

CHANGING CLASSROOM PRACTICE IN SCIENCE AND MATHEMATICS LESSONS IN EGYPT: INHIBITORS AND OPPORTUNITIES

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Abstract – *Egyptian science and mathematics teachers self-report shows that examinations are viewed as the dominant factor inhibiting changes to classroom practice. Although future reforms need to be focused on examinations, the analysis presented here suggests such work needs to be accompanied by changes to textbooks and classroom resources. As inhibitors to change are also located in students and their parents another task is helping them to reconsider what counts as education. The evidence comes from a postal survey of Egyptian science and mathematics teachers following their twelve week in-service programmes in the UK.*

Introduction and research questions

There is a line of reasoning in the literature on science teachers' professional development (Bell & Gilbert, 1996; Treagust, Duit & Fraser, 1996; Tobin, 1996; Tobin & Ulerick, 1992) which focuses attention on what science teachers think. One implication of this literature is that for a science or mathematics teacher to change their classroom practice they need to change their *ideas* about content, pedagogy, assessment, classroom relationships, responsibilities, and so on. Much of this literature has developed out of the experiences of those who research and teach in western or northern countries that have comparatively well resourced schools.

But concentrating simply on teachers' thinking ignores the wider background to the picture of teacher development and change within the school. The school, community and society are the context within which teacher development and change must take place. Heyneman (1997) provides a useful introduction to the quality of education in the Middle East and North Africa. Christina, Mehran and Mir (1999) have specifically reviewed early childhood and care, women's education and higher education within the social and political location of the Middle East. The consequences of neglecting the material conditions of education

in conceptualising the context of teacher change becomes more apparent the poorer the school. Johnson, Monk & Hodges (2000), in reviewing the current educational situation in the Republic of South Africa, have pointed to how differences between schools act as the material and socio-cultural background to teacher development and change and bring into focus wider issues than just teachers' thinking.

Recent research on educational environmental factors that effect teachers' classroom practice has mainly concentrated on the social-political dimensions rather than physical ones. From the perspective of developing countries, Crossley & Guthrie (1987) are amongst several commentators that point to the impact of examinations on classroom practice. Eleanore Hargreaves (1997) has specifically commented on the examinations 'monster' of the secondary leaving certificate in Egypt.

Johnson, Monk & Swain (2001) point out that although teacher's thinking, particularly in the form of pedagogical content knowledge (Shulman, 1987), is a necessary part of why teachers behave as they do, it alone is insufficient for a complete analysis of teachers' classroom practice. Johnson, Monk and Swain offer an evolutionary view of a teacher's classroom practice where consideration of the educational environment, physical as well as socio-political, is also necessary. Briefly, the argument is that any science teacher's classroom behaviour is better understood as a selection of pedagogical content knowledge that survives in the classroom environment in which the teacher has to work. Classroom practices that do not 'fit', do not survive. This goes some way to explaining the extinction of novel classroom practices when external support of the development agency is withdrawn (for example see Van der Waal & Pienaar 1996). Johnson, Monk and Swain argue for the need to research the science teacher's classroom practice *in the classroom environment*.

In trying to help teachers change their classroom practice it is necessary to pay attention to why teachers currently teach as they do. A parallel might be drawn between the medical physician's responsibilities for accurate diagnosis as well as for offering prescriptions for cures. A prescription without accurate diagnosis might prove lethal to the patient. The educational researcher needs to listen more carefully to the teacher's description of 'symptoms'. For where there is 'pain', it is the science or mathematics teacher, as 'patient', who is best able to describe the nature of that pain. This research is an attempt at a 'consultation' with science and mathematics teachers in Egypt. The research reported here looks at the views held by Egyptian science and mathematics teachers on both what stops them changing their classroom practice and what changes they can introduce, or have introduced, to that practice.

The research study

The sample

The sample is drawn from those Egyptian science and mathematics teachers who visited King's College London as part of an in-service programme organised by the Ministry of Education of the Arab Republic of Egypt (Arab Republic of Egypt 1996; 1999). These teachers worked at the prep-school (students aged 11 to 14) and secondary school (students aged 14 to 17) levels. They were selected for placement in the UK, or USA, according to a score on an English language test. Typically, the Egyptian science teachers (45 per group) and mathematics teachers (15 per group) spent twelve weeks in London. Over the past six years 1,000 teachers have visited King's College London. Postal questionnaires were sent out to teachers in groups who had returned to Egypt from the Autumn '98, Spring '99, Summer '99 and Autumn '99 programmes. A pre-paid envelope was included for the responses to be posted back from Egypt to England. Of the 240 questionnaires sent out 130 replies were received back.

