



Different outcomes of active and reflective students in problem-based learning

Yera Hur & Sun Kim

To cite this article: Yera Hur & Sun Kim (2007) Different outcomes of active and reflective students in problem-based learning, Medical Teacher, 29:1, e18-e21, DOI: [10.1080/01421590601045007](https://doi.org/10.1080/01421590601045007)

To link to this article: <https://doi.org/10.1080/01421590601045007>



Published online: 03 Jul 2009.



Submit your article to this journal [↗](#)



Article views: 1764



View related articles [↗](#)

WEB PAPER

Different outcomes of active and reflective students in problem-based learning

YERA HUR & SUN KIM

Department of Medical Education, College of Medicine, The Catholic University of Korea, Seoul, Korea

Abstract

Background: In the recent past, many medical schools have adopted the problem-based learning (PBL) method in their curriculum.

Aim: The key in this type of learning is the small group, which encourages students to perform and, thus, to learn effectively. This means the students must be grouped in such a way for the small group to facilitate the achievement of a better learning outcome.

Methods: Using Felder's Learning Inventory, three groups of students were formed: active, reflective and a control with no particular propensity.

Results: Some interesting results were found. Active learners did not have the highest score in any of the tested areas. Instead, the reflective group of learners had the best outcome in participation, and the control group showed the best teamwork in a PBL setting.

Conclusion: Overall, we have found that grouping students according to their varying learning styles can be very useful for specific and various learning outcomes.

Introduction

The learning style, as experienced by learners, is how information is recognized and processed (Kolb 1984). This study focuses on the effects of learning styles in classroom achievement. Among the many theories on learning styles (Dolmans & Wolfhagen 2004; Laight 2004; DiBartola et al. 2001 etc.), Felder (1993) was the one chosen for this study. Felder (1993) noted five matched pairs of learning styles that showed different methods of processing and organizing information, differing cognition paths, and favoring of information. The five pairs of learning styles are 'active–reflective', 'sensing–intuitive', 'visual–verbal', 'inductive–deductive' and 'sequential–global'.

This study focused on students with 'active' and 'reflective' learning styles. According to Felder (1993), in processing information active learners prefer physical activities and discussions, while reflective learners favor reflective thinking and deliberation. Our aim is to see which group of learning styles shows better learning outcomes in a problem-based learning (PBL) setting. In PBL, different types of learners can be expected to gain different effective learning outcomes since the tutorials require a combination of active discussion, visual materials and inductive and reflective thinking.

In this study, we attempted to address the following four questions:

- (1) Which type of learning style shows the highest level of participation in PBL sessions?
- (2) Which type of learning style shows the best problem-solving skills?

Practice points

- Active and reflective students show different learning outcomes.
- Reflective students show active participation in a PBL setting.
- A group with mixed qualities shows the best teamwork.

- (3) Which type of learning style scores highest on the quizzes?
- (4) Which type of learning style shows the highest level of teamwork?

Participants and instruments

Participants in this study were the third-year medical students at the Catholic University of Korea's medical school. A total of 111 students took the Learning Style Inventory questionnaire and 64 were finally chosen for the analysis.

Two major instruments were used in the study. One was Felder's Learning Style Inventory translated into Korean. The Learning Style Inventory consisted of 49 questions looking at specific characteristics of each learning style. The scale of each learning style was between –11 and +11, with ± 11 being the maximum score and ± 1 the minimum score. The study used the scores of the 'active-reflective' learning style.

Correspondence: Sun Kim, PhD, 505 Banpodong, Seocho-gu, Department of Medical Education, College of Medicine, The Catholic University of Korea, Seoul, Korea. Zip code: 137-701. Tel: 82-2-590-1384. Fax: 82-2-591-7185; email: skim@catholic.ac.kr

The other instrument used for the study was an assessment sheet developed by the authors. This instrument is called 'PBL assessment sheet', which has been used at the medical school for more than four years and content validation was done by four PBL professionals who were the professors in charge of the school's PBL module development and administration. This PBL assessment sheet measures students' participation (participating in class discussion, asking questions, involvement in group work), problem-solving skills (acknowledging the problem, logical thinking, providing solutions), quiz scores (five questions for each module based on the context of the module) and teamwork (dividing group work, collaboration) on a five-point scale (except for teamwork, rated as 'high', 'moderate' or 'low'. These scores were re-coded into a three-point scale for analysis). The PBL tutors assessed the students individually for each module.

