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AUTHOR Dolmans, Diana H. J. M.; And Others
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ABSTRACT

A method is presented for collecting information about the match between students' learning issues in problem-based learning and teachers' objectives. Subjects were 82 second-year medical students at the University of Limburg in Maastricht (Netherlands) in a problem-based curriculum. During a unit on pregnancy, childbirth, and child development, learning issues generated by the students were collected. Twenty-four raters, who were students from the group, were asked to judge the correspondence between faculty objectives and students' learning issues. Results indicate that the method is useful in identifying ineffective problems, problems that do not cause students to generate the appropriate learning issues. It must be remembered that student-generated learning issues define what students are going to study, but it is not certain that they will really result in student learning. Three tables present study findings, and there is an 11-item list of references. (SLD)

Do Students Learn What their Teachers Intend they Learn? Guiding Processes in Problem-Based Learning*

Diana H. J. M. Dolmans, Wim H. Gijselaers and Henk G. Schmidt

Department of Educational Research

University of Limburg

Maastricht, The Netherlands

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Correspondence concerning this paper should be addressed to Diana Dolmans, Department of Educational Research, University of Limburg, P.O. Box 616, 6200 MD Maastricht, The Netherlands.

Introduction

The process of problem-based learning starts with a problem, consisting of a description of a set of phenomena in need of explanation. A group of eight to ten students, discusses the problem and tries to explain the phenomena in terms of underlying processes, principles or mechanisms (Schmidt, 1983). Duri g this discussion issues emerge needing further exploration. These learning issues are the starting point for students' learning activities and serve as a guide for studying literature or other educational sources. Thus, student-generated learning issues are topics that each tutorial group decides are prerequisites to a better understanding of the problem under discussion. Each student individually seeks information regarding the learning issues identified. Two days later the group meets again and each participant reports what he or she has found. In this second meeting an attempt is made to integrate information collected and to draw conclusions. Each tutorial group is guided by a tutor, whose main task is facilitating group interaction.

The emphasis in problem-based learning is on the active acquisition of knowledge. Students themselves more or less define the content to be mastered. An often mentioned advantage of this student-centered learning approach is that students develop self-directed learning skills (Barrows, 1985; Blumberg & Michael, 1991). However, this approach to learning and instruction also is a source of concern to both teachers and students. Teachers worry that 'important' information will not be studied by students in a problem-based curriculum (Coulson & Osborne, 1984). Students, at least initially are thought to be unable to generate all the appropriate learning issues and would not identify all the 'required' knowledge (Blumberg, Michael & Zeitz, 1990).

Students are responsible for their own learning, but teachers also have their responsibility for developing the problems that serve as stimuli for self-directed learning. Problem design is a painstaking activity since problems should direct

students into specific content domains. Unlike in traditional educational systems, teachers have no direct influence on students' learning because students generate their own learning issues. In cases where students do not generate those learning issues as intended by teachers, students will not reach the intended faculty objectives. Faculty objectives define the subject-matter that students need to master. If students do not identify the intended faculty objectives, students' learning activities do not cover the intended content-coverage. Therefore, information is needed about the correspondence between faculty objectives and students' learning issues. The main focus of this paper is to present a method for collecting information about the match between students' learning issues and teachers' objectives. These data can provide insight into the learning issues which will arise from problems and the degree to which the intended objectives are reached by students.

Method

Subjects. This study was conducted at the Medical School of the University of Limburg, The Netherlands. The first four years of the problem-based curriculum are structured in units, a series of six-week courses. In this study 82 second year students participated of the 1989-90 academic year divided in 12 tutorial groups. These students attended a six-week course on normal pregnancy, delivery and normal development of children and adolescents. The unit consisted of problems concerning topics such as childbirth, childbed, psycho-motor development and psychosexual development. Students were randomly assigned to tutorial groups.

Procedure. During this unit learning issues generated by the students were collected. Each tutor was asked to record the learning issues generated by his or her tutorial group for each problem. A few weeks after the end of the unit, raters were asked to judge the correspondence between faculty objectives and students' learning issues. The raters were students who participated in the tutorial groups of this unit.

Student-raters seem to be the closest source because they are familiar with the unit content. Moreover, pilot-studies revealed that results from teacher-raters and student-raters were quite similar. The unit consisted of 12 problems and 61 faculty objectives, three to nine objectives for each problem, with an average of 5.1. These faculty objectives were in teachers' mind while constructing the 12 problems.