The instrument

The teachers who had returned to Egypt were asked how much they thought particular aspects of their school environment – physical and socio-political – stopped them changing their practice. They were also asked to identify aspects of classroom behaviour that they had changed recently or they had used since returning from the overseas in-service programme run at King's College London.

The instrument carried five questions:

- *Question 1* sought biographic data for identification purposes. Analysis of the data according to the Governorate (province within Egypt) looking at regional variations, is reported in Swain, Ghrist, Riddle & Monk (2001).
- *Question 2* sought data on promotion or extra responsibilities given to the respondent since returning to Egypt from the in-service programme in the UK. The analysis of data according to promotion is reported in Monk, Swain, Ghrist & Riddle (2001).
- *Question 3* invited respondents to rate 18 teaching activities in terms of the use they had made of them since their return to Egypt. The four point rating scale ran from 'never/ a little/ quite often/ a lot', with an additional 'not sure' rating. The 'not sure' rating was used in 56 ratings out of a total possible 2340 ratings

(2.4%). The classroom activities involved using: worksheets, translation activities (e.g. numbers to graphs or graphs to words (Monk & Johnson, 1995; Monk, Dillon & Fairbrother, 1993), structured questions, computers in lessons as well as computers for lesson preparation, demonstrations, practical work, group work with practical work, concept maps, class discussions, poster making, graphs, calculators, videos, tables of data or information, games or cut-out-and-stick activities, the chalkboard.

- *Question 4* asked respondents to rate 13 things that may have changed since they returned to Egypt. Again a four point rating scale was used running ‘no change/ a little change/ quite a lot of change/ complete change’ with the additional ‘not sure’ rating. The not sure rating was used in 42 ratings out of a total possible 1690 ratings (2.5%). The items that the Egyptian science and mathematics teachers were invited to respond to in terms of change were: the way you teach, the way you plan your lessons, the variety of activities in your lessons, the amount of practical work you do, the way you evaluate or test your students, your use of the computer, your use of resources inside the school, your use of resources outside the school, your relationship with your students, your relationship with other teachers, your relationship with parents of your students, your relationship with your subject inspector, your relationship with other schools.
- *Question 5* involved respondents rating 14 possible inhibitory factors on a 10 point scale running from ‘no effect’ to ‘a lot of effect’ on teaching. The instruction was, ‘Since your return to Egypt, how much of any of the following prevented or stopped you changing the way you teach? Put a cross in one of the boxes.’

The factors were: size of class, equipment or resources, type of examination, timetable in the school, other science or maths teachers, the head teacher, the subject inspector, the Governorate, the Ministry of Education, teachers’ centres attended, textbooks, syllabus, students, parents of students.

Analysis of ratings of inhibitory factors

Inhibitory factors

The data from each questionnaire was entered into a spreadsheet. For each of the items on the questionnaire an average score was calculated. In this study particular attention was paid to the data in response to question 5 (‘Since you returned to Egypt, how much of the following prevented or stopped you changing

the way you teach?’). The average scores for each item in question 5 were ranked from the highest average to the lowest.

Examinations stand alone as being the highest rated single factor Egyptian science and mathematics teachers in our sample cited as inhibiting their changing their teaching. The lowest rated single factor is other teachers. Egyptian teachers work as isolated individuals within their own classrooms. The measure of their performance is the examination results (Hargreaves, 1997).

TABLE 1: Average ratings for the 14 inhibitors to change in existing classroom and professional practice as reported by the 130 returned questionnaires from the Egyptian science and mathematics teachers

Inhibitor	Average	Standard deviation
The type of examination	6.9	2.9
Equipment or resources	6.3	3.1
The size of the class	6.1	3.5
The syllabus	5.9	3.1
The students	5.9	3.2
Textbooks	5.6	3.1
Timetable	5.4	3.3
The subject inspectors	5.2	3.2
Ministry of Education	4.9	3.4
Head teacher	4.3	3.3
Parents	4.3	3.2
Governorate (local education authority)	4.1	3.2
Teachers' centres	4.1	3.1
Other teachers	3.9	3.0

There is a fair spread in the ratings, as indicated by the standard deviations. Some of the profiles for the ratings are normally distributed, others showed either bi-modal, skewed or flattened distributions.

