Impact of the problem-based learning curriculum on the learning styles and strategies of medical students at the University of Transkei

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Objectives. This is a longitudinal cohort study of the learning styles and strategies of medical students in a problem-based, community-based curriculum as they progressed through the medical course. The purpose was to monitor and evaluate whether the programme was fulfilling the objective of producing self-directed and lifelong learners.

Methods. The short version of the Lancaster Inventory of Learning Styles was administered to the students on admission and thereafter on a yearly basis through the first 4 years of the medical course. Data were fed onto a database and subsequently analysed using a commercially available statistical package.

Results. 140 students (falling to 106 by year 4) were interviewed and followed up through the study period. Of the students 75% were black and 25% were of Asian descent. On admission the students had high scores for individual achievement motivation, and for meaningful learning. They had moderate scores for reproducing learning, comprehension learning, operation learning and versatile learning. They had low scores for learning pathologies, especially globetrotting and improvidence. There was no sexual difference in learning styles. Asian students had significantly higher scores for meaningful learning and for versatile learning. The effect of the problem-based curriculum was to reduce the score for individual achievement, decrease the score for fear of examinations, increase the score for operation learning, increase the score for versatile learning, increase the score for syllabus boundness, and decrease the scores for learning pathologies, especially for improvidence and globetrotting. By year 4, there was similarity in the learning styles of black and Asian students.

Conclusion. The problem-based curriculum had a positive effect on the learning styles of the students, especially the black students.

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The University of Transkei (Unitra) Medical School adopted a problem-based learning (PBL) and community-based education (CBE) medical curriculum, with the primary objective of producing health practitioners with technical and social skills necessary to confront the daunting health problems of the rural and underprivileged areas of South Africa. Among the goals of the curriculum is the development of students who are problem solvers and lifelong learners. The learning experience is offered in a non-formal small-group tutorial format that fosters co-operative learning. The learning process is student-centred, and to a large extent self-directed. The curriculum tries to promote metacognitive skills and thinking about how the student learns best for him/herself. It tries to motivate the student to develop interest in what is being learned, to look for meaning in what is being learned, and to relate whatever is being learned to real-life situations. It tries to discourage students from being syllabus-bound and from memorising facts and details without building up the overall picture. Above all, the curriculum encourages the student to develop the independent ability to structure and restructure information in a way that is both meaningful and retrievable.

As the students progressed through the course their learning styles and strategies were continuously monitored to determine whether the curriculum was fulfilling its objectives. This paper summarises the impact of the problem-based curriculum on the learning styles of the medical students over the first 4 years of the 6-year curriculum.

METHODS

A questionnaire on learning styles and strategies,[1] which is a shortened version of the Lancaster Inventory on Study Strategies, was administered to the students at the beginning of the first year of the medical course. The same questionnaire was subsequently administered to the students at yearly intervals as they progressed through the course. Participation in this evaluation programme was voluntary. The questionnaire has 30 items, each scored 0 - 4 on the Leikert scale. The items of the questionnaire were summed up according to following broad scales:

1. The 'achieving' orientation scale: this scale contains items relating to organised study methods, competitiveness and hope for success. It gives a score out of 24.

2. The reproducing orientation scale: this scale relates to the surface approaches to learning — syllabus-boundness, attempts to memorise, and extrinsic motivation (anxiety and fear of failure). It gives a score out of 24.

3. Comprehension learning scale: this scale explores the student's attempts to relate ideas to real life and the ability to map out subject areas. It gives a score out of 24.

4. The 'meaning' orientation scale: this scale is a measure of the 'meaning' dimension of deep approaches to learning, intrinsic and academic motivation. It gives a score out of 24.

5. Operation learning scale: this scale relates to the reliance on step-by-step logical approach to learning and to the emphasis on factual details. It gives a score out of 24.

6. Improvidence scale: this scale measures the student's failure to see how the various elements of the topic interrelate, and how the topic fits into the subject area in general. It gives a score out of 12.

7. Globetrotting scale: this scale contains items relating to the superficial approach to learning, to the tendency to jump to premature conclusions or to seek generalisations without sufficient evidence. It gives a score out of 12.

8. Versatile learning scale: this scale combines both the comprehension and the operational learning strategies, intrinsic motivation, and meaning orientation. It gives a score out of 48.

9. Pathological learning scale: this scale combines the reproducing learning strategy with the improvidence and globetrotting styles. It gives a score out of 48.

Statistical analysis

A two-way analysis of variance (ANOVA) with repeated measures design was used to analyse the effect of year of study and of race on the learning styles of the students. Because of the unbalanced nature of the study (more black students than Asians) the General Linear Model was used instead of ANOVA.

RESULTS

Subjects

One hundred and fifty students were admitted to Unitra Medical School from 1992 to 1995. Of these students 140 were interviewed in their 1st year, 132 during the 2nd year, 120 during the 3rd year, and 106 in the 4th year. Because of missing data, the analysis of only 106 students with complete data from years 1 to 4 is presented. Seventy-five per cent of the students were black Africans, predominantly from Transkei, and 25% were of Asian origin, predominantly from KwaZulu-Natal. Fifty-three per cent of the students were females and 47% were males.