Small-group PBL sessions were carried out from 24 May to 9 June 2005. During this period, 64 medical students in groups of 10 or 11 (six groups in total) studied three different PBL modules. These six PBL small groups functioned simultaneously in different PBL rooms. Tutors were different by group and by module.

Methods

This study used one of Felder's five pairs of learning styles, 'active' and 'reflective', and focused on the effectiveness of PBL small-group sessions. Before beginning these sessions, students completed the Learning Style Inventory survey. From these results, students were divided into six groups, two groups of active learners (minimum score +5) and two groups of reflective learners (minimum score -5), representing the four experimental groups, with the remaining two groups being the control with students of no specific inclination. These control groups were composed of a mixture of intermediate active and intermediate reflective students. The six groups consisted of 11 students each, except the control groups which had 10 students in each group.

Students had two PBL sessions for each module with each session lasting about an hour. Since the three modules were all different, analysis was done for each module.

The Learning Style Inventory and PBL assessment sheets were analyzed using the SPSS program version 11.5. And since the number of participants and the size of each group were small, a non-parametric method was chosen.

According to the groups as divided, differences among academic achievements (participation, problem-solving skills, quiz scores and teamwork) were studied. The statistical method used was the Kruskal-Wallis test and a one-way Anova. The Kruskal-Wallis test was used for analyzing each module since the number of students for this analysis was less than 50 in each group. One-way Anova with post-hoc test was done for the whole study period. For the categories with homogeneity of variances (participant level, problem-solving, quiz) LSD measurement was used, and for teamwork, Tamhane measurement was used since it did not have homogeneity of variances.

Results

A total of 111 third-year medical students completed the Learning Style Inventory survey. From the statistical analysis, 56 students were found to be 'reflective' and 55 'active'. From this result, 64 students were finally chosen for the analysis.

Maximum scores for participation, problem-solving skills and quiz were 5.0, and teamwork scores were originally given as 'high', 'moderate' and 'low', which were then translated into a three-point scale for the analysis.

Participation level

In participation level, of the three groups, the reflective group's mean rank was the highest in the first (42.05) and second (35.77) PBL modules (Table 1). And in these modules (first: $\chi^2 = 21.944$, $p < 0.001$; second: $\chi^2 = 6.134$, $p < 0.05$), students showed statistical differences in this area (Table 2). From the one-way Anova result (Table 3) there were significant differences ($F = 8.68$, $p = 0.000$) and the differences were between the active group and the reflective group ($MD = -0.64$, $p = 0.000$), and between the active group and the control group ($MD = -0.48$, $p = 0.004$).

Problem-solving skills

In problem-solving skills, the first ($\chi^2 = 7.170$, $p < 0.05$) and second ($\chi^2 = 7.204$, $p < 0.05$) modules showed significant differences (see Table 2). The highest mean ranks were found in the reflective group with a score of 38.45 in the first module and 37.50 in the second module (see Table 1). Significant differences are shown in Table 3 ($F = 3.06$, $p = 0.049$) and the differences were between the active group and the reflective group ($MD = -0.36$, $p = 0.015$).

Quiz scores

Quizzes were given after two sessions of each PBL module. They consisted of five short-answer questions. As a result, significant differences were seen in the second ($\chi^2 = 24.326$, $p < 0.001$) and third modules ($\chi^2 = 32.455$, $p < 0.001$) (see Table 2). In the second module, the control group's median score was the highest (48.85), and in the third module the reflective group's mean rank score was the highest at 47.50 (see Table 1). Significant differences are shown in Table 3 ($F = 8.15$, $p = 0.002$) and the differences were between the active group and the reflective group ($MD = -0.42$, $p = 0.032$), and between the active group and the control group ($MD = -0.71$, $p = 0.000$).

