MEDICAL EDUCATION

Impact of Problem-Based Medical Curriculum on Student's Approaches to Learning

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ABSTRACT

A problem-based strategy has been used in planning and implementing the medical curriculum at the Arabian Gulf University, Bahrain since 1984. Effectiveness of this currculum is being studied using qualitative and quantitative methods. Students' approaches to learning in this innovative programme have been investigated using an expanded version of Entwistle's Short Inventory of Approaches to Studying. A cross-sectional study across the whole medical curriculum and a longitudinal study with one batch of students were carried out. A comparison was also made with another Gulf School with traditional discipline-based curriculum. The results of the study revealed that students in the problem-based school with advancing years show significantly higher scores for meaning orientation, versatility, prediction of success and elaboration with lower scores for reproducing orientation and learning pathologies.

As an object of systematic inquiry, the processes of higher education have emerged from almost total obscurity to prominence within the last two decades[1]. In medical education attention is usually focused on designing the content of the curriculum, organisation of teaching and conducting examinations. However, with increasing trend for curricular reforms in medical schools, some attention is being given to the impact of these activities on the way students learn in innovative programmes[2]. This paper presents an investigation on the impact of the problem-based curriculum on students' approaches to learning.

A problem-based strategy has been used in planning and implementing the medical curriculum at the Arabian Gulf University, College of Medicine and Medical Sciences (AGU-CMMS) in Bahrain[3]. Effectiveness of this curriculum has been studied using a case-study approach, using qualitative and quantitative methods[4]. Various techniques of data collection including documentary analysis, participant observation, interview surveys, questionnaire studies, analysis of examination performance and inventory studies have been used for evaluating this curriculum[5,6]. The results of inventory surveys on students learning approaches are presented in this paper.

In their earliest contribution on students' approaches to learning, Martin and Salja identified deep and surface

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levels of processing, when students were questioned on academic articles given as reading assignments[7]. Surface level processing implies learning of the text itself with rote-learning strategies with "reproductive" conception of learning. In deep level processing, on the other hand, the student abstracts the principles embedded in the article which the author intended to illustrate through the article. Entwistle and his group developed and used standardised inventories incorporating a variety of constructs from research into individual differences in student learning[8-10]. From the mid eighties standardised inventories have been used in health professionals schools for comparing the effect of different curricula on students' approaches to learning[11-14]. Entwistle's thirty item inventory defined seven sub-scales which could be combined in various ways to yield eight dimensions[15]. In the present study a new dimension "elaboration" has been added to include ten additional items. A high score in this dimension is desirable in medical education where students are expected to relate basic sciences to clinical situations. Elaboration is considered as an important element in medical problem-solving. Scores for elaboration has been found to be greater in curricula where students relate basic sciences to clinical experience[16]. The description of these nine dimensions are presented in the Appendix of this paper.

METHODS

An expanded version of Short Inventory of Approaches to studying consisting of 40 statements was used in this study*[15]. A high score in achievement orientation, meaning orientation, versatility, prediction of success and elaboration are considered desirable. Comprehension learning and operation learning are considered as two distinct styles of learning. A high score

in reproducing orientation and learning pathologies are considered as undesirable.

A corss-sectional study was carried out with all students in the problem-based curriculum at AGU-CMMS, across the five years of medical programme. One batch of students in the first year was followed up and the same inventory was adminstered after 3 years, as a longitudinal study. Results of this inventory administered in a traditional discipline-based school in the Gulf region is used for comparison.

The inventory consisted of 40 statements as mentioned earlier for which the students responded across a four-point scale: definitely agree; agree with reservations; disagree with reservations; and definitely disagree. The completed forms were analysed according to instructions by the authors of the inventory. Further computer analysis was done using a purpose designed programme.

