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Medical students' approaches to learning before and after the cardiology problem-based learning practice

Evangelia Karagiannopoulou[1], Katerina Naka[2], Spiridon Kamtsios[1], Eugenia Savvidou[3], Lampros Michalis[2]

[1]Department of Philosophy, Pedagogy and Psychology, Section Psychology, University of Ioannina, Ioannina, Greece, [2]Department of Cardiology, Medical School University of Ioannina, Ioannina, Greece, [3]Department of Primary Education, University of Ioannina, Ipiros, Greece

Address for correspondence:
Spiridon Kamtsios, Univerity of Ioannina, Greece Ioannina, Greece.
E-mail: spiroskam@gmail.com

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ABSTRACT

Background: Recent literature reports inconsistent findings concerning the effect of the problem based learning (PBL) on medical students' approaches to learning. However, there is a lack of studies focused on the comparison of a pre-clinical traditional teaching context to a post clinical PBL context. Furthermore, no study has focused on approaches to learning reported by students with different pace of study and academic qualifications before and after the experience of a PBL curriculum. **Objectives:** The present study focuses on differences in approaches to learning reported by students of a Greek medical school before and after their clinical practice in cardiology employing a PBL curriculum. The effect of the PBL clinical practice on students' approaches to learning was explored for the total study group, as well as for students with different study pace and with and without a previous degree in a subject relevant to medicine. **Methods:** The sample consists of 109 5th-year students. The approaches to learning were explored by the Finnish version of the Approaches to Learning and Studying Inventory (ALSI). **Results:** Students in all groups reported higher scores in organized study and lower scores in the surface approach after the clinical practice compared with their scores prior to their practice. The deep approach was slightly increased in all groups after the clinical practice. The study indicated good psychometric properties of the questionnaire. **Conclusion:** The PBL clinical practice seems to be of benefit for all the groups of students concerning their approaches to learning (post-clinical scores). Curriculum planners are suggested to work toward the PBL clinical training to be early integrated in the curriculum.

KEY WORDS: Approaches to learning, cardiology, problem-based learning

INTRODUCTION

The educational literature discusses three approaches to learning: surface, deep and strategic [1]. Marton and Säljö [2] introduced the distinction between deep and surface approaches. The strategic approach, relating to study methods and effort, was described by Entwistle and Ramsden [3]. Students who adopt a surface approach attempt to rote learn material in order subsequently to reproduce it, describing an intention to complete the task with little personal engagement. Routine unreflective memorization and procedural problem-solving are associated strategies, with restricted conceptual understanding being an inevitable outcome [1]. Students adopting a deep approach seek meaning in order to understand for themselves [4]. This approach is associated with an intention to comprehend, to engage in active conceptual analysis and, if carried out thoroughly, generally results in a deep level of understanding [1]. Students reporting a strategic approach have the intention to achieve the highest possible grades by using organized study methods and effective time management [1,3].

Although a range of studies explore the relationship between approaches to learning and academic performance [5], research concerning the relationship between student learning and academic progression has been scarce. A few studies [6,7] have found a connection between deep approach to learning and better academic performance been measured by accumulation of credits. Parpala *et al.* [8] found that bio-science students, who had earned the (most) higher credits (ECTS), scored higher on scales measuring deep approach to learning and organized studying (equivalent to strategic approach) than did the students who had earned the (fewest) lower credits. A later study [9] indicated that organized studying has been related to academic progression and study success in bio-science students, suggesting that students who organize their studies, manage their time well and put effort into their studying earn more credits and receive higher grades. In the same line, Ruohoniemi *et al.* [10], examined the relationship between veterinary students' approaches to learning and their study success and found that students applying a deep approach achieved higher grade point averages and progressed faster in

their studies than did other student groups. Duff *et al*. [7], also found similar results. Besides, there is evidence of a relationship between approaches to learning and students' previous qualifications (Richardson, 2005) [11]. Students with higher prior qualifications tend to produce higher scores on the deep elements (seeking meaning, relating ideas, use of evidence) and organized studying but lower scores on surface elements (lack of purpose, unrelated memorizing and fear of failure).

Most of the studies focused on medical education have indicated that medical students report high scores in deep and strategic approaches and relatively lower scores in surface approach. There seems to be little change, in students' learning approaches during an academic year, slightly lower scores in the surface approach, even though efforts were made to encourage a deep approach through learning experiences that involved problem-based learning (PBL) [12]. Besides, medical students appear increasingly adopting a strategic approach to learning as they move through their medical curriculum [13]. Although the PBL varies between various schools, the literature indicates three characteristics considered as essential: (1) Problems as a stimulus for learning, (2) Teachers as facilitators of the learning process and (3) Group work as a stimulus for interaction [14].

A range of studies, since the early work of Newble and Clarke [15] have indicated that students who have been taught PBL become increasingly deep and less surface in their orientations. However, the recent literature indicates inconsistent findings [16,17]. Some studies have demonstrated that PBL students tend to adopt a deeper than a surface approach to learning [18-22]; others have shown a high degree of surface learning and a low level of deep learning [23]. Furthermore, some other studies report a shift over the course of time in the quality of students' approaches with students tending to adopt a more surface approach and a less deep approach over the course of the 1st year of their studies [19,21,22]; recent research indicates that PBL students tend to adopt deep rather than a surface approach although 2nd year students have a somewhat less deep approach than the 1st year students. Still, studies comparing students' approaches to learning in traditional and PBL curriculum indicate that after incorporation in a Princeton-Blairstown Center curriculum students score higher on the deep approach and lower in the surface approach [20].

