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Pakistan: The State, Religion and School Mathematics

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Abstract

The Punjabi curriculum, texts and policy documents in Pakistan demonstrate the ways in which the curriculum contributes to development of ethical, cultural and political dimensions. The selection of content in the mathematics curriculum, the nature of the problems provided and the content of the explanatory text provide insight into the role of mathematics education in the formation of individual and state identity. Further, the secondary curriculum, text and their relation to the matriculation examination suggests that the task of reforming the curriculum away from a pedagogy based on the transmission model of knowledge and of rote memory will be difficult.

The Problem

The transformations of curricular reforms as they move from culture to culture involve more than the simple translation problem of language. Ideas become recast in the traditions of thought and the dominant social beliefs of the new host. Thus, when mapping the reform of curriculum in light of international trends, a major problem is encountered; one which is often overlooked in such exercises as the international comparison testing projects and in attempts to transport curriculum materials from one country to another. In this paper, we will explore some problems inherent in the possible reform of the mathematics curriculum in Pakistan, within the policy document of 1998 (Ministry of Education, 1998), which, although written under the auspices of the former Sharif government, is still the policy of the current militarily backed regime.

Despite its original inception as a secular state (Talbani, 1996), Pakistani education has been infused with the belief that the "... system should be inspired by Islamic ideology" (Jalil, 1998, p. 36), a view stated explicitly in the 1956 constitution and echoed in the 1998 policy on education: "Pakistan is an ideological Muslim State" and "Pakistan is not a secular country" (Ministry of Education, 1998, p. 9). This paper explores a combination of long held cultural beliefs, governmental decisions concerning Islamization, and their effects upon the structure of courses, texts and in particular external examinations that drive mathematics teachers to a mode of teaching reliant on drill, repetition and a close knowledge of the text as authority.

Under the governments since the partition of India in 1947, and, in most strongly, those of the Zia regime and later, there has been a conscious effort to insert "Islamic thinking" into modern Pakistani schooling. The lens through which we will focus is the mathematics curriculum, with emphasis upon the content of Punjabi student texts and the Punjab matriculation examination. The analysis leads to two distinct strands. In the texts for the lower grades, attention is paid to the ways in which explanatory text and problem exercises are used to reflect or actively promote particular aspects of social, religious and political imperatives in Pakistani society. In the case of the secondary school material, the focus is on the nature of the mathematics in the student texts and the relation of the content of the matriculation paper to those books.

The mathematics textbooks for the State of Punjab are produced in two language editions: one series in Urdu, the other in English. In their organizational structures, there is an extremely high level of correlation between the mathematical content of the two sets of books, but there are also subtle differences.

The Context

Building identity: the Nation and the Faith

Pakistan was established as a result of the partition of the Indian subcontinent into two States, one predominantly Hindu, the other Islamic. Subsequently, the latter, Pakistan, itself partitioned into what is Pakistan today and Bangladesh. As a consequence, the present State of Pakistan carries in its formation the history of its colonial past. The partition was achieved only at the cost of massive transmigrations, as members of the two major faiths relocated. Pakistan, then, has significant historical divisions between groups such as those from Punjab and Sindh, who have the region as their historical homelands, and the immigrant groups. The task falls, at least in part, upon the schools to create a national identity based upon the primacy of the Islamic faith.

The school system

The Demographic and Health Survey's comparative study of education (Gardner, 1998) in the developing world provides stark data for Pakistan. For the population 15 years and older, 61.2 % have received less than one year of schooling (based on a sample of 25 320); 35.4 % have 4 or more years. The median period of schooling for this adult population is 0.8 years, but for those with some schooling it is 8.4 years. Both gender and urban/rural differences are striking (Gardner, 1998, Table A3.3, p.151). The median years of education by urban-rural residence, sex and age for a sample of 19 279 yield the following comparisons: For the population 15 years and older, the median for urban dwellers is 6.8 years, 0.8 years for those in rural areas. The median for urban women has improved from 0.8 years for those aged 35-49 to 5.3 years for those aged 15-24, whereas in rural areas the change is only from 0.5 to 0.7 years for the corresponding cohorts. At the same time, urban men have a median remaining static at about 8.5 years and rural men have moved from 0.8 years (35-49) to 5.3 years for 15-24 year olds.

Among the children, the situation is significantly better, but still one in which universal elementary education is an aspiration rather than a reality: 76.3% of the 12 562 sampled aged from 6 to 14 were attending school, with a gender difference of 64.5% of boys and 44.5% of girls. Of children aged 12-14, 54.8% were still in school (67.2% of boys and 41.4% of girls).

Pakistan's approximately 300 000 teachers, catering for about 11 million pupils in grades 1 to 10, have been prepared in a variety of ways. At the most basic level, completion of grade 10 is followed by a one year Primary Teaching Certificate (PCT) in government Colleges of Elementary Education; many teachers have 12-14 years of education, along with the Certificate of Teaching (CT) or B.Ed. degree, this latter offered by a College of Education after completion of a B.A. or B.Sc. Kizilbash (1998) points to six general universities offering graduate (master's and/or doctoral) programs in education. Kizilbash provides a figure of about 20 percent of untrained teachers in the late

1970's: it is unclear to the authors if this proportion has shrunk significantly.