The data for question 5 were then used in a correlation analysis to determine how much the responses to any one inhibitor were correlated with the response to any other inhibitor. The Pearson product moment correlations were then scrutinised. With an arbitrary cut off level of 0.5, only those items that correlated at 0.5 or above were noted. The items identified as correlated were then grouped into constellations of inhibitors. It is interesting to note that although

the correlation analysis is mathematical and ‘blind’ to the inhibitors, nevertheless those inhibitors that correlate into constellations can be seen to be associated on educational grounds.

TABLE 2: Pearson product moment correlations for the 14 inhibitors to change in existing classroom or professional practice

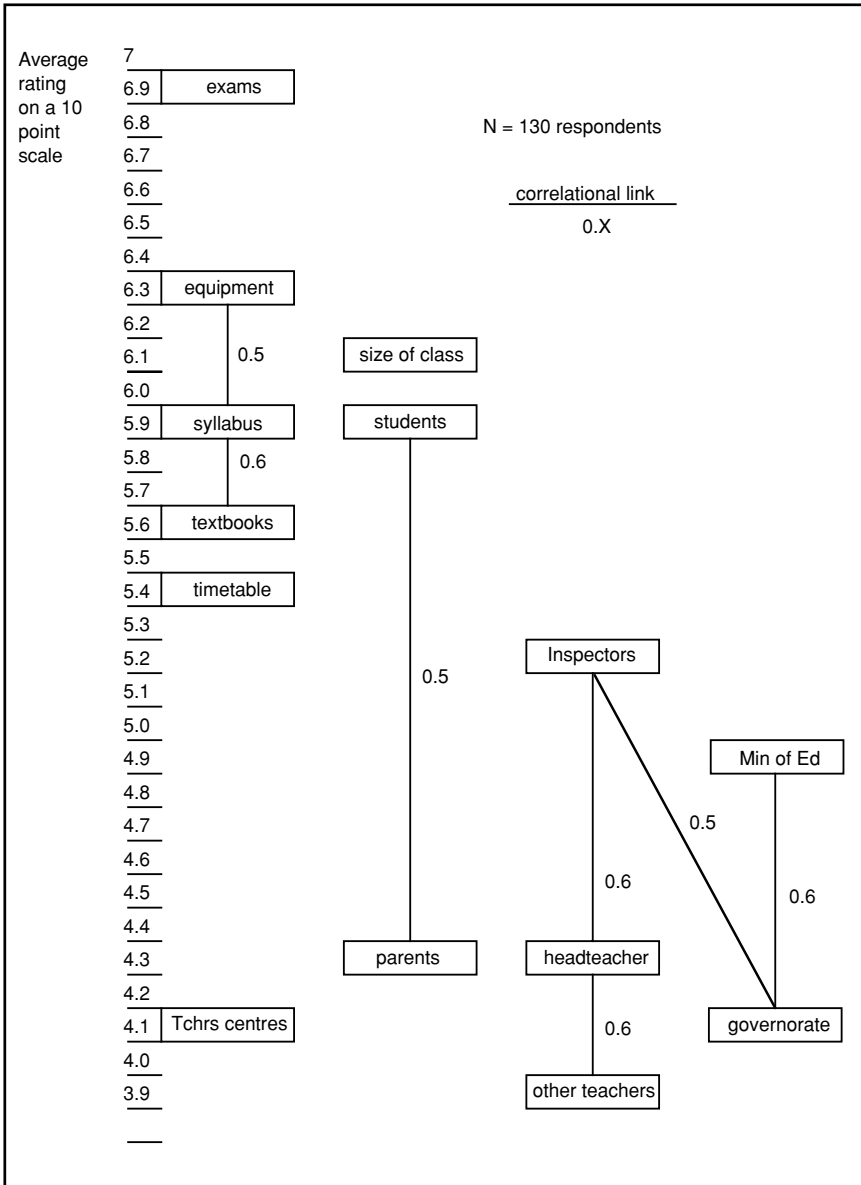
	Eq	Cl	Syl	Stu	Tex	Tim	Insp	Min	Hd	Pnt	G	TC	OT
Exam.	0.4	0.3	0.4	0.2	0.4	0.4	0.4	0.1	0.2	0.3	0.3	0.1	0.2
Equip.		0.4	0.5	0.1	0.4	0.2	0.4	0.2	0.1	0.4	0.2	0.1	0.2
Class size			0.3	0.1	0.3	0.2	0.2	0.2	-0.1	0.1	0.2	0.1	0.2
Syllabus				0.2	0.6	0.4	0.4	0.2	0.1	0.2	0.3	0.2	0.2
Students					0.1	0.1	0.3	0.1	0.3	0.5	0.3	0.2	0.2
Textbooks						0.3	0.3	0.3	0.1	0.2	0.4	0.3	0.2
Timetable							0.3	0.2	0.4	0.1	0.3	0.2	0.2
Inspectors								0.3	0.6	0.4	0.5	0.3	0.4
Ministry									0.2	0.2	0.6	0.4	0.2
Headteacher										0.2	0.3	0.3	0.6
Parents											0.3	0.2	0.3
Governorate												0.4	0.4
Tchrs’ centre													0.4