Teamwork

Teamwork scores were not given individually but as a team. The assessment was done using a three-point scale but as a result all the teamwork scores in the three modules showed very high significant differences. The chi-square scores of the first, second and third modules' were $\chi^2 = 43.313$ ($p < 0.001$), $\chi^2 = 15.711$ ($p < 0.001$) and $\chi^2 = 15.000$ ($p < 0.001$), respectively (see Table 2).

Table 1. Mean rank of three PBL modules.

	Learning style	<i>n</i>	Mean rank		
			Module 1	Module 2	Module 3
Participation	Active	22	19.41	26.64	27.61
	Reflective	22	42.05	35.77	36.55
	Control	20	36.40	35.35	33.42
	Total	64			
Problem-solving	Active	22	24.86	31.68	26.68
	Reflective	22	38.45	37.50	35.84
	Control	20	34.35	27.90	35.23
	Total	64			
Quiz	Active	22	31.98	25.14	18.14
	Reflective	22	29.41	25.00	47.50
	Control	20	36.48	48.85	31.80
	Total	64			
Teamwork	Active	22	16.50	30.25	27.50
	Reflective	22	48.50	24.75	27.50
	Control	20	32.50	43.50	43.50
	Total	64			

Table 2. Kruskal–Wallis test statistics for each PBL module.^a

		Participation	Problem-solving	Quiz	Teamwork
Module 1	Chi-square	21.944***	7.170	1.703	43.313***
	df	2	2	2	2
Module 2	Sig.	0.000	0.028	0.427	0.000
	Chi-square	6.134*	7.204*	24.326***	15.711***
	df	2	2	2	2
	Sig.	0.047	0.027	0.000	0.000
Module 3	Chi-square	2.857	3.573	32.455***	15.000**
	df	2	2	2	2
	Sig.	0.240	0.168	0.000	0.001

Notes: ^aGrouping variable: learning style. * $p < 0.05$, ** $p < 0.01$, *** $p < 0.000$.

The reflective group mean rank score was the highest (49.50) in the first module, but in the second and third modules the control group had the highest mean rank scores at 43.50 for both modules (see Table 1). Table 3 shows there is significant difference among the group ($F = 2.79$, $p = 0.000$) and the differences were between the active group and the reflective group ($MD = -0.25$, $p = 0.007$), and between the active group and the control group ($MD = -0.42$, $p = 0.000$).

Discussion

From these results we can see that there are significant differences in the learning outcomes when students are divided into groups according to the different learning styles. It should be noted that the lack of differentiation in outcomes between groups for 'Participation' level and 'Problem-solving' skills in Module 3 maybe due to the level of difficulty of the module. Or students' interest and motivation in PBL simply

could have dropped since it was the third and last module of the PBL program. Since this study did not execute factor analysis, searching for the reason could be another theme of the study.

A very interesting result was the learning group that showed the best outcome. We might simply hypothesize that the group of active learners would show the highest scores in student-oriented problem-based learning sessions, which asks for extensive active participation from the students, and because reflective students prefer reflective thinking and deliberation they would do well working alone or in pairs.

But the results from this study show otherwise. Active learners did not have better scores on any of the testing criteria. Even in participation, active learners showed the lowest mean rank. And it is known that active learners like to work in groups (<http://www.ncsu.edu/felder-public/ILSdir/styles.htm>) but, according to the results, active learners scored the lowest on teamwork (see Table 3). On the other

Table 3. One-way Anova result of students by learning style.

	Learning style	<i>n</i>	Mean	SD	Variation	SS	df	MS	F	Sig.
Participation	Active	66	3.97	0.98	Between groups	14.72	2	7.36	3.28***	0.000
	Reflective	66	4.61	0.78	Within groups	160.19	189	0.85		
	Control	60	4.45	0.99	Total	174.91	191			
Problem-solving	Active	66	4.23	0.78	Between groups	4.24	2	2.12	3.06*	0.049
	Reflective	66	4.59	0.72	Within groups	130.88	189	0.69		
	Control	60	4.38	0.99	Total	135.12	191			
Quiz	Active	66	3.64	1.15	Between groups	16.29	2	8.15	3.35**	0.002
	Reflective	66	4.06	1.11	Within groups	231.69	189	1.23		
	Control	60	4.36	1.14	Total	247.98	191			
Teamwork	Active	66	3.98	0.84	Between groups	5.57	2	2.79	14.51***	0.000
	Reflective	66	4.43	0.81	Within groups	36.29	189	0.19		
	Control	60	4.72	0.64	Total	41.86	191			