Conceptual Framework

Braudel (1980) suggests that in order to understand historical problems, we need to consider the history of very long time spans — the *longue durée* — as opposed to *l'histoire événementielle*, or the history of events. Thus, our discussion will move back and forth between the immediate and the past as we explore the nature of the mathematics curriculum and the implications of our findings.

There is an instructive literature which discusses the role of public schooling in the building of nation states. (For the case of Turkey, see Benatar, 1998). In this paper, we attempt an analysis of the implications of long-term cultural *mentalité* and shorter-term political decision-making for the mathematics curriculum. The case taken is that of Pakistan in the late 1990's.

School systems in nations emerging from a colonial past have a double problem with identity. On the one hand, much of the residual structures and forms of knowledge which have been superimposed on the indigenous cultures represents, objectively, aspects of power both at the local and the international levels. For example, in a number of such countries, the European colonial language — usually French or English — is the one non-regional tongue. Further, with the international discourse in science and in mathematics, certain standard forms of notation have become broadly accepted. It can be argued that it would be counterproductive to fly in the face of these realities. On the other hand, there is an imperative to use the schools to help forge a national identity; this is particularly the case in those parts of the world in which vast migrations occurred at the time of the formation of these nations. This is the case in Pakistan, where it is possible to see the interplay of colonial and post-colonial influences with the much older traditions of culture and religion.

The cultural dimension of mathematics and mathematics education has been a long and important history (see, for example, Joseph, 1994; Stigler & Baranes, 1988), with cross-cultural studies directed toward understandings of the human mind, both "primitive" and "civilized". There is a certain irony in the preoccupation with constructivist models for the acquisition of mathematical knowledge, while at the same time the psychologised models fail to take into account broader aspects of

the world views in which the individuals are immersed. This is of particular importance when the nature of the current international trends in mathematics education — at least, in Europe and the Anglo-Saxon "western world" — is taken into account. It has been argued elsewhere (Pitman, 1989) that the mathematics education reforms of the past twenty years in countries like Australia, the United States and the Netherlands constitute a fundamental redefinition of school mathematics as being based on an empiricist model, requiring independent thinking and the willingness to attempt creative, individualist approaches to the solution of unknown mathematics problems. In this, the "new new mathematics" is closer, both epistemologically and ontologically, to a view of western science.

Textbooks and Curriculum as Ideological Discourse

Talbani (1996) documents the politicized nature of the Islamization of the Pakistani curriculum, in particular drawing attention to the use of Social Studies to rewrite aspects of history. In his paper, he provides a valuable differentiation of the way in which Islamic content enters the curriculum, in the identification of the use of Islam as the legitimating frame for forms of knowledge, and the invocation of Islam as justification of the state. The tensions between the secular and sectarian have a long tradition in Islam, as in other religions. Initially, two forms of knowledge were recognized as coexistent in Islamic schools: the secular and the sectarian. The merging of the two under the legitimating framework of the sectarian, or religious started in the twelfth century, and is related to the historical establishment of the *madrasa* schools. In this shift is embedded the interpretative frames of those holding political power.

There has been a significant power shift in Pakistan since partition, from secular visions to a religious state since its formalization as a constitutional state. As Talbani makes clear, even the image of Jinnah, the founder of the country, has been transformed from a westernized intellectual striving for a secular home for Muslims, to a devout Islamist. The links with the power structures need to be understood in the long term; the *madrasa* schools provide an insight into this. Nayyar (1998) provides a useful account, from their eleventh century foundation to their role in present day Pakistan.

From its inception, Pakistani education has been infused with the belief that the " ... system should be inspired by Islamic ideology" (Jalil, 1998, p. 36). That this is still the case is evident, at least from the

policy point of view in the Matriculation Federal Board's 1994 Education examination paper, in which Question 2 asks, "What is the concept of education from Islamic point of view? Explain in the light of Muslim thinkers."

Traditions of rote and the nature of knowledge

Embedded in the traditions of the faith is the reverence of the power to recall and recite the Qur'an, in particular to be able to identify and recite accurately the appropriate sections for a particular question. The extent to which this view of what it means to learn and to know prevails can be gleaned from the same Education examination paper, in which Question 1, in part, asks the candidate whether it is correct that "Learning is confirmed by recapitulation."

Hoodbhoy (1991, p. 38) quotes a 1959 incident recounted by the Indian-born chemist, J.B.S. Haldane:

> I was walking near my house one Sunday afternoon when I heard a male voice raised in a monotonous chant. I supposed that I was listening to some mantras, and asked my companion if he could identify them. The practice of repeating religious formulae is, of course, about as common in Europe as in Pakistan.
>
> But my companion stated that the language of the chant was English and the subject organic chemistry. We returned, and I found that he was right. The subject of the chant was the preparation of aliphatic amines, with special reference to various precautions.