Each tutorial group generated 1 to 13 learning issues for each problem, with an average of 3.6. In order to match teachers' objectives with students' learning issues for one problem within one tutorial group, raters had to make about 18 (3.6 * 5.1) comparisons. Consequently, if each rater would have to judge 12 problems and 12 tutorial groups, about 2500 comparisons had to be made. In order to reduce the number of comparisons to be made, a design was used in which raters were nested within problems and within tutorial groups. This design is shown in Table 1. 24 raters, divided into 12 pairs, were asked to judge to what extent the learning issues of a specific tutorial group had matched the objectives intended by the teachers for a particular problem.

Table 1

Distribution of raters among problems and tutorial groups

	Tutorial groups				
Problems	1	2	3	..	12
1	$X_{1,2}$	$X_{3,4}$	$X_{5,6}$	..	$X_{23,24}$
2	$X_{23,24}$	$X_{1,2}$	$X_{3,4}$	..	$X_{21,22}$
3	$X_{21,22}$	$X_{23,24}$	$X_{1,2}$	..	$X_{19,20}$
..	..	..	..	..	..
..	..	..	..	..	..
12	$X_{3,4}$	$X_{5,6}$	$X_{7,8}$	..	$X_{1,2}$

Analysis. The task for the raters consisted in comparing each learning issue with each faculty objective within one problem and one tutorial group. In order to illustrate this, the intended faculty objectives and the learning issues generated by one tutorial group for Problem 10 will be shown.

Problem 10: Ellen

Last few years Ellen has grown tall very fast. She has always been a tall girl, but at an age of 11 years and 5,4 feet in height she rises head and shoulders above her age group. People do always take her to be older, which sometimes becomes wearisome. What will become of her? She still has not reached her age of puberty .....

Teachers had five faculty objectives in mind while developing this problem:

1 Normal rates of child growth
2 Normal stages in secondary sexual characteristics
3 Endocrine control processes of growth
4 Psychological effects of being extremely taller compared to the age group
5 Diagnostic procedures to predict ultimate height

One tutorial group had generated five learning issues:

1 Normal pattern of growth rate
2 Which factors do influence growth, which hormones are concerned with growth and what are their effects?
3 Physical changes during puberty and possible explanations
4 Diagnostic possibilities with regard to growth
5 Medical intervention of abnormal growth

Since Problem 10 in this unit contained five faculty objectives and one tutorial group had generated five learning issues, raters had to make 25 comparisons for this problem. For each comparison raters had to judge whether a particular learning issue: (1) definitely corresponds with a particular faculty objective or (2) that learning issue definitely does not correspond with that faculty objective. In Table 2 an example is shown of two raters judging Problem 10, containing five faculty objectives stated on the horizontal axis, with one tutorial group who had generated five learning issues, stated on the vertical axis. If one rater judged one or more learning issues corresponding to one faculty objective, then this particular objective was judged as 'identified' by the tutorial group. As shown in the lowermost row in Table 2, rater 1 judged four out of five objectives as identified and rater 2 judged three out of five objectives as identified by student ' learning issues. Both raters agreed that objective 1, 3 and 5 were definitely identified by the students and that objective 4 was definitely not identified by the students. Both raters disagreed whether objective 2 was identified by this tutorial group. A faculty objective was scored as identified if both raters agreed. If both raters agreed that the faculty objective is definitely not identified, then it is assumed by the researchers that the students failed to study the content domain specified for this objective.

Table 2

An Example of the Ratings of Two Raters for One Problem and One Tutorial Group

Raters											
1						2					
	Faculty objectives						Faculty objectives				
Issues	1	2	3	4	5	Issues	1	2	3	4	5
1	+	-	-	-	-	1	+	-	-	-	-
2	-	-	+	-	-	2	-	-	+	-	-
3	-	+	+	-	-	3	-	-	+	-	-
4	-	-	-	-	+	4	-	-	-	-	+
5	-	-	-	-	-	5	-	-	-	-	-
	+	+	+	-	+		+	-	+	-	+

Results

The interrater-agreement for each pair, varied between 64.2 percent and 85.0 percent, with an average of 76.9 percent. This implies that the raters disagreed about 23.1 percent of the faculty objective whether they were reflected by students' learning issues. Since these percentages are overestimated, because of agreement based on chance, kappa-coefficients were computed for each pair of raters. The kappa-coefficient takes into account the expected proportion of agreement that would occur if assignments were made by chance alone and varies between values lower than zero and one. The kappa-coefficient for the pairs of observers, varied between .22 and .57, with an average of .35. The average percentage of .35 demonstrates a

fair agreement between the raters (Landis & Koch, 1977). These results seem to support the reliability of the match procedure. Other studies (Dolmans, Gijselaers, Schmidt & Van der Meer, 1992) revealed similar findings, whereas the average kappa-coefficient was .45, demonstrating a moderate agreement.