Equipment, syllabus and textbooks form a cluster that is essentially elements of the immediate, proximate, teaching milieu. The students and their parents form a constellation that links the school to the community. The Ministry of Education, the Governorate (local education authority), inspectors, the head teacher and other teachers form a constellation of the bureaucratic and professional milieu that is distal to the teachers classroom life. The average scores and the correlated constellations are displayed in figure 1.

Analysis of change by constellation of inhibitory factors

For each of the individual inhibitors and constellations, identified through the correlations, a profile of the distribution across the rating scale was drawn up. The rating scale was a ten point scale. These distribution profiles were used to cut the sample population into two sub-samples: those with high ratings and those with

FIGURE 1: Averaged Egyptian science and mathematics teachers' ratings for inhibitors to change in classroom and professional practice



low ratings. (The cuts did not always produce sub-samples of equal sizes as the profiles indicated particular patterns of response across the whole sample.)

Responses to the 18 items for questions 3 ('Have you used.....?') and 13 items for question 4 ('Have you changed.....?') were then subjected to a two-tailed t-test to determine the difference between the means and the statistical significance of the difference between the means. The level of statistical significance that would be noted was set at 0.05.

Examinations

The profile for the ratings on the immediate inhibitor of the examinations carried a large number of responses in the range 8 to 10 with a tail running from 6 to 1. A cut was made to give two sample populations. 77 respondents were placed in the sub-sample that claimed examinations prevented their changing their practice (ratings 8 to 10) and 53 were placed in the sub-sample of those that claimed examinations had less effect (ratings 1 to 7).

TABLE 3: Differences for claims that examinations inhibited changing practice

Rating	1	2	3	4	5	6	7	8	9	10
Respondents per rating	11	8	3	8	7	5	11	29	25	23
Sub-samples	53							77		
Activity and p value	Mean ratings for sub-samples									
Used worksheets	0.8							1.2		

p = 0.01

Of the Egyptian science and mathematics teachers who reported examinations did inhibit changes to their teaching they also reported changes of practice where they had used the more student centred activities associated with worksheets. This was the only item of the 18 for question 3, and 13 for question 4, that showed any statistical significance with a probability of less than 0.05. With a cut off at the 0.05 level, all the other item ratings were indistinguishable for the two sub-populations.

This finding is worth noting for it points to a general principle. The specific pattern is that Egyptian science and mathematics teachers who feel inhibited by the examinations, were, on their own report, more likely to try activities that did

not specifically direct students to the recall required in Egyptian examinations. The general principle is that, in trying something out, the teachers became more aware of the pressures that inhibit them in their pedagogic choices.

Size of class

The profile for the ratings on the single inhibitor of size of class was bi-modal with ratings clustering at either end of the scale. Two sub-populations were formed with 66 respondents (ratings 7 to 10) claiming prevention and 64 respondents (ratings 6 to 1) claiming less effect. Again the sub-sample populations reported the same degree of use of change except for just one item. The sole item from question 3 showing statistically significant difference between the means which indicated that class size was seen to have an effect on change was the teachers self reported use of graphs. Working on graphs requires the simple physical resources of graph paper, rulers, pens, pencil, rubber and perhaps calculators. Giving each and every student such resources in a large class is costly. Those Egyptian teachers who have tried graph work self-report the inhibiting factors.

