X
Measurement	X	X	X	X
Statistics		X	X	X
Algebraic		X	X	X
Probability				X
Calculus				X

Competencies

In 1999, two years into the implementation of the curriculum, a new competency-based student assessment system was introduced. The competency used in the system is a performance-based objective encompassing a number of related instructional objectives that cut across lessons, units, and even subjects. As an example, the competency "perform operations on algebraic expressions" (Grade 8) cuts across different units in Grades 7, 8, and 9. However, the textbooks, teacher guides, and assessment had been already implemented on the basis of the objective-based curriculum.

Achievements of Goals

Achievement data are available from a national study on student achievement (Jurdak, 2001), which was one in a series of studies to assess the new curricula. This study was conducted in spring 2000 as the first phase of a two-phase project. The purpose of the first phase was to provide quantitative data on the achievement of the competencies in seven basic subjects (including mathematics) of the new curricula in Lebanon. Specifically, this study aimed at—

1. Assessing and comparing achievement profiles of each of the seven subjects in four grades: Grades 5 and 8 (studying the new curricula) and Grades 6 and 9 (still studying the old curricula).

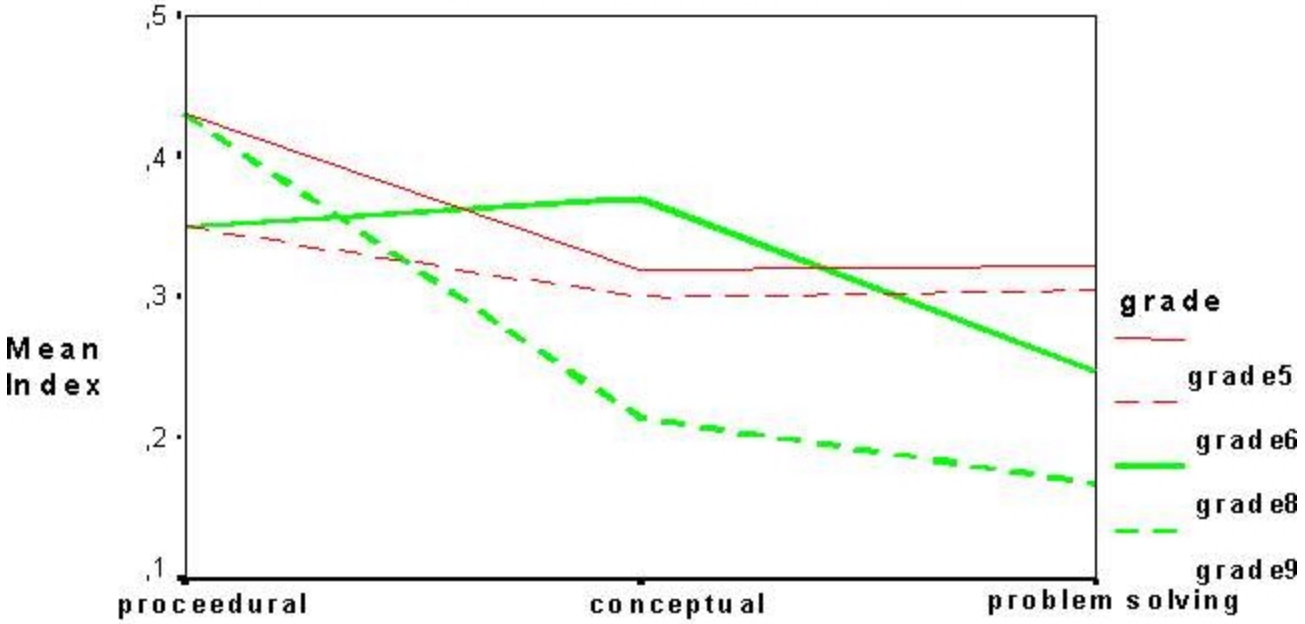
2. Identifying the strengths and weaknesses in the achievement of the competencies in the seven subjects.
3. Identifying the differences in the achievement of competencies associated with educational–organizational variables, teacher variables, and school variables.
4. Establishing baseline data for phase two of the study, to be conducted in May 2001, at which time the curriculum would be fully implemented.