Notes: * $p < 0.05$, ** $p < 0.01$, *** $p < 0.000$.

hand, reflective learners showed the highest learning outcome in problem-solving skills, which is what they are good at. They had the highest score in participation as well. A possible interpretation for this is that although reflective learners do not enjoy group discussions they like cognitive thinking, which provides them with the motivation to participate in sharing their thoughts with others.

The quiz scores did show significant differences in some areas but as there was no consistency we need to go over the reason for this with a fine tooth-comb.

In problem-based learning, teamwork is very important. From the three modules, different results were obtained. In the first module the reflective learners showed better teamwork but in the second and third the control group, consisting of students with no specific active or reflective propensity, did better in this area. This shows that in order to learn teamwork there is no advantage to students related to their learning styles.

A grouping method is only one way of elevating students' learning outcome. It would be wise to consider student grouping in addition to applying suitable instructional strategies to improve learning outcome (Hur & Kim 2002). For example, reflective learners perform better in participation and on quizzes, and if the instructor wishes to focus on strengthening students' participation and high achievement in quiz scores, highly reflective students should be sufficiently included as members of the group. And if the instructor wishes to focus on enhancing students' teamwork, grouping students with mixed learning styles is suggested. This means instructors can choose the method of grouping students' according to the specific objectives that are to be achieved.

From the results of the study, some suggestions for further studies can be made. First, this study could be repeated with a larger number of students. Second, another control group of students with very high active or reflective propensity could be used. Third, the study could be extended to include 11 groups for all 10 of Felder's Learning Inventory qualities (plus one control). Fourth, we can also see if there is a significant difference in learning outcomes according to various

instructional strategies other than PBL sessions. Fifth, learning styles can be developed and can change through learning experiences (Sutcliffe 1993; Kreber 1998; Brock & Cameron 1999), which means learning can be more effective if the curriculum is developed taking the students' learning styles into account. An inspection of students' learning styles from each year including pre-medical students to students in year four would be necessary.

Notes on contributors

SUN KIM, PhD, Associate Professor, is an expert in medical education and educational psychology and has vast experience in medical education curriculum development and assessment.

YERA HUR, PhD, Researcher, has just finished her doctoral thesis on medical professionalism. Her main interest is in curriculum development, teaching and learning method.

References

- Brock KL, Cameron BJ. 1999. Enlivening political science courses with Kolb's preference model. *Polit Sci Polit* 32:251–256.
- DiBartola LM, Miller MK, Turley CL. 2001. Do learning style and learning environment affect learning outcome? *J Allied Health* 30:112–115.
- Dolmans DH, Wolfhagen IH. 2004. The relationship between learning styles and learning environment. *Med Edu* 38:859–867.
- Felder RM. 1993. Reaching the second tier: learning and teaching style in college science education. *J Coll Sci Teaching* 23:286–290.
- Hur YR, Kim S. 2002. Teaching and learning strategies of PBL. *Korean J Med Edu* 14:145–156.
- Kolb DA. 1984. *Experimental learning: experience as the source of learning and development*. Englewood Cliffs, New Jersey: Prentice-Hall.
- Kreber C. 1998. The relationship between self-directed learning, critical thinking, and psychological type and some implications for teaching in higher education. *Stud High Edu* 23:71–78.
- Laight DW. 2004. Attitudes to concept maps as a teaching/learning activity in undergraduate health professional education: influence of preferred learning style. *Med Teach* 26:229–233.
- Lee MO. 2000. Nursing students' methods of learning. *Korean Nursing Soc* 30:1521–1530.
- Sutcliffe L. 1993. An investigation into whether nurses change their learning style according to subject area studied. *J Adv Nursing* 18:647–658.