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Comparing Problem-Based with Conventional Education: A Review of the University of Limburg Medical School Experiment

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Abstract

Findings from a continuing programme of evaluation research at the University of Limburg are presented. The research programme aims to clarify to what extent problem-based learning is an effective and efficient approach to medical education and if so: Why. The data gathered over the years suggest that there is no particular reason to believe that problem-based curricula provide inferior training to medical students as compared with conventional curricula. Medical students in a problem-based curriculum do not spend less time on their study, and their achievement is comparable to that of students of traditional schools. Problem-based curricula do appear to provide a friendlier and more inviting educational climate, which, in turn, creates a comparatively lower dropout rate. There is some evidence now that students in a problem-based curriculum integrate knowledge from different domains better and acquire superior reasoning skills, than students in conventional curricula.

This paper reviews findings from a continuing programme of evaluation research carried out at the University of Limburg. The research programme attempts to clarify to what extent problem-based learning is an effective and efficient approach to medical education and if so: Why. We present data on medical students' attitudes toward instruction, student achievement in terms of test scores measuring medical knowledge, and problem-solving capabilities acquired by students. Comparative data on duration of study, dropout rates, and study load are also presented.

In this discussion, we capitalise on a unique aspect of the Dutch medical student selection system: the lottery. This process allocates students by chance not merit or other considerations to various medical schools after baseline requirements have been met. The student bodies of the medical schools in The Netherlands are thereby more similar than is typically the case in the rest of Europe or in the United States. This is a boon for comparative evaluation research of the kind reported here. However, as selection of the students in the studies present is not always entirely random, the comparisons - although scientifically justified - need to be interpreted with some caution.

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Brief Overview of the Medical Curriculum at the University of Limburg

The Maastricht medical curriculum is a 6-year programme. The first 4 years are devoted to understanding pathophysiologic mechanisms underlying disease and the final 2 years are focused on clinical training. Each year of the curriculum consists of a number of 6-week "blocks" or units. During each unit, students meet twice a week for a two-hour, small-group tutorial in which problems are analysed and learning goals are formulated. These groups are guided by tutors drawn from the staff whose role it is to facilitate the learning process of the students (Barrows and Tamblyn, 1980). Each unit includes a skill-training programme in which students are taught diagnostic and therapeutic skills. Their newly acquired diagnostic skills are tested in encounters with subjects who simulate patients.
In each year, the units are organised around one central theme. In the first year, the various ways in which the human body adapts to the environment are the focus of study, featuring units on metabolism, response to infection, regulatory mechanisms and homeostasis. The second year considers human functions as perception and locomotion and deal with development issues like growth and differentiation. For the third and fourth years, the Faculty has chosen health problems that are crucial in terms of prevalence and severity in Dutch society. Problems such as pain in the chest, fatigue, and blood loss comprise the themes of the units. Electives for a variety of research and clinical experiences may also be chosen as part of the curriculum.
The curriculum components - problem-based learning, small-group tutorials, and emphasis on self-study - distinguish the University of Limburg medical curriculum from the traditional Dutch medical schools with which it is here compared.

Review of Outcomes

Student Attitudes toward Instruction

In a study carried out in Groningen (Bender, 1979) students were asked to write a letter answering the following question: "What do you think of your instruction?" The letters showed one general trend. These medical students had generally experienced their instruction as boring, irrelevant, and sometimes anxiety provoking. Of course, there were exceptions; individual teachers or programmes were genuinely enjoyed and contributed to the students' motivation to become doctors. However, in general their medical education had not appeared to be an enriching experience. Schmidt and Moust (1981) replicated Bender's study. They randomly selected 50 students from the Maastricht problem-based curriculum, 10 from each class[1], and asked them to write a similar letter about their experiences. Ninety-two percent of the students responded. The authors extracted positive and negative evaluative remarks from the letters, coded the answers in a number of categories, and tallied frequencies. They scored 147 evaluative comments by the Maastricht medical students on aspects of their curriculum. Of these, 117 were positive, indicating that the Maastricht medical students had a largely positive attitude toward their curriculum.

[1] At that time only five classes were available for study.

A closer look at the student responses is instructive. For example, the tutorial groups in addition to being praised could also be a source of discontent. One student wrote:
"During tutorial groups students behave rather disinterestedly or do not react at all. If the tutorial does not work the way it should or if a group doesn't click they merely shrug their shoulders, even though the tutorial group is the key to the entire study. Your relationship with people is what it is all about, now and in the future. And if that is not feasible (not even in a tutorial group) then what is? One of my characteristics is that I feel very dependent on others to maintain my motivation. In this self-directing approach, the others are my stimulus."
One of the more interesting findings was that first-year students expressed difficulties with self-directed learning. They seemed to need at least 6 months to adapt to this new learning environment in which they are responsible for what they study and how they study. One of them wrote:
"As we are unfamiliar with a self-directed study programme we are confronted with a totally new educational system in the first year. This is strange: because we have to discover how to study by ourselves: no certainties; hardly any guidelines, but after a year's hard work it turns out to be less difficult."
Opportunities for gaining acceptance within the medical care system and patient care were most frequently rated positively. The conclusion should be drawn that early and frequent involvement of medical students with a health care provider is of developmental importance This is particularly so as a source of motivation. One student wrote:
"I gained most insights into my studies during my electives with physicians and in the hospital. Only then did I realize how little I knew. After each of these rotations I experienced a considerable increase in my study activities. For me, the confrontation with practice is a very important and positive asset in the curriculum of the Maastricht Medical Faculty. Because of this practice you get a very good - be it a rather broad - insight into the health care system. It gives you a good impression of what you are studying."
These representative qualitative descriptions provide a candid and generally positive reaction to the Maastricht curriculum by a random sample of students.