Learning styles and strategies

Achieving orientation

There was a significant drop in the achieving orientation score over the 4 years of PBL. On admission there was similarity in the scores of black and Asian students (mean (SD) 18.9 (3.1) v. 19.1 (2.3)). In both groups of students there was a significant drop in the scores over the 4 years ($P < 0.001$). Black students showed a more pronounced drop in the score than Asian students (from 18.9 (3.1) to 15.5 (4.0) v. from 19.1 (2.3) to 16.8

Table I. Summary of learning styles and strategies of 106 Unitra medical students (mean (SD))

	Year 1	Year 2	Year 3	Year 4
Achieving orientation (out of 24)	19.0 (2.8)*	18.1 (2.6)*	17.3 (3.0)	15.9 (3.2)**
Reproducing orientation (out of 24)	14.3 (3.5)	14.1 (3.7)	13.5 (3.8)	14.0 (3.8)
Meaning orientation (out of 24)	19.3 (2.6)*	19.0 (2.4)	17.3 (3.1)*	18.9 (2.7)
Comprehension learning style (out of 24)	15.3 (2.8)	15.1 (3.2)	15.0 (2.8)	15.1 (2.7)
Operation learning style (out of 24)	15.1 (1.8)*	15.6 (2.2)	16.0 (1.5)	16.6 (1.8)*
Improvidence (out of 12)	6.9 (1.6)*	6.2 (2.4)	5.5 (2.0)	5.1 (2.6)*
Globetrotting (out of 12)	5.6 (2.4)*	5.0 (2.2)	4.9 (2.0)	4.1 (2.1)*
Versatile learning style (out of 48)	36.4 (5.3)*	38.8 (5.2)	39.7 (4.6)	40.2 (4.1)*
Learning pathology (out of 48)	26.8 (6.4)*	25.2 (6.4)	24.6 (6.6)	23.7 (7.0)*

*$P < 0.05$.

(2.5); $P = 0.17$). In both groups of students the drop in the achieving orientation score was due to the drop in the level of competitiveness (the desire to do better than their colleagues).

Reproducing orientation

On admission the reproducing orientation score was moderate. Black and Asian students had similar scores (14.4 (3.8) v. 14.1 (3.6)). Whereas the black students' score declined through the 4 years, the Asian students' score actually rose over the same period (12.7 (4.3) v. 15.5 (4.0); $P < 0.05$). The rise in the Asian students' score (out of 12) was due to increased syllabus-boundness, from an initial score of 7.2 (2.2) to 8.7 (2.4); $P < 0.05$. The fall in the black students' score (out of 12) was due to a decrease in the fear of failure/extrinsic motivation, from an initial score of 6.4 (2.5) to 5.2 (2.8). Over the 4-year period black students showed little change in the degree of syllabus boundness (7.9 (2.6) to 8.3 (2.2)).

Meaning orientation

There was a high meaning orientation score on admission, with Asian students having a significantly higher score than black students (20.2 (2.2) v. 18.9 (2.1); $P < 0.01$). There was a significant drop in the score in the 3rd year of study ($P < 0.05$). However by the 4th year, the score was comparable to that on admission.

Comprehension learning style

On admission the comprehension learning score was moderate. There was no significant difference in the scores on admission between black and Asian students (15.2 (2.9) v. 14.9 (2.9)). Overall there was little change in the score over the 4-year period. There was a small but significant difference in the scores of black and Asian students. Whereas the black students' score dipped from 15.2 (2.9) in the 1st year to a low 14.0 (2.0) in the 3rd year, the Asian students' score progressively rose from 14.9 (2.9) in the 1st year to a high of 16.1 (2.4) in the 4th year ($P < 0.01$).

Operation learning style

On admission operation learning style score was moderate, with no significant difference between black and Asian students (15.2 (3.3) v. 14.5 (3.0)). Over the 4 years there was a small, sustained and significant rise in the scores for both groups ($P < 0.05$).

Versatile learning style

On admission the versatile learning score was moderately high, with Asian students having a significantly higher score than black students (38.9 (5.1) v. 35.3 (5.3); $P < 0.05$). There was a small, sustained and significant increase in the score over the 4-year period ($P < 0.01$). The improvement in the black students' score was significantly higher than that of the Asian students ($P < 0.01$). In the 4th year the black students' score was comparable to that of the Asian students (40.1 (4.6) v. 40.8 (3.7)).

Improvidence

On admission the improvidence score was moderate, with no significant difference between black and Asian students (6.9 (2.4) v. 6.2 (2.2)). There was a small, steady and significant decline in the score over the 4-year period. The drop in the score was greater among the Asian students than the black students. In the 4th year Asian students had a significantly lower score than the black students (4.4 (2.1) v. 6.1 (2.3); $P < 0.01$).