In his discussion of this story, Hoodbhoy writes,

> ... to a significant degree, the rote nature of contemporary education can be traced to attitudes inherited from traditional education, wherein knowledge is something to be acquired rather than discovered, and in which the attitude of the mind is passive and receptive rather than creative and inquisitive. The social conditioning of an authoritarian traditional environment means, as an inescapable consequence, that all knowledge comes to be viewed as unchangeable and all books tend to be memorized or venerated to some degree. The concept of secular knowledge as a problem-solving tool which evolves over time is alien to traditional thought. (Hoodbhoy, 1991, p. 39)

If there is in fact "traditional thought" as a process, interwoven with religious belief, then it is not surprising that it reaches far beyond the teaching of religion. The 1964 thesis by Zaki draws a negative correlational connection between attitudes to science and to religion among science teachers (cited in Hoodbhoy, 1991, p. 39). The issue of traditional cultural attitudes, authority and mathematics is not confined to the Pakistani case. In the Palestinian context, Fasheh (1982, p. 2) asks of students in what he calls Third World countries, "Why are most students who major in mathematics in these countries usually 'conservative' in their social outlook and their behaviour and 'timid' in their thinking and their analysis?" Fasheh's conclusion from his own experience is that mathematics teaching is a political act which, flowing from the way in which students experience their mathematics, leads to the creation of " ... attitudes and intellectual models that will in their turn help students grow, develop, be critical, more aware and more involved ... or ... students who are passive, rigid, timid and alienated. There seems to be no neutral point in between." In a society which discourages "critical, original, and free thinking and expression, especially when that touches on 'important' issues in the society,"

> (S)tudents who ask relevant questions about important events in the immediate community and see new alternatives and seek new interpretations of what exists are usually considered 'dangerous'. Teaching people to question, to doubt, to argue, to experiment, and to be critical, and teaching that increases the awareness of students, constitute, in my opinion, the real threat to existing and established institutions, beliefs and authorities everywhere and of every kind. (p. 7)

He then recounts the history of the brief flowering and rapid demise of mathematics and science clubs in West Bank schools under pressure of "... the constant attacks, harrassments, and hostile attitudes that began to mount from two directions. Both the Israeli authorities and fanatical conservatives among the local Arab population fought the

existence of these clubs — each for its own reasons and in its own ways."

The conflict suggested by Fasheh between "traditional" Islamic thinking (of his "fanatical conservatives", for example) and that of the Greco-European tradition can be traced as far back as the 11th century Islamic theologian Al-Ghazzali, who recorded some of the most cogent criticisms of the nature of scientific and mathematical thinking. It is essential to understand that the concern with mathematical and scientific knowledge is not particularly one of content, but rather one of the way of thinking:

> There are two drawbacks which arise from mathematics. The first is that every student of mathematics admires its precision and the clarity of its demonstrations. This leads him to believe in the philosophers and to think that all the sciences resemble this one in clarity and demonstrative power. Further, he has already heard accounts on everyone's lips of their unbelief, their denial of God's attributes, and their contempt for revealed truth; he becomes an unbeliever merely by accepting them as authorities (from Hoodbhoy, 1991, p. 105).

Official policy in Pakistan is to encourage the Islamization of the population. This means not only assuring instruction in the beliefs of Islam — religious education — but also instilling the curriculum with the ways of thinking and of dealing with problems which are taken as part of the Islamic tradition. Thus the historical tension enters the curriculum. Hoodbhoy (1991, p. 123) summarizes the differences between what he calls Traditional Education and Modern Education:

	Traditional Education	***Modern Education***
1	Other-worldly orientation	Modern orientation
2	Aims at socialization into Islam	Aims at the development of individuality
3	Curricula unchanged since medieval times	Curricula respond to changes in subject
4	Knowledge is revealed and unchangeable	Knowledge is obtained through empirical and deductive processes
5	Knowledge is acquired because of a divine command	Knowledge is needed as a problem-solving tool
6	Questioning of precepts and assumptions not welcomed	Questioning of precepts and assumptions welcomed
7	Teaching style basically authoritarian	Teaching style involves student participation
8	Memorization is crucial	Internalization of key concepts is crucial
9	Mind set of student is passive-receptive	Mind-set of pupils is anti-positivistic
10	Education is largely undifferentiated	Education can be very specialized

A traditional view of schooling, then, can be seen as based around the belief in the centrality of revelation, particularly as found through authority, including the text. Knowledge is externally real to the recipient and to be learnt with accuracy. In his discussion of what he describes as "the crisis of legitimacy of science in Islamic schools", Talbani (1996) identifies the critical and innovative aspects of science as being incommensurable with traditional Islamic schooling.

> [In Islamic society] originality, innovation, and change were never upheld as intrinsic values. The ideal of Islamic culture was not mechanical evolutionary progress but the permanent immutable transcendental divinely revealed moral, theological, spiritual values of the Qur'an and Sunnah. (pp. 77-78)

In contrast, a modern (that is, in this context, Western?) view is based on ontological, epistemological and psychological assumptions which are based on diametrically opposing assumptions.