TABLE 4: Differences for claims that class size inhibited changing practice

Rating	1	2	3	4	5	6	7	8	9	10
Respondents per rating	23	13	16	5	6	4	7	20	17	29
Sub-samples	64							66		
Activity and p value	Mean ratings for sub-samples									
Used graphs	1.2							1.6		

p = 0.02

Equipment or resources, syllabus and textbook constellation

The distribution profile for the ratings on this constellation of the teaching milieu is flattened. A cut was made to give two sample populations. 71 respondents placed in the sub-sample that claimed the proximate teaching milieu prevented their changing their practice (rating 6 to 10) whilst 59 were placed in the sub-sample that claimed less effect (ratings 1 to 5).

Again 30 of the 31 items (17 for question 3 and 13 for question 4) showed no statistically significant difference between mean ratings at the 0.05 level or less.

TABLE 5: Differences for claims that the proximal constellation of – equipment, the syllabus and textbooks – inhibited changing practice

Rating	1	2	3	4	5	6	7	8	9	10
Respondents per rating	11	8	11	11	18	16	16	20	13	6
Sub-samples	59								71	
Activity and p value	Mean ratings for sub-samples									
Used concept maps	1.2							1.6		

p = 0.05

The responses of the sub-populations – those that claimed the proximate classroom milieu influenced their changes in practice and those that reported it did not – were, apart from just one item, otherwise the same. From the two tailed t-test the one sole item which showed a statistically significant difference between the means for the two sub-samples was the use of concept maps. Using concept maps as a pedagogic strategy takes time, uses paper, and does not directly address the prime task set by the examinations off recalling facts, procedures and results. To try to use concept maps involves acting against the direction set by the syllabus and textbooks which present certainty – not student interpretation or uncertainty.

Students and their parents

The profile for the ratings for the constellation was spread about a mode of 6. The cut was made at a score of 5.5. Those scoring 5.5 and above being put into the sub-sample that claimed students and their parents effected their changing their teaching (65 respondents) and those scoring 5 and below being put in the sub-sample that claimed students and their parents did not effect their changing their teaching (65 respondents).

Yet again, the sub-samples are essentially indistinguishable except for two of the 31 items. Those that claimed students and their parents prevented their changing their teaching also reported that they made more use of the chalkboard and class discussions. Class discussion takes time away from students copying from the board. Copying from the board provides students, particularly upper preparatory and secondary students, with a feeling of certainty and thereby, confidence with their entry into the examinations. The general principle found in

TABLE 6: Differences for claims that the constellation of – students and parents – inhibited changing practice

Rating	1	2	3	4	5	6	7	8	9	10
Respondents per rating	19	16	8	16	6	28	9	8	12	8
Sub-samples	65					65				
Activity and p value	Mean ratings for sub-samples									
Used chalkboard p = 0.01	2.4					2.8				
Used class discussions p = 0.05	2.5					2.7				

the analysis according to examinations, class size and the teaching milieu, is repeated again – in trying something out, the teachers became more aware of the pressures that inhibit them in their pedagogic choices.

Timetable

The profile for the single inhibitor ratings was bi-modal and the cut was made between a rating of 5 and 6. This produced two sub-samples: those that claimed the timetable did effect the introduction of changes (N=62) and those that claimed less influence (N=68). Once more the populations were essentially the same in their self-report of use and changes. Two items did show statistically significant differences in the means and these were the use of the chalkboard and reports of changed relationship with other teachers.

How one meets and talks with other teachers depends upon physical contact. Physical contact depends upon availability and availability depends upon the timetable. The chalkboard is the trace of a lesson that is left when the teacher departs the class.

The constellation of bureaucratic and professional constraints

The profile has a skewed distribution. A cut off point of 4.6 was used to produce the two sub-samples. (The rating for the constellation is averaged across the five contributing factors.) 64 respondents were put into the sub-sample that reported the bureaucratic and professional environment inhibited their changing their practice. Those who had an average rating off 4.6 and less

were put into the sub-sample that claimed the bureaucratic and professional environment was less likely to affect their changing classroom practice. The two populations showed no statistically significant difference in their means on 30 of the 31 items. Of those that claimed that the bureaucratic and professional environment stopped them changing their teaching they also reported a statistically significant increase in mean rating for their use of group work with practical.

