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# Problem-Based Learning at Maastricht University: Evaluation of Psychiatric Education with the Progress Test

*Problemorientiertes Lernen an der Universität Maastricht:  
Evaluation der Ausbildung in Psychiatrie mit dem Progress Test*

## Abstract

The limited presence of Psychiatry and Behavioral Sciences in problem-based learning (PBL) curricula is regarded as problematic. It is important to know how students' knowledge in Psychiatry and Behavioral Sciences develops because knowledge of those domains is important to the expertise of doctors. We investigated the growth curves of those domains at Maastricht Medical School (MMS). That PBL curriculum claims to be student-centered and to be horizontally and vertically integrated. We hypothesized that the growth curves show a linear upward trend and be similar throughout the curriculum. **Methods:** The progress test (PT) is a main feature of the MMS assessment program, and provides a tool to study growth of medical knowledge. All PT's of students who entered MMS between 1993–2000 were scrutinized for items pertaining to Psychiatry and Behavioral Sciences. Those data were used to estimate growth curves. **Results:** The growth curves were best explained by a quadratic (i.e. curved) function, explaining slightly more than 90% of the variance in both cases. Psychiatric knowledge increased from 8 to 56%, and Behavioral Sciences knowledge from 21 to 58%. Psychiatric knowledge differed significantly from Behavioral Sciences knowledge during the first three years, a difference that vanished during the last three years. **Conclusions:** The growth curve for Behavioral Sciences started to level off after year three and the growth curve for Psychiatry after year four. This shift in knowledge of Psychiatry and Behavioral Sciences should not occur in a student-centered, horizontally and vertically integrated PBL curriculum and is one of the reasons that MMS is currently revising its curriculum.

## Key words

Problem-based learning · growth of medical knowledge · progress test

## Introduction

Over the past 30 years, problem-based learning (PBL) has been increasingly applied in undergraduate medical education. Problem-based curricula claim to be student-centered and attempt to integrate multiple disciplines (horizontal integration) and basic and applied sciences (vertical integration) of subject matter. To achieve these goals, students and tutors meet regularly to unravel real patient problems [1]. The learning process starts with an analysis of unfamiliar terms and proceeds by activation of prior knowledge and subsequent analysis of these patient problems in terms of pathophysiological explanations. The learning objectives that are derived by students are achieved individually through a variety of resources and this new information is applied to the original patient problems when groups reconvene. Compared to more traditional curricula, the PBL approach not only enhances learning [2], long-term retention of learned knowledge [3] and intrinsic motivation [4], but also encourages the development of skills such as listening, summarizing, collaborating, peer teaching and assessing [5].

In view of these developments and the importance of psychosocial factors in medical practice [6], the limited presence of undergraduate education in Psychiatry and Behavioral Sciences in PBL

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curricula is regarded as problematic [7]. This may be reflected in the paucity of reports concerning the overall structure and content of medical curricula in terms of undergraduate education in those domains. For instance, a Medline/PsycINFO search using the phrase „(education OR teaching) AND (undergraduate) AND (psychiatry OR behavioral)“ of English-language papers published between 1985–2003 returned only two reports that provided detailed descriptions of the overall curricular structure and content of undergraduate education in Psychiatry [5,8]. Of the remaining 159 papers, three concerned general descriptions of the „core“ curriculum in Psychiatry [9–11], and the other papers provided partial information of relevance to undergraduate education in Psychiatry and/or Behavioral Sciences. Of those papers, 42 concerned evaluation and examination of specific psychiatric concepts, 31 addressed student's attitudes towards Psychiatry, 13 were related to education in Child Psychiatry, 12 to communication skills, 11 to addiction, 10 to personality factors that influenced recruitment into Psychiatry as a medical specialty, and nine to education with respect to human sexuality. In addition, nine reports concerned student's language difficulties in mastering psychiatric concepts, seven addressed ethical issues, six were concerned with old age Psychiatry, and six were survey studies of what particular elements of psychiatry were taught across medical schools in a specific country. This state of affairs is disappointing because knowledge of Psychiatry and Behavioral Sciences is an important factor in the expertise of doctors. To evaluate the effectiveness of a medical curriculum in this respect, one needs to know how student's knowledge in Psychiatry and Behavioral Sciences develops during the course of their training. To our knowledge, only one study has been published that investigated the relationship between structure and content of an undergraduate curriculum and the development of student's „overall“ medical knowledge over the entire training program [12]. That study was performed at Maastricht Medical School (MMS), the Netherlands, which started in 1976 with a problem-based, student-centered, horizontally and vertically integrated curriculum, organized around interdisciplinary thematic units. A steady upward growth curve in overall medical knowledge was found. However, the knowledge curves for Behavioral Sciences (including Psychiatry in that study) and basic sciences started to level off in the years four and five, suggesting the existence of discrepancies between the actual and the planned curricula. That study, however, did not take into account that MMS undertook a major revision of its curriculum in 1988 to provide a better horizontal and vertical integration. Moreover, the cluster of Behavioral Sciences in that study not only included the disciplines of Psychiatry and Medical Psychology, but also health care economics, health care laws, epidemiology, and ethics and philosophy.