Nayyar's (1998) chapter dealing with the history of *madrasa* education provides a useful summary of the evolution of this Traditional Education, tracing it to eleventh century Baghdad.

The pressure to Islamize the school system has been accompanied by the growth of the *madrasa* schools, which, although diverse in their nature, are generally characterised by a fundamentalist curriculum

which purposefully eschews characteristics of modern education. As Nayyar (1998) points out, these schools have in recent years been receiving financial support through the government's Zakat fund. It is in these schools that we can see, albeit in an extreme form, the elements of Islamic traditionalism which are brought to bear on mathematics education in the system as a whole.

The true thought is the sectarian: secular thinking stands in opposition to it and is therefore to be treated with caution. Mathematical thinking is of value only insofar as it can contribute to utilitarian application.

Data Sources and Procedures of Analysis

The lens through which we will focus is the Punjabi mathematics curriculum, with emphasis upon the content of student texts and the Punjab matriculation examination. We will now consider such evidence of Hoodbhoy's claims as they arise first in the textbooks for year 1 to 8, and then in the level 9/10 text and its culminating external examination.

In the texts for the lower grades, attention is paid to the ways in which explanatory text and problem exercises are used to reflect or actively promote particular aspects of social, religious and political imperatives in Pakistani society. In the case of the secondary school material, the focus is on the nature of the mathematics in the student texts and the relation of the content of the matriculation paper to those books.

The mathematics textbooks for the State of Punjab are produced in two language editions: one series in Urdu, the other in English. In their organizational structures, there is an extremely high level of correlation between the mathematical content of the two sets of books. There are also subtle differences, not least being that the one is not a direct translation and matching of discursive and problem content of the other. We will deal first with the similarities, and then draw those contrasts which strike us as important. In both language editions the short-term "event" of governmental policy determination is evident.

The student mathematics texts and mathematics examination papers were reviewed page by page, and the content noted as to its mathematical topic/content, content of explanatory text, nature of mathematical tasks required of students, and content of examples. The

results of this review were classified by emergent themes. These themes were then retested against the content of the material.

FINDINGS

Elementary school mathematics: The Elements of Ideologies

One nation, two languages

The texts in both languages are explicit in their proclamation of their mission to promote nationalism and Islam. All books carry religious and patriotic symbolism on their covers: The outside back cover carries the Pakistani National Anthem, in Urdu, for both English and Urdu editions.

The inside front covers bear a message from Major (Ret.) Iqbal Ahmad, the Chairman of the Punjabi Book Board. Included is the following, taken from the English edition:

> ... the Board also takes care, through these books to inculcate in the students a love for the Islamic values and an awareness to guard the ideological frontiers of your home land.

A similar statement is contained in the Urdu books.

Each book contains on the inside back the same green drawing of trees. In the Urdu books the caption translates as, "The caretaking of trees is equivalent to free prayer to God." In English, the corresponding caption reads, "Greenery is the evidence of Allah".

The salutations differ between the two language series: In English, the greeting is "Dear Students" and the message concludes with "Enjoy reading. Well wisher." By contrast, the Urdu texts commence with the lengthier, traditional, "I start with the name of Allah, the most beneficent and merciful. Greetings and peace be on you," and conclude with a traditional farewell from Arabic roots.

Students are introduced, in Grade 6, to Basic Concepts of Geometry (Chapter 10). The mathematics is similar in the two language versions, but the initial examples differ. The English version starts with a drawing of a cricket field, with dots, labeled A, B, C, ... representing positions of players. It might be noted that the diagram is

schematic and not to scale; indeed, it is as if viewed from an angle. The corresponding Urdu text points out that the positions of the principal cities of Pakistan can be fixed by use of ordered pairs of numbered coordinates. The map is reasonably accurate.

At the high school level, the English text starts with a quotation from the Quaid (that is, Jinnah):

> You must devote yourself wholeheartedly to your studies, for that is your first obligation to yourselves, your parents and to the state.

The Urdu text carries a markedly different quote from Jinnah:

> Your attention should only be toward the acquisition of education. It is only through this that you will attain glory in making your country the biggest, the most powerful and the most technologically advanced in the world.

It follows the Islamic quotation, not provided in the English version: "In the name of Allah the most merciful and beneficent." This use of stronger nationalistic language in the Urdu texts occurs consistently from the beginning of primary school.

Some simple problems involving numeration shed some light on the mix of nationalism and religion: In the Grade 2 Urdu text (p.5), questions 1-4 relate to facts about Islam; questions 5-7, 13 and 14 refer to national history and geography; question 9 refers to height of a Lahore mosque. Examples include:

> Q. 1 There are ninety nine famous names of Allah (write the numeral).
> Q. 4 Muslims pray five times a day (write the numeral).
> Q. 5 Pakistan was founded on the fourteenth of August.
> Q. 6 Quaid-e-Azam Mohammed Ali Jinnah [the founder of the nation] was born on the twenty-fifth of December.