TABLE 7: Differences for claims that the timetable inhibited changing practice

Rating	1	2	3	4	5	6	7	8	9	10
Respondents per rating	23	17	10	6	12	6	3	21	19	13
Sub-samples	68					62				
Activity and p value	Mean ratings for sub-samples									
Used chalkboard p = 0.02	2.4					2.8				
Changed relationship with other teachers p = 0.04	1.6					2.0				

TABLE 8: Differences for claims that the distal constellation of – subject inspectors, the ministry of education, the headteacher, the governorate and other teachers – inhibited changing practice

Rating	1	2	3	4	5	6	7	8	9	10
Respondents per rating	20	17	19	12	20	12	8	6	4	2
Sub-samples	68					62				
Activity and p value	Mean ratings for sub-samples									
Used group work with practical p = 0.05	1.2					1.7				

TABLE 9: Differences for claims that the teachers' centres inhibited changing practice

Rating	1	2	3	4	5	6	7	8	9	10
Respondents per rating	39	19	16	4	7	10	8	8	14	5
Sub-samples	74			56						
Activity and p value	Mean ratings for sub-samples									
Changed evaluation or testing of students p = 0.03	1.7			2.1						
Changed the way I teach p = 0.01	1.7			2.0						
Changed use of computers p = 0.01	1.4			1.9						
Used calculators p = 0.006	1.0			1.6						
Used computers in lessons p = 0.05	1.1			1.5						
Used computers for lesson preparation p = 0.002	0.5			1.1						
Changed relationship with other schools	0.9			1.0						

Again this result follows the general principle. To attempt to do any practical work in science and mathematics requires chemicals, glassware, specimens, apparatus, calculators etc. To try to do practical work the Egyptian science and mathematics teacher is faced with the shortage of such provision. Attention turns to the school authorities, at local or national level, as the inhibitor, in not providing such resources.

Teachers' centres

With an averaged rating of only 4.1 on the 10 point scale, the teachers' centres were rated as the one feature of the teachers' environment that was least likely to inhibit their changing their practice. The profile of the distribution of ratings was weighted towards the lower end with a tail at the upper end. The cut to form the

two sub-populations was made at the low rating of 3. So 74 respondents rated teachers centres as 3 or below whilst 56 rated teachers centres as 4 or above. For the 31 items t-tested, 3 items of use from question 3 and 4 items of change from question 4 showed statistically significant differences between the means.

Those who claimed teachers centres prevented or stopped them changing their practice also made statistically significantly different claims of more use of computers for lesson preparation, use of calculators, changes to the way they teach and changes to their use of computers, changed relationships with other schools, changed evaluation or testing of their students and the use of computers in lessons.

Discussion

Change is difficult

The 31 items in questions 3 and 4 (18 use of activity items and 13 change in practice items) when crossed with the 7 inhibitors, or constellations, give 217 possible differences. However, the t-tests showed statistical significance on only 15 differences (7%). Therefore, generally the two sub-populations were similar. Those who saw obstacles to change were not that much different in their self-report of use and change to those who saw no obstacles. This is because the teachers teach in the same circumstances and under the same constraints. What can actually be done in Egyptian science and mathematics classrooms is severely limited and limited by the same set of factors regardless of one's opinions. So producing change, any change, is a difficult thing for an Egyptian science or mathematics teacher to do.

This data adds support to the conjecture made by Johnson, Monk and Swain (2001) that teachers in what Beeby (1966) terms untrained and mechanical educational systems have repertoires of classroom practice that are selected by the classroom habitat in which they work. Johnson Monk and Swain are of the opinion that the notion of the reflective practitioner (Schön, 1983, 1987) is only useful when considering teachers who work in what Beeby terms professional educational systems. The data reported here shows that teachers may have quite widely differing opinions about how they are, or are not, constrained to use different practices or change their practices. However, because they all work in somewhat similar classrooms and schools, the reported use and reported change of use is much the same.

Where differences in reported use or change occur they are associated in all instances with a heightened awareness of the effect of the various factors that

effect change. The data appears to point to the teachers who report use and change being more sensitive to the factors that inhibit change. Trying to change makes you painfully aware of the limits to change.

Use of classroom activities and the awareness of inhibitory factors

In the analysis there are a potential 126 classroom activity/inhibitor combinations (7 inhibitors, or constellations, x 18 items of use in question 3). Only nine activities show statistically significant differences for the means of reported use. Only one item – the use of the chalkboard – turns up twice (associated with the constellation of students/parents and the timetable). All items show an increase in reported use. The self reported differences in use involved:

- worksheets (associated with examinations),
- graphs (associated with class size),
- concept maps (associated with syllabus/ textbooks/ equipment),
- the chalkboard (associated with students/ parents and the timetable),
- class discussion (associated with students/parents),
- group work with practical (associated with bureaucratic organisation),
- calculators (associated with teachers' centres),
- computers in lessons (associated with teachers' centres)
- computers for lesson preparation (associated with teachers' centres).