Criterion-referenced tests based on the competencies as defined and published by the Center for Educational Research and Development (CERD, 1999) were constructed for each of the four grades. The tests were content-validated by experts and piloted before being used in the target sample. A national sample of 5350 students in Grades 5, 6, 8, and 9 was selected by stratified cluster sampling techniques; of these, 950 students in the four grades took the mathematics tests.

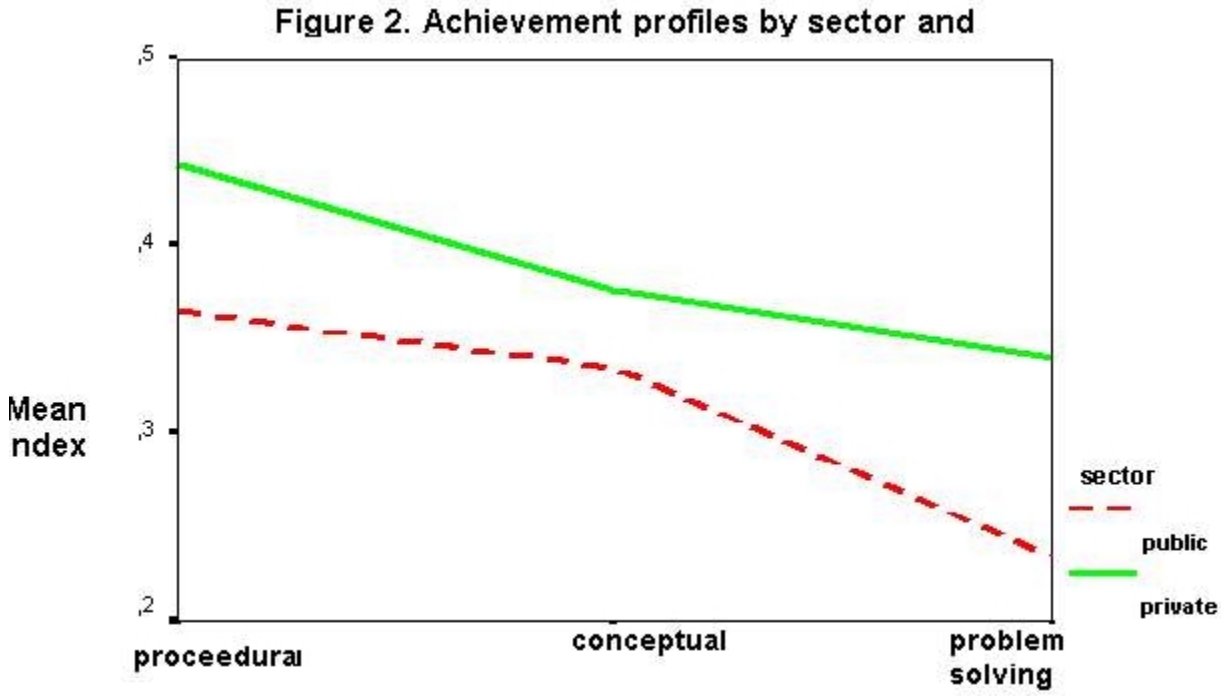
Figure 1 presents the achievement profiles by mathematical ability (procedural knowledge, conceptual understanding, problem solving) and by achievement mean index (defined as the ratio of the mean score of a set of items to the maximum score of that set). The results are as follows:

1. The overall achievement index for all grades combined and for each of the four grades is less than 0.
2. The achievement index for procedural knowledge was the highest followed by conceptual understanding and problem solving (which was the lowest).
3. In the great majority of cases, grades that have studied the new curricula (Grades 5 and 8) had a higher mean achievement index than grades that had studied the old curricula (Grades 6 and 9).