The extent to which the mathematics texts are used to form national identity as Islamic can be seen in the ways in which religion is incorporated into the materials. We identified three major strands, which we termed Islam as identity, Islamic ethics, and Islamic law. These strands provide an insight into the official interpretations of religious life as it is to be inculcated through the schools.

Islam as identity

The Urdu texts give explanations of the background of the mathematical content. For example, the Islamic and Christian months are discussed in Grade 2 (p.111) in Chapter 10. First, the moon rotates around the Earth; Muslims get their months from the moon, in contrast to the Christians, who get theirs from the sun. Religious events in different months, as required by Islamic law, are discussed: Ramadan, the ninth month according to Islamic calendar; Eid-ul-Fitr which arises on the first day of the tenth month; and Shawal. The lunar months are referred to and the solar year is called Eiswy months, the months of the followers of Jesus; it has 12 months, counting from the year the prophet Eisa (Jesus) was born.

The accounts of the origins of algebra differ markedly in the two language series. The English Grade 7 text contains the following:

> The word algebra ([spelt in Arabic]), that begins ([Arabic symbols]) is a good reason to believe that its origin be considered as Arabic. Actually the complete word is ([in Arabic]) which means the two sides of an algebraic equation.
>
> Mathematicians from different countries were working on this branch of mathematics, for instance in Egypt, Greece, India.
>
> Al-Khawarzmi is considered to be the mathematician, who did the spade-work on this subject.
>
> Algebra is used in Chemistry, Physics, Biology, Economics and Statistics these days.

The more detailed information concerning the history of algebra is given a year earlier in the Urdu Grade 6 book. Here the emphasis is different, in that Al-Khawarzmi is described as being a Muslim mathematician, and "the crown for its invention is given to the Muslim

Mahomet ben Musa al Khawarzmi." Further, a rationale is provided for the need to develop algebra.

Islamic Ethics: Percentages, Zakat and a lack of interest

That part of the curriculum dealing with percentages provides excellent examples of the ways in which a particular ethic can be infused into a subject such as mathematics. It is to be seen here both as a filter for the inclusion of some classes of problems and the exclusion of others. In particular, the inclusion of discussion and problems relating to the responsibilities of the rich to provide for the poor (Zakat) and the exclusion of any reference to interest problems.

Zakat

Section 5.8 of the English text (p. 56) begins:

> ZAKAT Islam has laid down fundamental principles for all aspect of life. In order to establish equity and fraternity in social and economic life, the rich have been exhorted to look after the economic need of the poor Muslim brothers. Accordingly in Islam, the rich are duty bound to deposit every year 2½% of their savings in a Fund meant for meeting the needs of the poor. This amount is called "Zakat". It is the religious duty of every Muslim who saves in a year 6 hectograms of silver or 8.7 decagrams of gold or any amount equal to the value of these metals to give 2½% of that amount as "Zakat".

Examples follow. One set of problems deals with Zakat, partnership and commission (Exercise 5.4). Sections 5.9-12 deal with partnerships, commissions and finding profit and loss, sale and purchase price.

In the Urdu book (p. 51ff, with the Zakat starting on S5.13, p. 75), the explanation differs, providing the Arabic root of "Zakat": to be clean and pure (that is, from the evil of too much wealth). This implies that the provision of monetary help is incumbent on every Muslim with the means, to follow after prayer and fasting. The help to poor Muslims is then discussed: 2.5% of the wealth (annual income) and this seen as the equivalent of 6 hectograms of silver or 8.7 decagrams of gold, or any amount equal to the value of these metals. The government's 1980 Zakat Fund is mentioned. It is suggested that one give to this fund for the government to distribute. By contrast, in the English edition, no mention is made of how one should dispose of the Zakat obligation

The examples which follow are different in the two versions. In English, the amounts of gold and silver held are not included in the calculation of eligibility for Zakat. In the Urdu, amounts of metals are taken into account; in the Urdu book, Zakat has a longer set of problems devoted to Zakat alone, with a greater degree of difficulty (metals included, and 10 problems as against 5 in the English). Each topic has a separate exercise. The English text has 5 partnership problems and 5 on commission, whereas the Urdu text has 7 on partnership, 1 on profit and 8 problems on commission.

In Grade 8, the Urdu book deals with Zakat at the start of the chapter on percentages; referring to the importance of reading the Qur'an, and of prayer. The giving of Zakat for the cleansing of one's wealth, gives rise to truth and helps prevent the spoiling of money, and gives the donor protection from the agents of bad luck. The English text starts without explanation — only refers to previous year.

The lack of interest

There is a total absence in the textbooks of both languages of any discussion of the calculation of interest. This can be ascribed to the strictures under Islam regarding the taking of interest on loans. Thus, in Grades 7 and 8, there are sections dealing with profit and loss as percentages, but all such problems are based upon transactions involving goods or services. No problems deal with the situation of a bank making a percentage profit, although Pakistani banks employ the term "profit" in defining the return to investors (Banks use investment instruments which avoid the direct lending of money to respect the strictures against usury).