For teachers in Egyptian science and mathematics classrooms, all except the use of the chalkboard are relative novelties and can therefore be associated with an attempt to introduce more progressive practices into science and mathematics teaching. To struggle to introduce such practices into one's own teaching would heighten awareness of the difficulties in doing so.

For instance, the demands of the examination put pressure on teachers to cover the syllabus. So student centred activities like using worksheets slows the pace of coverage of the syllabus. Or, if one wants to introduce more graphical work then the shortage of graph paper, rulers and calculators becomes an issue and the size of the class one teaches limits how much, and how often, graph work is possible. Concept maps, as a learning activity, again, in being student centred, slows the pace of coverage of the syllabus and also requires material resource in paper and pens. Students' own ideas are of little interest if one operates a content centred model of pedagogy where recall of the ideas in text books are what really matter in passing the examination. More class discussion may help the weaker students but slows the faster ones. The faster students (and their parents) will offer censorship of the teacher who goes too slowly. If one is struggling to introduce

more group practical work one will quickly become aware of how the provision of facilities, through the bureaucratic machinery of the school, local government and national government, inhibits how much one can do.

If one has attended a teachers' centre and learnt about how to use calculators and computers in teaching then one might be frustrated by the lack of provision in school. Why the Egyptian science and maths teachers responded as they did is not completely clear from the questionnaire data and does require further investigation.

Unlike the increases for other eight activities the use of the chalkboard, of itself, is not novel. However, more progressive practice involves a different use of the chalkboard, as teachers move away from a teacher centred didactic copying mode, to using the chalkboard as a means of keeping track of the points raised in conversation in a more student centred mode, students would be the first to notice such changes. Both through their own comments, and those of parents, they can affect censorship on any such attempt to change practice. It is possible that the Egyptian teachers who thought students and parents inhibited their changing their practice used the chalkboard more as the classroom aide memoir, rather than producing more notes for students to copy down. We have no evidence for this and so it too needs further investigation.

How can one interpret the reported increase in use of the chalkboard when the responses were analysed for the teachers being aware of how much the timetable effected their teaching? An awareness of the effect of the timetable showed a statistically significant difference for both the increased use of the chalkboard and a changed interaction with other teachers. Perhaps, the imprint of a lesson that remains after the lesson has finished is the work that has not been wiped from the chalkboard. Other teachers who both precede and follow may comment in the staff room on work seen on the chalkboard. So, perhaps the timetable affects how one interacts with colleagues where the point of interaction is the chalkboard. Such a conjecture provides another issue that needs further research. From the data it is not clear how the Egyptian teachers were responding to the item on the use of the chalkboard. Were they responding to a vision of a changed mode of use of the chalkboard – as seen in the UK – or a global coverage of the surface – as carried out in Egypt?

Changes to professional practice and the awareness of inhibitory factors

There are potentially 91 combinations of change to practice and inhibitory factors in the analysis (7 factors or constellations x 13 items in question 4). Of the five instances of statistically significant differences for the means of reported changes in practice all show an increase in reported change. Again, a positive

report of change appears to be associated with an increased awareness of the obstacles to change. The self-reported instances are a changed:

- relationships with other teachers,
- way of evaluating or testing students,
- ways to teach,
- use of computers,
- relationship with other schools.

The self-reported changed relationship with other teachers is associated with the timetable as an inhibitor. Nearly all Egyptian teachers in preparatory and secondary schools move from room to room as the students stay in their home room for most of the day. The timetable therefore dictates who is in a class teaching and who is out of class in the staff room at any one time. Teachers return to the staff room when they are not teaching as they do not have rooms which they would see as being their own. Who they meet in the staff room, or do not, is dictated by the timetable.

The last four instances of self-reported change are all associated with the teachers' centres.

The work of teachers' centres

With an average rating of 4.1, the teachers' centres were placed second to last for the individual inhibitors having a preventative or stopping effect on changing practice. The lowest averaged rating was for the factor of 'other teachers'. However, the self-report of usage and changes to practice actually showed the highest number of instances with the factor of teachers' centres. Three instances of usage and four instances of change of practice are associated with a higher report of the inhibitory effect of teachers' centres on changing practice. No other single inhibitor, or constellation, in this analysis shows such a number of effects or such statistically significant differences between the means (p ranges from 0.002 to 0.05) of the sub-populations created in the analysis. Here there is a raft of change and usage.