In order to assess whether students identify the intended faculty objectives, information will be presented about the degree to which faculty objectives are explored by student-generated learning issues. The average percentage of overlap for each problem and each tutorial group is shown in Table 3. The cells in this table show the percentage of faculty objectives identified by students' learning issues. The mean percentage of overlap for each tutorial group varied between 51.9 and 73.9. This percentage does not differ across tutorial groups ($F(11,141)=.87$, $p=.569$). The correspondence between faculty objectives and student-generated learning issues for each problem varied between 33.3 and 77.0 percent and differed across problems ($F(11,141)=2.99$ $p<.001$). The average percentage of overlap for the 12 problems together was 62.4. In other words, an average of 62.4 percent of the faculty objectives were definitely identified by the 12 tutorial groups. This implies that an average of 37.6 percent of the faculty objectives were either definitely not identified by the students or the raters did not agree whether these faculty objectives were identified. Other studies (Dolmans, Gijselaers, Schmidt & Van der Meer, 1992) revealed a quite similiar average percentage of overlap of 64.2.

Table 3

Percentage of teachers' objectives matched by students' learning issues for each problem and each tutorial group

	Tutorial groups												
Problems	1	2	3	4	5	6	7	8	9	10	11	12	Mean
1	89	67	67	100	67	100	100	67	33	78	89	67	77.0
2	100	100	29	29	100	.71	71	43	86	86	86	43	70.3
3	25	25	75	25	75	75	50	100	100	100	100	100	70.8
4	67	33	44	56	11	78	67	56	67	22	78	22	50.1
5	67	100	0	100	83	67	50	**	50	67	50	83	65.2
6	67	67	67	67	33	100	33		100	33	67	67	63.7
7	75	75	75	75	100	50	50	25	75	75	100	75	70.8
8	100	100	67	67	100	67	67	100	33	67	100	0	72.3
9	40	60	80	40	40	60	20	60	60	20	80	40	50.0
10	75	50	50	100	100	75	75	50	50	25	25	75	62.5
11	75	50	50	75	75	50	75	75	75	50	75	25	62.5
12	0	67	67	33	67	33	0	33	33	0	33	33	33.3
Mean	65.0	66.2	55.9	63.9	70.9	68.8	54.8	60.9	63.5	51.9	73.6	52.5	62.4

** Two cells are empty because two tutorial groups omitted one problem

Conclusion and discussion

The results demonstrate that the method is useful in identifying ineffective problems, that is problems which do not lead students to generate the appropriate learning issues. In this study, for instance, Problem 12 seems to be an ineffective problem taken into account that only 33.3 percent of the intended objectives is identified by students' learning issues. This low percentage of overlap, however, may be due to end-of-unit-effects, such as decreasing motivation and lack of time because students are preparing their end-of-unit examination. Problems 4 and 9 also seem to be ineffective since the average percentage of overlap between the faculty objectives and students' learning issues is about 50 percent. The average percentage of content coverage for the unit as a whole is 62.4 (*SD*=26.6). Consequently, approximately 60 percent of the faculty objectives are identified by students' learning issues. Similar findings are reported in other studies. For example, Tans, Schmidt, Schade-Hogeveen and Gijselaers (1986) who conducted a study concerning the correspondence between teachers' objectives and students' learning issues reported a mean percentage of 68.3 (*SD*=24,6). Coulson and Osborne (1984) concluded that at the course level, tutorial groups succeeded in identifying all of the faculty-generated faculty objectives. However, each faculty-identified learning issue was generated on the average by five out of twelve tutorial groups (42 percent).

The assumption underlying the relationship between a problem and certain learning issues or course objectives is that each problem leads to formulate unique learning issues or objectives. However, it is questionable whether this assumption is valid. Analyzing the data concerning this issue revealed that students only in minor cases generated learning issues which were intended to be generated for other problems. Moreover, tutors remarked that most of these learning issues were not initially derived from the problem at hand, but were repeated because students did not master that issue and needed to spend some more study time.