Taxes

Taxes are universal, it seems. Grade 8 students (p. 79-84) are given percentage information and problems which cover Zakat and other, formal taxes: Income, property, octroi (municipal tax), road tax, water tax and land tax. Profit and loss problems conclude the chapter. The two books are consistent on the tax problems.

Islamic law: Proportions and Wills

Again we found the inclusion of particular classes of problems which specifically provided instruction and practice in one aspect of what can only be read as an official interpretation of Islamic law.

In Exercise 7.4 of the Urdu Grade 6 text, questions 5-10 deal with the distribution of estates through wills. In every case, debts are paid first; of the balance, the widow (if still living) is to receive one eighth of the estate, and sons and daughters to gain shares in which the sons receive twice the value given to the daughters. In the English text, no mention of Islamic Law is made in the introduction, or in the worked examples (although they all conform to the law). The 10 English language problems include other proportions in the distribution, although when the ratios vary from the one eighth and 2:1 condition, the relation of the beneficiaries to the deceased is vague. Question 4 has a father leaving an inheritance to be divided in the ratio of 3:5:7, after paying Rs. 1500 in the fund for the poor; questions 7 and 8 assume that students know that sons should receive twice the inheritance that the daughters obtain. The role of Islamic law is mentioned only in the last (tenth) problem, in which students are supposed to know the appropriate ratio to apply.

The Secondary School Mathematics Curriculum

Some views of mathematics

The more subtle effects of *mentalité* are to be found in the secondary school experiences of students. The nature of the mathematics provided and its relation to the contents of the external examination suggest strong influences of deeply ingrained cultural/religious beliefs regarding what it means to know and to learn.

There is a range of ways in which the idea of mathematics is conceived and imparted to students. Two of these seem to be characteristic of the curriculum: Mathematics as a rigorous application of skills within an abstract math conception (arithmetic, algebra), and mathematics as a set of formal structures based upon sets and the application of defined operations (sets).

The view of mathematics presented is quite formalistic, particularly in the texts for the higher grades. Thus, sets are introduced formally in Grade 7; the Grade 9/10 book starts the chapter on algebra building directly on the first chapter's treatment of set theory. The highly formal, set-based Bourbakistic reform of the new mathematics of the 1960's is still strong in the content of the curriculum in a way that has lost much of its potency in countries such as Canada, the United States and Australia.

The view of mathematics as a means of reasoning (Euclidean geometry) is pronounced at the secondary level. Geometry is introduced in Grades 9/10 through its postulates and axioms, with definitions and proofs which may be required for examination purposes. About 60 pages are devoted to proof-driven deductive geometry. Only later is there a chapter dealing with practical geometry. It is clear that the relation between the theoretic and structural nature of geometry and its application is one based upon the primacy of the abstract system. On the surface, this would appear to present an alternative way of working in mathematics. When, as we will now discuss, the final examination reproduces questions from the text, however, either from exercises or from worked examples, then the reliance on memorization is what becomes emphasised. Interestingly, the bulk of geometric questions on the final examination are proofs.

Given the very formal view of mathematics, the nature of the tasks given students is one of the correct application of the appropriate rules in order to satisfactorily reach solutions. Thus, the inflexible nature of mathematical tasks is one of application within the realm of known mathematics — that is, known to the students. In general, problems are abstract with no — or highly artificial — relation to application. The examination papers are very much in line with the nature of the problems in the texts: in fact, while we have not taken the time to trace every one of the items in Sections 2 to 4 of the paper, all those which we have, we have been able to find the exact question in the student text either as a worked example, as a given proof or as an exercise question. This is true for the two language versions.

Traditions of thought: The examination and the text

Embedded in the traditions of the faith is the reverence of the power to recall and recite the Qur'an, in particular to be able to identify and recite accurately the appropriate sections for a particular question. The extent to which this view of what it means to learn and to know prevails can be gleaned from the matriculation Education examination

paper, in which Question 1, in part, asks the candidate whether it is correct that "Learning is confirmed by recapitulation."

The national system of examinations has had a difficult history, with widespread charges of corruption (see, for example, Greaney & Hasan, 1998). Attempts to combat the problem of corruption range from the legislation of heavy penalties — rarely enforced — to the instruction in the practice questions for students that only first attempts at questions will be marked, no changes being permitted (Punjab Textbook Board, 1996). This latter invocation must only reinforce the view of mathematics as the efficient recall of the appropriate procedure for application.

The formal assessment at the Grade 9 and Grade 10 levels, administered at the end of Grade 10, is under the aegis of the provincial examinations board in Punjab; importantly, the people responsible for setting the paper are not, in general, faculty members of the universities.

The relation between the contents of the mathematics textbook and the final, provincial examination is made clear with the advice given at the start of the student textbook, in each of the languages:

> Punjab Textbook Board has included the objective questions at the end of the textbook, instead of publishing it in the form of a separate book. It has been done to avoid the extra financial burden on the students and the parents.