Globetrotting

On admission the globetrotting score was low, with no significant difference between the two groups ($P < 0.15$). There was little change in the score over the 4-year period.

Learning pathologies

The learning pathologies score was low on admission. There was a small but significant decline in the score over the 4-year period. Most of the decline in the score occurred over the first 2 years. There was no significant difference in the scores of black and Asian students.

DISCUSSION

A survey of the literature reveals the paucity of studies on the learning styles of African medical students. Learning styles are

inter alia a reflection of personal traits, cultural practices and the mode of learning. The absence of other comparable studies on African students makes the interpretation of these results difficult. However it is evident that the learning styles of black students from rural and disadvantaged areas of South Africa are to a large degree similar to those of Asian students from relatively more affluent urban settings in KwaZulu-Natal.

This study reveals that at the time of admission the students at Unitra, a predominantly black African university, had a high achievement motivation. This is in keeping with other studies, which have shown that medical students in general show a higher achievement motivation than arts and science students.[2] The score compares favourably with that of Indonesian medical students.[3] The drop in the achievement motivation score over the 4-year period was due to a decrease in competitiveness and the overwhelming desire to excel (individual-oriented achievement). The PBL curriculum encourages co-operative learning and minimises competitiveness. The drop in the achievement motivation score could therefore be attributed to this specific aspect of the PBL curriculum. What the PBL curriculum encourages but the Lancaster Inventory does not assess is social-orientated achievement, e.g. improved interpersonal skills and successful group interaction. The drop in individual-orientated motivation should therefore not be interpreted as a sign of disillusionment with the study programme.

The Unitra student's approach to learning was more 'meaning'-orientated (deep approach) than 'reproducing'-orientated (surface approach). This is in keeping with the observations of Montecinos and Pantola[4] among Chilean medical students, but contrasts with the observations of Newble and Gordon[5] on Australian medical students, who had higher scores on reproducing orientation in all the years tested. Ideally the PBL curriculum should pave the way for an increase in meaning orientation scores (deep learning) and a decrease in reproducing orientation scores (surface learning). However, in this study there was no significant change in study orientation from the 1st to the 4th year. Although the level of anxiety and fear of failure subsided over the years, the students became more syllabus-bound as the years progressed.

At the time of admission the Unitra students showed no dominant learning style. Both the comprehensive learning style (the holist approach) and the operational learning style (the serialist approach) showed moderate scores. As the years progressed the students showed increased usage of the operational learning style. Similar observations have been made by Stafford[6] regarding occupational therapy students, and by Hendricson *et al.*[7] with regard to dental students. Although in theory the PBL curriculum encourages a comprehensive holistic approach to medical education, the way we practise it in Unitra might be encouraging students to adopt a logical and sequential cognitive style. PBL in the Unitra context utilises the hypothetico-deductive model in a small-group learning context as a structural basis for the learning experience.[8] Learning within the context of small groups is good for the development of non-cognitive skills such as communication, sharing, team spirit, confidence and leadership. But the clinical reasoning process, where information is provided sequentially and logically (the so-called progressive disclosure method) in order to arrive at a diagnosis, may actually serve to reinforce the student's predisposition toward the concrete sequential orientation.

The increased use of the operational learning style was in addition to, rather than at the expense of, the comprehension learning style. In other words, students were becoming more versatile learners. Versatile learners can vary their strategy from holist to serialist and vice versa according to the characteristics of the task, and should therefore be able to cope with diversity and inconsistency. Further evidence of this trend is provided by the decline in the scores for globetrotting (overemphasis on comprehension learning) and for improvidence (overemphasis on operation learning) as the course progressed.

Is a versatile approach to learning a desirable attribute in our students? There are two conflicting opinions on this issue. Pask[9] contends that thorough understanding involves both description building and operation building, i.e. the use of the overall picture and a careful examination of details. To attain the deep level of understanding the student should use holist or serialist strategies as appropriate and in an effective sequence. A versatile approach to learning is therefore desirable. On the other hand, Schmidt *et al.*[10] contend that versatile learning, sometimes referred to as strategic learning, is an attempt to be successful with minimum effort. Students do only what is required by a course, and depth of knowledge on the subject matter is dependent on the external pressure provided by the instructor. This then becomes an undesirable trait in a self-directed and lifelong learner. The results of this study seem to point towards the latter view in that as our students became more versatile learners, they simultaneously became more syllabus-bound. This is in contrast to the observation of Newble and Clarke[11] at the University of New South Wales, where PBL students were found to be less syllabus-bound and less often predisposed to the strategic goal of just passing an examination. These differences may reflect the students' personality traits more than the mode of learning. In the absence of other comparable studies on the learning styles of African medical students in either traditional or PBL curricula, this issue will remain speculative.

In conclusion, the first 4 years of the PBL curriculum had a noteworthy impact on the motivation and learning styles of the medical students concerned. The students became more versatile learners with a leaning towards operation learning style. There was less competitiveness, globetrotting and improvidence. However, the students still remained highly syllabus-bound.

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