Study Load

In investigating study load, Weggeman and Moen (1982) adopted a skeptical point of view - they asked whether the positive student attitude, expressed in the Schmidt and Moust study, was merely an indication that students were satisfied with the Maastricht curriculum because it did not demand too much academic effort. Weggeman and Moen asked: "Does an emphasis on independent learning with a de-emphasis on summative assessment merely produce easygoing students"? To explore this question, they used a comparative approach and surveyed the study load of first and fourth year Maastricht medical students during a randomly selected week of their respective programme. The authors then compared the study load estimates with those from various other Dutch university curricula. They found an average study load per week of 34.5 hours for first year students and 39.3 hours per week for fourth year students at Maastricht. Students in five natural science oriented program-

mes, ranging from biology to medicine, at other universities in The Netherlands spent on the average 27.8 hours a week on their study. The results of this comparison indicate that there is no reason to suppose that emphasis on independent learning and absence of pressure from summative examinations create a learning environment that breeds students who put less effort into their studies.

Years of Study and Dropouts

Post, De Graaff and Drop (1986) investigated the relative efficiency of the Maastricht curriculum in terms of producing graduates and limiting dropouts. These are important data, as the mean dropout rate at Dutch universities in the early 1980s was no less than 52%. Duration of study and dropout rate of the first five classes at Maastricht were compared with statistics from other Dutch medical schools. The results clearly demonstrated that the efficiency of the Maastricht medical school exceeded that of the other Dutch medical schools. The majority of the Maastricht students graduated within 6 and a half years. Median study duration at the other medical schools ranged from 7 to over 8 years. The percentage of students who graduated of was 85% for Maastricht and ranged from 64% to 71% for the other medical schools. The Maastricht curriculum thus produced relatively more graduates in less time. As there has been no differential entrance selection of students to the various medical schools, the most likely explanation for the higher efficiency of the Maastricht curriculum would appear to be the motivating effect of problem-based learning.

Achievement

The dropout rates are described in a positive light as an achievement of the medical curriculum. However, when the data are viewed from a more critical perspective, the Maastricht medical
curriculum could perhaps graduate students who might not have succeeded in other schools. To answer this question, Bender from the University of Groningen, and his associates from several other medical schools (1984) asked: "To what extent is performance of students in the domain of medical knowledge in a problem based curriculum comparable with that of students in a traditional school?" The investigators compared the achievement of the Maastricht medical student with that of students in two traditional medical curricula and a reference group of graduates from various medical schools. For each group in the comparison, all levels of medical expertise were represented and all groups from first year to the sixth year took the same test. The test administered consisted of 200 items, a random sample from a large item bank covering medical knowledge as a whole: Clinical, biomedical and behavioural. The main conclusion drawn by Bender et al (1984) was that, whatever the differences, they were small and insignificant at all levels of expertise. Their findings, then, do not support the assertion that lower dropout rates are associated with poorer performance and less critical scrutiny by the medical school at Maastricht.

Integration of Knowledge and Clinical Reasoning

Integration of knowledge is an important topic in advanced learning. Flexible application in solving difficult problems can only be expected when knowledge bases are integrated. Problem-based curricula, while focusing on the application of "old" knowledge in new situations, are said to encourage the integration of knowledge from different domains (e.g. biomedical and clinical knowledge), while traditional curricula seem to assume that integration occurs automatically.

In order to investigate the effects of type of curriculum on integration of knowledge, Boshuizen and Schmidt (1990) compared the perfomances of students from two medical schools, one problem-based and one conventional. These (preclinical) students were asked to explain how a specific metabolic deficiency could be related with a specific disease. Knowledge of biochemistry and internal medicine had to be integrated and applied. In addition to these students, two groups of experts, biochemists and internists, were incorporated in the study. Students from the problem-based curriculum and the biochemists appeared to take an analytical approach to the problem by first exploring the biochemical aspects of the problem, and subsequently linking them to clinical aspects. Students in the conventional curriculum and internists tended toward a more memory-based approach. They searched their memories in order to find a direct answer to the question. This latter strategy, however, resulted significantly less accurate responses and more frequent failures by the students in the conventional programme. These results suggest that students in a problem based curriculum integrate their knowledge better with resultant more accurate reasoning than students in a traditional curriculum. Whether better integration and more accurate reasoning translate into better diagnostic hypotheses remains to be explored.

Conclusion

The studies presented here have presented global comparisons of curricula at Dutch universities The studies are suggestive, but their quasi-experimental nature does not allow us to conclude that the differences are purely the result of differences in the curricula. The studies were outcome-orientated and all were at some risk of being unduly influenced by shortcomings of sampling. However, all the studies dealt with core issues of the discussion whether problem-based learning and related innovations really provide a viable alternative to conventional education. These issues included performance in achievement tests, clinical reasoning, efficiency and effectivity of problem-based programmes, time spent on study, and attitudes toward instruction. The data suggest that there is no particular reason to believe that problem-based curricula provide inferior training for medical students as compared with conventional curricula. The data in this paper clearly demonstrate some "bottom-line" results: medical students in a problem-based curriculum do not spend less time on their studies, and their achievement is comparable to that of students of traditional schools. Furthermore, problem-based curricula do appear to provide a friendlier and more inviting educational climate; the response of students in their evaluation of instruction clearly demonstrated this influence. Such an educational climate facilitates the emergence

of positive attitudes toward study and may be responsible for the lower dropout rate. There is also some evidence that students in a problem-based curriculum integrate knowledge from different domains better and acquire superior reasoning skills. Finally, there is growing evidence that problem-based learning approaches and problem analysis in a small-group tutorial may be an effective facilitator of the processing and retention of new information (Schmidt, De Volder, De Grave, Moust, & Patel, 1989).

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