In order to assist students in preparation for the matriculation examination, copies of old papers are reproduced by, for example, Lahore and Gujranwala Board (n.d.). There are two immediate observations concerning the matriculation examination papers as provided in this book. Problems are abstract and, in the case of the short answer "objective" questions, brief to the point of being cryptic. The explanation for this emerges with the second observation: all problems are derived, word for word, from the official text.

Typically, students are to solve problems or perform proofs, using the correct definitions or formulaic methods, which rely on knowledge of the text. For example, questions in the 1998 paper include: "1(a) vi A LINEAR equation in two variables represents a ____", which is incomprehensible without recourse to the text, in which the full sentence appears.

Question 4 is an exact transcription of problem 30 in Exercise 4.11 of the textbook (page 97):

> If
>
> $$x^4+4x^2+Q+\frac{8}{x^2}+\frac{4}{x^4}$$
>
> is a perfect square, find the value of Q $(x \neq 0)$

Question 6 is taken directly from question 13, Miscellaneous Exercise 5 (that is, of chapter 5). Similarly, Question 7 is to be found as question 11 in Exercise 6.5 (page 151):

> Solve by Matrix method:
> $7x - 3y = 3$
> $2x + y = 2$

Question 8, in the text as Question 15, Miscellaneous exercises 7, requires the respondent to identify the unknown as a letter, set up the equation, solve and eliminate the negative solution:

> Find the natural number which when added to its square gives 9 times the next natural number.

Question 11 (a reproduction of a worked example in Chapter 14, Section 15 (p. 307-309) asks students to find the variance for a set of scores, oddly enough without asking anything related to the associated measure of central tendency, the mean. The text requires a greater level of understanding in a number of its questions than does the examination.

Any of these last few examples might in other circumstances present students with a creative challenge — if they were previously unseen and used mathematical ideas taught in slightly novel ways. Here, recall of a well learnt text is what is primarily required.

The section dealing with geometric proof, requires the formal presentation of proofs given in the text. For example, Question 12 requires that students produce the proof of the text's proof Theorem 13 (pp. 221-222).

Assessment and teaching

The presence of central examinations provides a strong marker for teachers as to what is to be considered important in content and process. In the student text, students are given some guidance to the final examination, although it must be noted that the type of questions provided as examples account for only ten percent of the paper. These objective questions, provided at the end of the textbooks, are preceded by the following warning:

> Note 1: The questions which follow are being set as samples. In the examination questions different from these may be asked.
>
> Note 2: Answers written after cancellation of answers originally written will not be accepted. (p. 316)

The nature of the questions which are provided for each chapter are True/False, fill in the blank, matching of items from given lists and multiple choice.

A characteristic of some interest is the introduction of English terminology, written in Urdu; for example, in the problems which require students to match mathematical terms in two columns and indicate their answers in a third column, the phonetic reading of the column headings are "column", rather than the Urdu word. The answers are to be given as Roman letters a, b, c, etc.

In the examination itself, there are four sections. Section 1, worth 10 per cent of the paper, is compulsory, about half of which is devoted to objective questions. Sections 2 and 3 cover a wide range of algebra, number and trigonometry. Section 4 is dedicated to geometry, principally involving construction. Students must answer three of six questions in Section 2, two of four in Section 3 and three of six from Section 4

The 1994 Mathematics (Elective) examination is more challenging than the compulsory paper (p.50). For example, the final section, dealing with geometry, contains six questions, five of which call for formal proofs.

Matching of examination and classroom problem typologies

The sampling of the text to provide the examination questions has the effect of reinforcing the narrow view of mathematical accomplishment in that it actively discourages students from going beyond the prescribed book. Rather, memorization and reproduction are rewarded.

Significant changes are to be seen in the text contents when the secondary books are compared to those for the younger grades. First, the content and contextual differences in the two language versions observed in those books for the lower grades have disappeared in the Grades 9/10 books. The influence of the examination may well be at play here: given that we have been able to trace the questions on the Matriculation examination to the texts — both English and Urdu — it would seem that equity would demand matching of content. This would become a very powerful influence if the emphasis was to be upon recall of actual textual information, as is clearly the case.

Further, the nature of the mathematical content has been narrowed: virtually all contextual information has disappeared. The mathematics is presented as an abstract, logical system based upon definitions and rules of application which are to be followed in order to obtain the one correct result, both in the nature of the method used and in the actual obtained answer/solution. Memorization becomes important in the effort to reconstruct those aspects of knowledge which are to acquired, as Hoodbhoy (1991, p. 39) observes.

Discussion

The conscious decision of a series of governments to use the school system to help in the Islamization process has clear effects on both the content and the processes in the mathematics curriculum — and hence the view of mathematics projected to students.

The effects of the Islamization push is most obvious on the content of the grades 1 to 8 texts, in the references in explanatory text and in

problems, to Islamic law and traditions, some small mention of Islamic mathematics, and in the absence of any content dealing with interest gained from investment or loans. Interestingly, there is a heavier intrusion of nationalistic and Islamic content and exhortatory language in the Urdu texts than in the English, and, insofar as there are differences in difficulty between the two sets of texts, the more challenging work is in the Urdu version.