RESULTS

Table 1 provides the percentage response rate for the inventory studies carried out at the AGU-CMMS. Means and standard deviations obtained in the cross-sectional study for students in years 1 to 5 in the year 1987 are given in table 2. In order to identify any differences in their approaches t-tests were carried out for the nine dimensions between the different years. The last column of Table 2 provides the results according to the "t" test. Since for each dimension ten pair by pair comparisons between years have been made the probability level for significance has been kept at 0.005 level. Reproducing orientation and learning pathologies showed a progressively declining mean score over the five years of the medical course. At the same time mean scores for versatility, prediction of success and elaboration showed a significant increase by the final year of the course.

Table 1
Inventory returns (Repeat administration for the longitudinal group is given in parentheses)

Curriculum Level	1st year 1987	(3rd year) (1990)	2nd year 1987	3rd year 1987	4th year 1987	5th year 1987
Total Number	42	(43)	50	32	40	34
Inventory Returns	34	(37)	35	30	27	28
Percentage	81	(86)	70	94	68	82

* The inventory could be made available on request to the author

Table 2
Results of Cross-Sectional Study in the AGU-CMMS (Means and Standard deviations of Scores)

Learning Approach		Year 1 (n=34)	Year 2 (n=35)	Year 3 (n=30)	Year 4 (n=27)	Year 5 (n=28)	Pair by pair comparisons between years (significant results on student's 't' test)
Achievement	X̄	17.29	14.97	17.03	17.27	16.96	None
Orientation	SD	3.94	4.44	4.62	3.44	2.92	
Reproducing	X̄	17.00	13.97	16.67	14.38	13.21	Years: 1&2; 1&4; 1&5;
Orientation	SD	3.06	3.63	4.46	3.70	4.58	2&3; 3&5
Meaning	X̄	18.40	16.44	18.40	18.20	19.00	None
Orientation	SD	3.46	5.58	4.55	2.48	3.14	
Comprehension	X̄	17.09	15.61	16.03	16.81	15.5	None
Learning	SD	3.62	3.01	3.50	2.60	2.43	
Operation	X̄	16.97	14.50	16.46	16.56	15.57	None
Learning	SD	3.70	4.97	3.39	3.19	2.89	
Versatility	X̄	37.13	34.46	38.03	38.76	39.85	Years: 2&5
	SD	6.59	8.68	7.40	3.7	5.18	
Learning	X̄	32.31	26.38	29.68	27.12	23.42	Years: 1&2; 1&4;
Pathology	SD	5.58	7.32	5.91	6.70	7.34	1&5; 2&5
Prediction	X̄	69.55	71.45	74.48	76.17	80.78	Years: 1&4; 1&5
of Success	SD	9.79	13.90	10.06	8.51	10.92	2&5
Elaboration	X̄	26.69	22.54	25.39	29.62	30.46	Years: 1&5; 2&4; 2&5;
	SD	5.74	8.47	6.77	4.37	4.24	3&4; 3&5

Key: X̄ = mean, SD= Standard deviation

* *Since there were ten pair by pair comparisons on each of the learning approaches, only pairs in which the differences were significant at the 0.005 (.05 ÷ 10) probability level are presented in this column.*

Data for the different dimensions for the batch of students responded from first year in 1987 has been compared with their repeat responses during their 3rd year in 1990 on the same inventory. The means, standard deviations, t-values and p-values for the longitudinal study are given in Table 3.

The differences have been highly significant for decrease in scores for learning pathologies and increasing scores for elaboration in their 3rd year. Their reproducing orientation is lowered (P=.06). Prediction of success shows a suggestive increase in the third year. As in the cross sectional data score for comprehension learning has shown a marginal decrease.

Table 4 provides the means, standard deviations, t-values and p-values for each year separately, for the

AGU-CMMS and the Gulf school with discipline-based curriculum. The comparative study shows that in year 2 there was significant increase in reproducing orientation and learning pathologies (P<.001) in the Gulf School with discipline-based curriculum. Operation learning, and elaboration are also higher in the Gulf school (P<.001). However in year 3 the mean values of achievement motivation, meaning orientation, versatility and prediction of success are higher in AGU-CMMS. The same trend is seen in years 4 and 5. In particular in the 5th year meaning orientation, versatility, prediction of success and elaboration show a significantly higher score in the AGU-CMMS. The mean scores in reproducing orientation and learning pathology are significantly lower in AGU-CMMS at the same time.