For the present study, therefore, we decided to specifically investigate the separate growth curves of psychiatric and behavioral sciences knowledge in the MMS 1988 curriculum. Almost all MMS students enter this six-year curriculum directly from secondary education. The first four years are pre-clinical and consist of mostly six-weeks, interdisciplinary thematic units. During the clinical phase, students rotate throughout the major clinical disciplines [13,14].

### Psychiatry and Behavioral Sciences in the MMS 1988 curriculum

The contribution of Psychiatry and Behavioral Sciences in the 1988 curriculum can briefly be summarized as follows: Year 1 includes juridical and ethical aspects of psychiatric practice, learning concepts such as classical and operant conditioning, and concepts of stress and trauma. Year 2 includes concepts of perception, consciousness and emotion, concepts of normal and pathological development, and concepts of normal and pathological aging. Year 3 includes neuropsychological concepts of neurological diseases, psychological concepts of skin diseases and eating disorders, and a six-week unit that is entirely devoted to Psychiatry at large (mood/anxiety disorders, schizophrenia, personality disorders etc; psychopharmacological concepts; introduction of the DSM and of the Dutch mental health care system). Year 4 includes concepts of normal and pathological development of sexuality, chronic fatigue, weight loss/increase, and acute psychotrauma. Finally, almost all MMS students have their psychiatric attachment in year 5. The duration of that attachment is eight weeks and includes specialized theoretical seminars for all students of the major psychiatric concepts. A detailed description of the MMS 1988 curriculum is presented elsewhere [14].

### The progress test

Since 1976, the progress test (PT) has been a main feature of the MMS assessment program. A PT system continuously assesses previously learned material and discourages test-directed studying, because every three months a new PT is constructed with the intention to reflect the final objectives of the curriculum. Each PT contains 250 critically reviewed multiple format items (true/false/I do not know), that span all disciplines within the curriculum [15]. The PT is administered in September, December, March and May to all students, regardless of their class, which means that over the course of the six-year curriculum, each student sits 24 PT's. Student's collective successive PT scores reflect the development of medical knowledge throughout the curriculum, and thus provide a tool to study growth of medical knowledge. A detailed description of the PT system is given elsewhere [16].

As outlined above, the contribution of knowledge relevant to Psychiatry and Behavioral Sciences in the MMS 1988 curriculum is spread across the first four years, and continues in the fifth year when students have their psychiatric attachment. We therefore hypothesized that the growth curves of Psychiatry and Behavioral Sciences would both show a linear upward trend throughout the curriculum. Furthermore, we hypothesized that the integrative nature of the 1988 MMS curriculum should lead to similar continuous growth curves for both domains. Finally, the absence of sustained contributions of either Behavioral Sciences or Psychiatry (i.e. virtually none of the MMS students have their psychiatric attachment in year 6) led us to suspect that these growth curves were likely to level off during the last phase of medical training.

## Methods

### Instrument

As stated previously, the MMS undertook a major revision of its curriculum in 1988. Until the academic year 1992–1993, therefore, the PT system included students who did not base their Psychiatric and Behavioral Sciences knowledge on the 1988 curriculum, but on the previous 1976 curriculum. Therefore, to ensure a proper database in which all students obtained a similar contribution of Psychiatry and Behavioral Sciences, as summarized above, we restricted ourselves to all PT's administered between September 1993 and May 2001. For MMS students, 24 PT scores are available, 16 during the four pre-clinical years and eight during the two clerkship years. Each individual PT score is a measurement of a student's medical knowledge and represents a dot on his/her individual knowledge curve across these 24 measurements. A correct answer to a PT item is rewarded with a positive mark (+1), while an incorrect answer is penalized with a negative mark (-1). The answer „I do not know“ is neither penalized nor rewarded. The sums of the positive marks per item (e.g. PT item „x“ as answered by first, second, third up to sixth year students in September of 1993) were determined and expressed on a percentage scale.