At the grades 9/10 level, the history of mathematics is almost completely ignored, except for the "Islamic mathematician", al Khawarzmi and a passing mention of two Islamic mathematicians who made contributions to trigonometry. The rich mathematical tradition of the subcontinent is entirely ignored. The naming of mathematical theorems, etc. reflect the European traditions: Euclid, Pythagoras, and so on are given with European pronunciations even in the Urdu texts, and, at the secondary level, are reproduced in English.

The use of symbols for numeration is that of the Western Arabic system from the first level. In geometry and algebra, alphabetic symbols are those of the Roman alphabet. International mathematical symbols (eg {}, +, -, x, sin, cosec) are employed, and titles and important terms in the Urdu texts are given in English terms as well as the Urdu. The mathematical content is heavily influenced by the Bourbakist reforms of mathematics in Britain and other Western countries in the 1960's. This content is tied to a system which encourages memory learning and reproduction of prescribed processes and solutions.

The use of constant repetition, with its emphasis on the importance of the power of recall, reflects an Islamic tradition of recitation and of viewing knowledge as external and to be revealed. Hoodbhoy's recollection of the teaching of chemistry comes to mind in this context. Indeed, a study of the questions in the 1998 Matriculation Federal Board examination in Mathematics and their direct location within the student text reinforces this view.

The memorization of the Qur'an as a precedent to coming to an understanding of its meaning is consistent with the approach that one should come to understanding of mathematics only after one is able to quote and reproduce its contents.

Evidence was found to support the view that both short term and long duration influences were inextricably bound in the mathematics

curriculum of both elementary and secondary schools in Pakistan. As a case, the country is unique; there are, nevertheless, two general issues which become evident. First, the pedagogical assumptions and content of mathematics curriculum are culturally and politically embedded. Secondly, long established world views, with their concomitant assumptions about the nature of knowledge, of learning and of the relation of the intellect to the temporal and the spiritual worlds render problematic assumptions about the simple flow of educational reforms between countries.

Conclusions

The analysis points to the complex ways in which deeply ingrained world views, combined with the policy decisions of successive governments, have penetrated the mathematics curriculum. The influences emerge not only in the nature of examples and content included and excluded; they also emerge in tacit understandings of the relation between knowledge and the learner. It is instructive to revisit the differentiation made by Hoodbhoy between what he terms "traditional" and "modern" education.

The current mathematics curricular reforms in much of the Western countries aim at the development of the individual student, with curricula which are developing in response to changes in the subject itself. Further, they are predicated upon the use of empiricist activities in combination with both inductive and deductive processes, at least partly with the aim of encouraging the student to become an independent solver of non-standard problems. Teaching styles based upon developmental psychological models assume the internalized development of personal knowledge structures.

In contrast, we found considerable evidence that the Pakistani mathematics curriculum takes a conservative approach to mathematical content, and Islamic principles are incorporated into problems and explanatory text at the primary (elementary) level. The didactic nature of the texts, in concert with the nature of the matriculation examination point to an externalized view of knowledge, revealed through the authority of the text. Memorization of prescribed procedures encourages conformity at the expense of originality in the dealing with standard problems.

The study of the mathematics curriculum provides strong support for the claims made concerning the collapse of the traditional

differentiation of the secular and the sectarian forms of knowledge in Pakistani education. Dominance of the revealed view of knowledge has important consequences that emerge from the analysis, in particular in the relation between the text and the examination. In the context of current international reforms in the teaching of mathematics, it becomes virtually impossible for the Pakistani system to take up the most defining aspects of the reforms in the face of the incommensurability of the epistemological and ontological assumptions of the new mathematics curricula and those of traditional Islamic educators.

The use of Islam in the elementary school mathematics, in particular, as the glue for reinforcing a national identity exacerbates the problem, as it becomes not only one of addressing long held world views, but also the shorter term political concerns of those involved in the struggle for the school curriculum.

One of the more puzzling findings to emerge from the study involved the differences in problem difficulty between the Urdu and English texts at the primary level. The explanation as to why, where such differences occurred, the Urdu version was the more challenging, is not obvious to us; poor translation is not the explanation, as discussion and problems differ substantively between the text series. The stronger patriotic and religious flavours of the Urdu texts do seem to reflect a stronger desire to mobilize the loyalties and beliefs of those schooled in that language. The degree to which this is related to rural/urban and to class factors is a matter for further study, although Talbani (1996) does point to the tendency of those "who can afford it [to] send their children to private English-medium schools" (p. 82).

The differences in findings in the primary and high school texts point to the value of an approach to dealing with the evidence which pays attention to the *longue durée* and *mentalité*, as well as the immediate and recent history of events.

Notes

Subsequent to the writing of this paper, a new, secularized set of mathematics texts was introduced and, after fierce controversy, withdrawn. Immediately thereafter, the Chair of the Textbook Committee resigned.

The texts referred to in the paper are those, produced by various publishers, for the Punjab Textbook Board, Lahore and printed in the period 1997-1998.

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