Table 3
Results of longitudinal study between year 1 and 3

Learning Approach	Year 1 $\overline{X}$	(n:34) SD	Year 3 $\overline{X}$	(n:37) SD	't'	p
Achievement Orientation	17.29	3.94	17.21	3.28	0.093	0.464
Reproducing Orientation	17.00	3.06	14.95	3.68	2.520	0.006*
Meaning Orientation	18.40	3.46	17.62	3.99	0.867	0.192
Comprehension learning	17.09	3.62	15.70	2.50	1.905	0.029
Operation learning	16.97	3.70	16.89	3.87	0.086	0.468
Versatility	37.13	6.59	37.00	7.02	0.080	0.468
Learning pathology	32.31	5.58	28.16	5.35	3.190	<0.001*
Prediction of success	69.55	9.79	74.05	10.40	–1.864	0.031
Elaboration	26.69	5.75	31.00	5.30	–3.283	<0.001*

* Results considered statistically significant allowing for the number of comparisons made.

Table 4
Comparison of mean scores on learning approaches in the AGU-CMMS
and a traditional Gulf medical school
By year of Medical Course

LEARNING APPROACH		YEAR 1 CMMS (n:34)	GULF (n:114)	p**	YEAR 2 CMMS (n:35)	GULF (n:106)	P	YEAR 3 CMMS (n:30)	GULF (n:66)	P	YEAR 4 CMMS (n:27)	GULF (n:70)	P	YEAR 5 CMMS (n:28)	GULF (n:99)	P
Achievement orientation	X̄	17.29	16.3	0.082	14.97	16.1	0.060	17.03	15.2	0.014	17.27	15.9	0.054	16.96	15.2	0.015
	SD	3.94	3.60		4.44	3.55		4.62	3.48		3.44	4.00		2.92	4.11	
Reproducing orientation	X̄	17.00	17.7	0.137	13.97	17.0	<0.001	16.67	16.8	0.436	14.38	16.1	0.022	13.21	15.8	<0.001
	SD	3.06	3.39		3.63	3.86		4.46	3.36		3.70	3.92		4.58	3.67	
Meaning orientation	X̄	18.40	17.2	0.036	16.44	16.8	0.333	18.40	16.2	0.006	18.20	15.2	0.003	19.00	15.1	<0.001
	SD	3.46	3.52		5.58	3.06		4.55	3.85		3.48	4.04		3.14	3.58	
Comprehension learning	X̄	17.09	15.9	0.045	15.61	16.3	0.146	16.03	14.8	0.057	16.81	15.8	0.121	15.50	15.7	0.397
	SD	3.62	3.64		3.01	3.54		3.50	3.65		2.60	4.29		2.43	3.92	
Operation learning	X̄	16.97	17.5	0.211	14.50	17.3	<0.001	16.46	17.4	0.142	16.56	16.8	0.382	15.57	16.6	0.077
	SD	3.70	3.34		4.97	3.17		3.39	4.30		3.19	3.68		2.89	3.58	
Versatility	X̄	37.13	35.8	0.123	34.46	36.0	0.119	38.03	34.2	0.004	38.76	33.5	<0.001	39.85	33.5	<0.001
	SD	6.59	5.77		8.68	5.99		7.40	6.33		3.70	6.32		5.18	6.12	
Learning pathology	X̄	32.31	32.5	0.428	26.38	31.7	<0.001	29.68	30.9	0.166	27.12	30.3	0.003	23.42	29.8	<0.001
	SD	5.58	5.43		7.32	6.02		5.91	5.81		6.70	6.17		7.34	2.87	
Prediction of success	X̄	69.55	67.0	0.083	71.45	68.5	0.079	74.48	66.3	<0.001	76.17	67.1	<0.001	80.78	67.0	<0.001
	SD	9.79	9.52		13.90	9.69		10.06	8.97		8.51	9.22		10.92	9.15	
Elaboration	X̄	26.69	28.2	0.103	22.54	29.7	<0.001	25.39	27.8	0.037	29.62	28.4	0.173	30.46	27.6	0.008
	SD	5.75	6.34		8.47	5.29		6.77	6.02		4.37	6.28		4.24	6.03	