Figure 1. Achievement profiles by grade and level

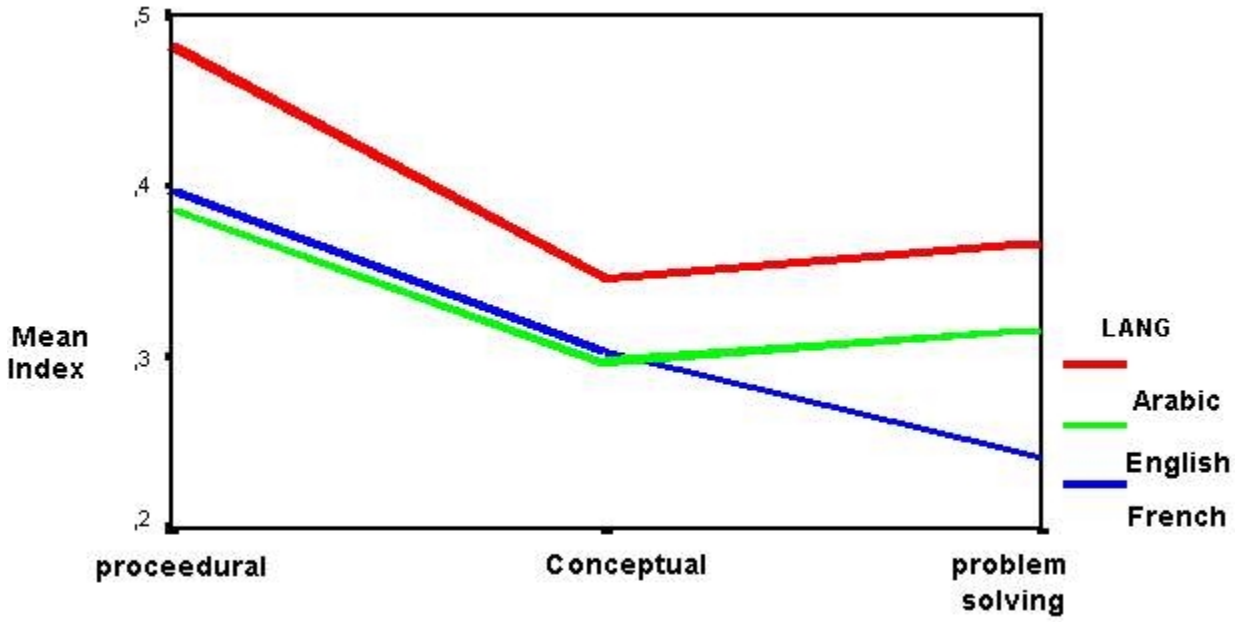


Of the many independent variables studied, differences associated with "sector" were largest in favor of the private sector (see Figure 2). Needless to say, this bundle of variables cannot be disentangled easily from each other and include factors related to students, teachers, facilities, school culture, degree of centralization, and others.



One variable that showed an impact on achievement in Grade 5 was the language of instruction in mathematics. The results support the inference that instruction in Arabic was associated with higher achievement index than instruction in a foreign language (English or French; see Figure 3). It was not possible to make a similar comparison for other grades because in these the language of instruction in mathematics was either English or French.

Figure 3: achievement profiles by level and language of instruction



Conclusion

The declared goals of the new mathematics curriculum in Lebanon include the three levels of mathematical abilities: procedural knowledge, conceptual understanding, and problem solving at all levels of education. In basic education (ages 6–15), the emphasis is on mathematical literacy whereas in secondary school (ages 16–18), the goals for the four tracks are more specialized and are differentiated by scope and level of treatment. The goals of mathematics, whether for mathematical literacy or for specialization, remain within the confines of the traditional paradigm in being content based within a closed system of the concepts and skills of mathematics, decontextualized, and not responsive to the demands of mathematical literacy in the information age.

Evidence from a national study for the basic education stage indicates that the achievement of mathematical goals is partial and low (mastery level is less than 40%). Improper alignment of instruction with the assessment competencies and unfavorable school teaching/learning conditions may have significantly contributed to the low level of achievement.

The level of mastery was higher in procedural knowledge than in conceptual understanding, with both higher than the level of mastery in problem solving. Private schools, which normally attract students from middle and higher socioeconomic levels and which enjoy autonomy, had higher achievement indices in the three levels (procedural, conceptual, and problem solving). Anecdotal and impressionistic reports confirm the same pattern in secondary school and also confirm that mathematization is a goal that is neither targeted nor achieved.

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