Although problems are the starting point for students' learning activities and determine the generation of learning issues, it should be noted that it is not sure that students actually pursue these learning issues in all cases. Students will not employ certain learning activities related to a particular problem when they have already studied this material before. Students can also decide it to be more relevant to spend time on other issues. Moreover, it is possible that students pay a lot of attention on an issue during the discussion in the tutorial group and decide not to define this learning issue as a guide during independent study. This issue, although not formulated as a learning issue, might be dealt with adequately according to students' perceptions. On the other hand, it seems clear that during independent self-study and during discussion in the tutorial group, students frequently learn about other related topics that go beyond student-generated learning issues. In summary, student-generated learning issues define what students are going to study, but it is not sure that they will really lead student learning. Learning issues are only possible reflections of student learning. Although this question may be raised, preliminary results from a study conducted by Tans et al. (1986) revealed that learning issues are valid indicators for students' learning activities, since the correlation coefficient between the frequency of generating students' learning issues and students' achievement on test items corresponding with those issues was .42.

Furthermore, it should be noted that the correspondence between faculty objectives and student-generated learning issues is quite difficult to judge since a learning issue is arisen from the discussion in the tutorial group that is not available to the raters. This lack of background information makes it quite difficult in some cases to judge to what extent a learning issue is relevant to a particular objective, although the students involved probably exactly know what is intended. The agreement between the raters, however, was fairly high indicating that in most cases the raters were able to make these judgments, without additional context information.

Another deficiency of the procedure presented to compare students' faculty objectives with student-generated learning issues is that, although it provides a means of detecting ineffective problems, it does not contain information about the nature of the shortcomings of these problems. In order to provide information about improvements it is necessary to identify features determining problems' quality. However, until now little is known about the criteria along which problems should be constructed. The effectiveness of a problem is supposed to be related to students' prior knowledge about the subject-matter, linkage to students' future profession, the length of the text and the presence of structuring remarks (Bouhuijs & Gijselaers, 1987; Majoor, Schmidt, Snellen-Balendong, Moust, & Stalenhoef-Halling, 1990).

Furthermore, research is needed about the nature of learning issues generated by students that do not correspond with teachers' objectives. Additional information should be collected in order to assess the appropriateness of these learning issues.

References

Barrows, H. S. (1985). *How to design a problem-based curriculum for preclinical years.* New York: Springer.

Blumberg, Ph., Michael J. A., & Zeitz H. (1990). Roles of student-generated learning issues in problem-based learning. *Teaching and Learning in Medicine, 2,* 149-154.

Blumberg, Ph., & Michael J. A. (1991, April). *The influence of content definition on self-directed learning.* Paper presented at the AERA, Chicago: Illinois.

Bouhuijs, P. & Gijselaers, W. H. (1987). De constructie van taken in probleemgestuurd onderwijs. (The construction of problems in problem-based learning). *Vorming, 36,* 26-39.

Coulson, R. L., & Osborne, Ch. E. (1984). Insuring curricular content in a student-directed problem-based learning program. In: H. G. Schmidt, & M. L. De Volder (Eds.)., *Tutorial in Problem-Based Learning. A new direction in teaching the health professions* (pp. 225-229). The Netherlands: Van Gorcum.

Dolmans, D. H. J. M., Gijselaers, W. H., Schmidt, H. G., & Van der Meer, S. B. (1992). Content-Coverage in a Problem-Based Curriculum. Studies about the Effects of a Self-Directed Learning Approach. Manuscript submitted for publication.

Landis, J. R., & Koch, G. G. (1977). The measurement of observer agreement for categorical data. *Biometrics, 33,* 159-74.

Majoor, G. D., Schmidt, H. G., Snellen-Balendong, H. A. M., Moust, J. H. C., & Stalenhoef-Halling, B. (1990). Construction of problems for Problem-Based Learning. In Z. M. Nooman, H. G. Schmidt, & E. S. Ezzat (Ed.), *Innovation in Medical Education: An Evaluation of Its Present Status* (pp.114-122). New York: Springer.

Rovinelli, R. J., & Hambleton, R. K. (1977). On the use of content specialists in the assessment of criterion-referenced test item validity. *Tijdschrift voor Onderwijsresearch, 2,* 49-60.

Schmidt, H. G. (1983). Problem-based learning: Rationale and description. *Medical Education, 17,* 11-16.

Tans R. W., Schmidt H. G., Schade-Hoogeveen B. E. J., & Gijselaers W. H. (1986). Sturing van het onderwijsleerproces door middel van problemen: Een veldexperiment. (Directing the learning process by means of problems: A field experiment). *Tijdschrift voor Onderwijsresearch, 11,* 1, 35-46.