### Subjects

All students who entered MMS between September 1993 and September 2000 were included in the study.

### Procedure and examples of PT items pertaining to Psychiatry or Behavioral Sciences

All PT's between September 1993 and May 2001 (32 in total) were scrutinized for items pertaining to Psychiatry and Behavioral Sciences. Therefore, a total of 8000 items (32 PT's times 250 items) were evaluated.

*Example of a PT item pertaining to Psychiatry:* Electroconvulsive therapy is given to patients who suffer from certain psychiatric disorders and who do not respond to other treatment. These disorders include: Panic Disorder with Agoraphobia (yes, no, ?).

*Example of a PT item pertaining to Behavioral Sciences:* A certain percentage of the Dutch adult population has an IQ of between 85–115. This percentage is closer to: 40 than to 70 (yes, no, ?).

### Statistics

The percentage „correct“ for all items pertaining to either Psychiatry or Behavioral Sciences of all PT's between September 1993 and May 2001 were used to calculate mean test scores for each of the 24 measurement points. The estimated growth curves are thus based upon groups of first to sixth grade students in the year 1993–94 up until first to sixth grade student in the year 2000–2001. This kind of design is called a mixed longitudinal design, which is considered a good design to measure growth [17]. Both linear and quadratic regression models were used (SPSS 11.0) to analyze the „curve of best fit“ across these 24 measurement points. Although those curves might also be used to examine differences in knowledge growth between Psychiatry and Behavioral Sciences, part of the variability in those growth curves may be due to differences in the PT versions as administered in September, December, March and May. For this latter

comparison, therefore, we decided to aggregate those four PT versions into one average for groups of first to sixth grade students in the year 1993–1994 up until first to sixth grade student in the year 2000–2001. In this way, the calculated means are based upon the entire array of PT items for either Psychiatry or Behavioral Sciences. Univariate ANOVA with „domain“ (Psychiatry or Behavioral Sciences) and „trend“ (grade 1 to grade 6) as fixed factors was used to examine whether the growth curves of Psychiatry and Behavioral Sciences were different. Post-hoc t-tests were used to examine in which specific grades the two curves differed. Finally, Bonferroni post-hoc multiple comparisons were used for either Psychiatry or Behavioral Sciences to examine differences between the various grades in the growth curves of either Psychiatry or Behavioral Sciences.

### Results

Table 1 depicts the number of PT items pertaining to Psychiatry and Behavioral Sciences that were posed in September–May of the academic years 1993–1994 till 2000–2001. In all, 529 PT items (6.6% of the 8000 evaluated items) were related to Psychiatry and Behavioral Sciences. Of those items, 284 (3.6%) were related to Psychiatry, and 245 (3.0%) to Behavioral Sciences. Fig. 1 depicts the growth curves for either Psychiatry or Behavioral Sciences and the associated curves of „best fit“ that best explain the data. A linear function explained 86.2% of the variance in the growth curve for Psychiatry ( $p < 0.01$ ). This increased significantly to 90.3% by using a quadratic (i.e. curved) function ( $p < 0.01$ ). In addition, a linear function explained 73.5% of the variance in the growth curve for Behavioral Sciences ( $p < 0.01$ ). This increased significantly to 91.8% by using a quadratic function ( $p < 0.01$ ). In both cases, the quadratic functions are plotted in

Table 1 Number of PT items pertaining to Psychiatry and Behavioral Sciences

	Year	September	December	March	May	Total
Psychiatry	1993–94	6	5	6	12	29
	1994–95	6	6	6	9	27
	1995–96	7	8	10	10	35
	1996–97	6	10	11	9	36
	1997–98	8	11	10	13	42
	1998–99	15	10	9	9	43
	1999–00	11	7	8	11	37
	2000–01	8	10	7	10	35
Total		67	67	67	83	284
Behavioral Sciences	1993–94	6	5	6	4	21
	1994–95	9	10	13	5	37
	1995–96	10	7	12	9	38
	1996–97	8	8	3	8	27
	1997–98	11	13	10	9	43
	1998–99	4	10	4	8	26
	1999–00	5	5	3	9	22
	2000–01	8	7	7	9	31
Total		61	65	58	61	245
Grand Total		128	132	125	144	529