The logic of the analysis so far has been that where teachers have tried to introduce changes they have been more forcefully confronted with inhibitors. Such a line of reasoning should therefore apply to teachers' centres as an inhibitor. Those that report the few changes and use identified in the analysis are also more likely to cite the teachers' centres as having an inhibitory effect. Using the same logic leads to the uncomfortable conclusion that teachers' centres do not help in the introduction of the changes and usage reported. The teachers have introduced

new usage and changes to their practice *despite* the teachers' centres, not because of them.

Such a conclusion is uncomfortable because it goes against the grain of common sense. Common sense is that at teachers' centres teachers can develop their knowledge and learn new skills. However, the knowledge has to be related to the examinations for it to be useful to the teachers. The skills have to bear some relationship to the classroom environment in which the teacher works. For as Johnson, Monk and Swain (2001) have pointed out, such knowledge can only produce a changed practice as and when the environment in which the teachers work allows such practice to be effected. Knowledge of itself will not change a teacher's classroom practice unless the classroom environment allows that changed practice to survive. What happens at teachers' centres needs to be very carefully tailored to classroom practice if it is to have any chance of uptake in the classroom.

Conclusions

As Crossley and Guthrie (1987) have written,

'Teachers are not generally irrational opponents of change but they rationally weigh alternatives according to the realities they perceive.' (pp.65-66)

Later they go on to comment:

'A necessary, but not sufficient condition of attempts to change classroom practice is that innovations should not be incongruent with teachers' and pupils' perceptions of the requirements of any public examination system.' (p.74)

The data reported here and the analysis presented suggests that the final examination, although the single most important inhibitor, is not the only one. Equipment, syllabus and textbook are also important as part of the proximal environment within which the teacher must work. The attitudes of the students and parents have an effect on what is acceptable practice, both in classroom activities and professional matters. Whilst teachers may think what they wish, the physical and socio-political environment about them does not allow them to just do as they wish. Any classroom practices or professional behaviour that does not fit within the latitude the teacher's environment allows will quickly cease – die out – due

to the selection pressures of that environment. This is the down side of the conclusions that might be drawn from this study.

Turning this argument about, and thinking more positively, the environment of the teacher does allow some latitude to classroom practice and professional behaviour. Not all the teachers who responded to the questionnaire reported the same degree of use or change to their practice. The data presented here does point to how changed practice and usage does occur. The Ministry of Education in Egypt faces a difficult task in trying to move its educational system forward (Souror 1990; 1996) out of the mechanical stage, identified by Beeby, and on to a more professional stage. The 'diagnosis' here is that the teachers, as 'patients', identify examinations as the single most important factor to shape their own classroom practice. But some caution is required on the part of the educational reformer, as 'doctor', for James (2000) alerts us to how examination reform can be a very blunt instrument. This can be understood in the light of Chapman & Snyder's (2000) suggestion that the potential institutional functions of examinations can be more complex than just testing students: shaping teachers' practice; motivating teachers to improve; providing feedback information; targeting the provision of resources; and influencing the disbursement of funds.

Of course, 'Change the examinations' is easily written down but a good deal more difficult to bring about in practice in Egypt (Abu-Hatab & Carroll, 1996). Our interpretation of the data presented here shows co-ordinating changes to examinations with changes to syllabuses, textbooks and material resources is likely to be even more effective in bringing about reform, although the price-tag is much higher for this particular 'medicine'. A campaign that aims to help students and parents re-evaluate what is important in education may at first sight appear to be marginal and of little consequence. But our analysis suggests it too is necessary. It may be the 'tonic' that allows a speedy recovery rather than a lingering 'convalescence'.

The work of teachers' centres in Egypt, as reported by the science and mathematics teachers in this survey, appears to be of little direct or immediate effect on classroom practice. The data appears to point to teachers acting independently of the teachers' centres. And yet, to dismiss teachers' centres as being irrelevant might be a mistake. For teachers do need a mechanism by which they can develop their *thinking* about their practice. To close teachers' centres to save on education budgets may be to throw out the baby with the bath water. Teachers teach as they do because of what they think *and* the material and socio-political environment in which they have to work. All the factors identified are necessary, none, taken on their own, is sufficient for reform to be effective. The wise educational reformer will try to move forwards on several different fronts in concert.

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