* "n" gives the number of students
** probability based on student's test, only "p" values of .005 or lower have been considered significant thus allowing for number of
comparisons made in each year

DISCUSSION

Three different studies using the inventory have been considered in this paper. Two of the studies relate to data within AGU-CMMS. In the third study cross-sectional data from a discipline-based Gulf School from the same region was compared. In the cross-sectional study within AGU-CMMS, with advancing years in the curriculum, increasing scores have been seen in desirable dimensions (Versatility, prediction of success and elaboration), and decreasing scores for undesirable dimensions (Reproducing orientation and learning pathologies).

The longitudinal follow up study with one batch of students represent a "before and after" experimental design. Evidence is seen, that within 3 years of exposure to problem-based curriculum, there have been increases in scores in prediction of success and elaboration, the latter being significant. There was also significant decrease in learning pathology and reproducing orientation.

The comparative study with the discipline-based Gulf School has reinforced the findings of the other two studies. By the end of final year significant increases in the mean scores in meaning orienttion, versatility, prediction of success and elaboration were seen in AGU-CMMS, along with significant decreases in reproducing orientation and learning pathology.

When all three studies are considered together, it is becoming clear that students in the problem-based school with advancing years show significantly higher scores for desirable dimensions with lower scores for undesirable dimensions. These results reinforce the earlier fidings on comparative studies carried out by Coles and Newble & Clarke[11,17]. However there is no consistent pattern for operation learning and comprehension learning styles. The additional finding from the current study is the increase in the scores for "elaboration" with advancing years. More studies with larger samples are required to validate the construct "elaboration" which is a key element for medical problem-solving in problem-based curricula.

APPENDIX

The Dimensions:

1. Achievement Orientation:

   Indicates well organised study methods, regular and efficient study habits, competitiveness, desire to achieve, and an awareness of implications of academic demands by staff members.

2. Reproducing Orientation:

   It relates to a preoccupation with memorising and an interest in the course only for the qualification it offers, with reliance on the syllabus and staff members to define studying tasks.

3. Meaning Orientation:

   Indicates efforts to understand the subject matter and relate new information with what is already known and a motivation fed by interest in the topics to study.

4. Comprehension Learning:

   A high score indicates an inclination to "map out" the subject area, to think divergently, and to inter-relate ideas, a characteristic found to be more related to "arts" courses.

5. Operation Learning:

   Indicates an inclination toward emphasis on facts, logical step by step analysis, and use of evidence to reach conclusions.

6. Versatile Learning:

   Indicates an ability to use and adequately vary learning approaches depending on the learning task. This ability includes efforts to understand the subject matter, to relate new information to what is already known, to inter-relate ideas, to think divergently, to map out the subject area, and to use logical step by step analytic procedures.

7. Learning Pathologies:

   Indicates the presence of one or more of the following poor studying approaches: (a) an inclination to rote learning, (b) an over cautious reliance on textbook definitions and on details in the study material, (c) a tendency to prematurely reach conclusions, (d) an inclination to ignore pertinent details or to focus on irrelevant details, or (e) a tendency to generalise without sufficient evidence.

8.   Prediction of Success:

A composite score derived by adding scores on desirable dimensions and subtracting score on Learning Pathologies. Indicates good overall studying approaches that make academic success likely.

9.   Elaboration:

Indicates the ability to relate to previously learned materials (relating basic sciences to clinical situations), organisation of information from a variety of sources for subsequent use which cannot be predicted at the time of learning.

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