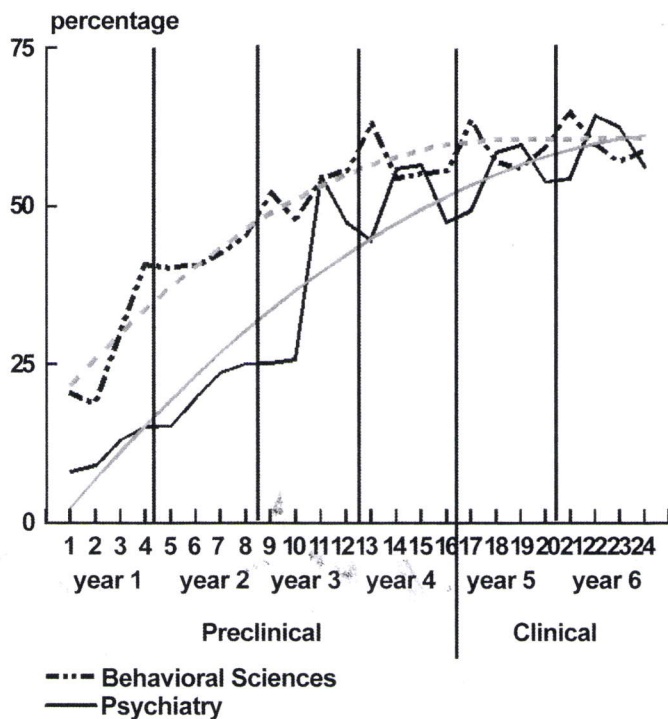


Fig. 1 Mean percentage PT score per measurement moment and associated curves of best fit for Psychiatry and Behavioral Sciences.

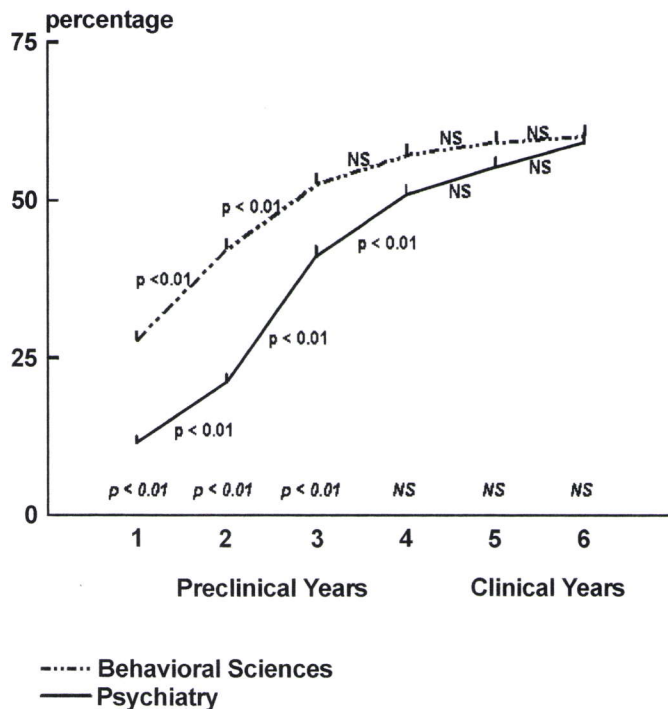


Fig. 2 Growth curves for Psychiatry and Behavioral Sciences. Data are mean + SEM. P values along the growth curves are those of post-hoc Bonferroni multiple comparison. P values in italics above the X-axis are those of post-hoc t-tests.

Fig. 1. Psychiatric knowledge increased from 8 to 56% during the 1988 MMS curriculum, and Behavioral Sciences knowledge increased from 21 to 58%. To examine those increases more closely and circumvent the possibility that domain differences may be (partly) due to differences in PT versions as administered in Sep-

tember, December, March and May, the PT versions of those months were aggregated into one average for groups of first to sixth grade students in the year 1993–94 up until first to sixth grade student in the year 2000–2001. Fig. 2 depicts the growth curves as obtained from those aggregated data. Univariate ANOVA revealed that Psychiatry was significantly different from Behavioral Sciences ( $p < 0.01$ ), that the trend was significant ( $p < 0.01$ ), and that the domain X trend interaction was significant ( $p < 0.01$ ). Inspection of Fig. 2 reveals that the growth curves for Psychiatry and Behavioral Sciences show an upward increase, and do not run parallel. To examine the significant difference and the significant domain X trend interaction between Psychiatry and Behavioral Sciences more closely, post-hoc t-tests were performed. Psychiatric knowledge differed significantly from Behavioral Sciences knowledge during the first three years of the curriculum, a difference that vanished during the last three years ( $p$  values for this analysis are indicated in italics in Fig. 2 just above the X-axis). Apparently, students know most about Behavioral Sciences and least about Psychiatry on entry to medical school. To examine the significant trend more closely, Bonferroni post-hoc multiple comparisons were used for either Psychiatry or Behavioral Sciences. The growth curve for Behavioral Sciences started to level off after the third year of the curriculum and no additional significant growth was present in later years, including the clinical years. The growth curve for Psychiatry started to level off after the fourth year of the curriculum, and again no additional growth was present in the subsequent clinical years.

## Discussion

At the end of the curriculum, slightly less than 60% of PT items were answered correctly for the domains of Psychiatry and Behavioral Sciences, which seems rather low for graduating students. However, comparative studies that have used the PT as a measuring instrument report similar scores [18, 19]. The first explanation for this rather low score is that some of the PT items are too difficult, or fail to assess the end-objectives of undergraduate medical education in either Psychiatry or Behavioral Sciences. Further research is needed to test this hypothesis. A second explanation is that the integrative nature of the 1988 MMS curriculum is not met for Psychiatry and Behavioral Sciences. Our results, for instance, do not support the hypothesized similarity in the growth curves for Psychiatry or Behavioral Sciences. On the contrary, these growth curves are quite distinct, suggesting that the multidisciplinary units of year one – four, in which contributions of Psychiatry and Behavioral Sciences have been incorporated, do not provide an adequate integration of those two domains. To this may be added that the MMS curriculum has one six-week unit that is entirely devoted to Psychiatry at large. The single largest increase in growth of Psychiatric knowledge (see Fig. 1) is also observed just after this six-week unit with no significant additional growth afterwards.

Apparently, students pay more attention to other clinical disciplines after year 4 [12] at the expense of either Psychiatry or Behavioral Sciences. This is further supported by the fact that our results do not support the hypothesized linear growth curves of either Psychiatry or Behavioral Sciences throughout the curriculum. The growth curve for Behavioral Sciences started to level

off after the third year of the curriculum and no additional significant growth was present in later years, including the clinical years. The growth curve for Psychiatry started to level off after the fourth year of the curriculum, and again no additional growth was present in the subsequent clinical years. A final explanation, therefore, for the rather low scores at the end of the curriculum is that the curricular objectives for either Psychiatry or Behavioral Sciences during years five and six are not met. This marked shift in knowledge characteristics in the domains of Psychiatry and Behavioral Sciences during the last phase of medical training was already observed in a previous study [12], and should not occur in a PBL curriculum that claims to be student-centered and attempts to provide both horizontal and vertical integration of subject matter. We suspect that this is attributable to the actual 1988 curriculum. Currently, this curriculum is being revised with the objective to avoid the distinction between pre-clinical and clinical years: Patient contacts and clerkships will start much earlier in the new curriculum [20]. This will hopefully encourage students to pay attention to Psychiatry and Behavioral Sciences during each phase of the new curriculum.

### Conclusion

In conclusion, the results show that the growth curves for Psychiatry and Behavioral Sciences are quite distinct. Psychiatric knowledge increased from 8 to 56% and Behavioral Sciences knowledge increased from 21 to 58%. Psychiatric knowledge differed significantly from Behavioral Sciences knowledge during the first three years of the curriculum, a difference that vanished during the last three years. The growth curve for Behavioral Sciences started to level off after the third year of the curriculum and no additional significant growth was present in later years, including the clinical years. The growth curve for Psychiatry started to level off after the fourth year of the curriculum, and again no additional growth was present in the subsequent clinical years. This marked shift in knowledge characteristics in the domains of Psychiatry and Behavioral Sciences should not occur in a student-centered, horizontally and vertically integrated PBL curriculum and is one of the reasons that MMS is currently undertaking a major revision of its curriculum.

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