Most of the above-mentioned quantitative studies have not focused on clinical practice. However, learning in the clinical setting during medical education is a different environment, and learning is affected by both the particular clinical context and students' general ways of learning. Understanding learning from the students' perspective, in terms of their approaches to learning, is important in improving learning in a clinical setting [24]. The clinical practice as deliberate practice has been characterized by attention, concentration, effort and repetition of skills until performance becomes fluent and enhances higher order cognitive processes and metacognition, deep learning, through (a) observation and feedback provided to students [25] and, (b) tutors and students combined responsibility for optimizing the effectiveness of deliberate practice in clinical skills acquisition.

The present study explores differences in students' scores on approaches to learning before and after the clinical practice in a cardiology department. It investigates the benefit of a PBL clinical practice for students according to the study pace and their previous qualifications. The study has been stimulated by the discussion recently developed by a particular school about reformation of the curriculum, including the time students join the clinics. Gunderman [26] suggested that the same clinical case that helps to reinforce important anatomical and physiological principles for a 2nd-year student can also help a 4th-year student consolidate important diagnostic and therapeutic principles, supporting the idea of integrated curricula with clinical practice starting from the 1st year.

Aim and Relevance

The aim of the present study is two-fold. First, to investigate whether the approaches to learning reported by 5th-year medical students change after PBL clinical practice in the cardiology clinic. This involved the exploration of differences in approaches reported (a) by students with a different study pace and, (b) by students who held or not a previous degree in a subject relevant to medicine. Second, to explore the reliability and validity of the Finnish modified version of the Approaches to Learning and Studying Inventory (ALSI). The ALSI is included in the Experiences of Teaching and Learning Questionnaire (ETLQ) (see the ETL project website at http://www.etl.tla.ed.ac.uk).

The Present Study

The current study takes place in a traditional School of Medicine which has recently stresses the need for reformation of the academic curriculum. During the first 4 preclinical years, students are taught basic science courses, for example physiology and anatomy. Teaching mainly involves auditory lectures and examinations that test a wide range of factual knowledge. Following this pre-clinical phase, in which students have no contact with patients, students come to hospital departments not having necessarily attended the relevant theoretical course to get the appropriate knowledge. The particular school curriculum does not include compulsory courses. Consequently, many students are likely to join the clinics having failed in the theoretical course, which corresponds to the particular clinic and possibly in a vast number of classes, which make them differ in their study pace.

The particular cardiology department has developed a "problem-based" curriculum in which short lectures that provide the appropriate scientific information are underlying contextualized understanding which is developed through strategic selection of patients for students to illustrate specific principles or learning frameworks, problem-presentation, hypothesis-driven physical examination and differential diagnosis, group discussions, bed side teaching following structured lectures on a particular issue (e.g., individual maneuvers). Tutors act as facilitators; they support students construct their personal understanding and develop effectively the appropriate skills. In this particular clinical setting, students take multiple choice examinations

besides case presentations and oral exams; these practices require students to use more deep learning [25].

METHODS

Participants

In the academic year of 2013, we invited all students in year 5th enrolled in practice in the cardiology clinic to participate in the study. Six cohort of students, 109 students (95% of response), took part in the study aged from 23 to 28. Students completed the questionnaires in the 1st day they joined the clinic and also in the last day (after a 3 weeks practice).

Instrument

Approaches to learning

The instrument used in the present study to measure approaches to learning is the Finnish version of the ALSI included in the ETLQ (see the ETL project website at http://www.etl.tla.ed.ac.uk) [27] developed to explore approaches to learning in a particular course unit [28,29] (Parpala Personal Communication, 30 June 2013). The psychometric properties of the questionnaire have been reported as appropriate; [29] the factor structure and the reliability coefficients have remained similarly high over the years [29]. The original questionnaire included in the ETLQ consisted of 18 items and the shortened adjusted version used in the present study consists of 16 items that correspond to the deep approach (8 items), organized studying (4 items) and surface approach (4 items).

Study pace

The study pace, appropriate and delayed, concerns the number of classes students have failed so far. Those students who have failed in more than eight classes by the 5th year of their studies have been categorized as possibly delayed students. This number of classes exceeds the mean rate of failure (about two classes/year), in the particular school.

Prior qualification/degree

Students were asked in a single question to answer whether they had got or not a previous degree and to report the particular title and subject (this degree was in a subject close to medicine).

Statistical Analysis

The present study is the first Greek study that uses the Finnish version of the ETLQ measuring approaches to learning. An exploratory factor analysis (EFA), using principal components analysis as an extraction method, with a varimax rotation was performed in order to examine the psychometric properties of the questionnaire. After the EFA that was run on the Finnish version of the approaches to learning inventory, we explored the coherence of learning profiles of the six groups (concerning the approaches to learning), using one-way ANOVA analysis. Paired samples *t*-test was used to explore significant differences between the average values measurement (approaches to learning) carried out under two different conditions (before and after the clinical practice). Paired samples *t*-test was also used to identify differences in approaches to learning before and after the clinical practice reported by students who (a) were late in the study pace (failed in more than eight classes) and those with a good study pace and, (b) study medicine as a first degree and those who have got a previous degree in a subject close to medicine.

RESULTS

Results from EFA

The EFA yielded a three factor solution, accounting of 54% of the total variance, with eigenvalues for all factors exceeding 2.4. All item loadings are acceptable to high and correspond appropriately to the deep approach (Factor 1), surface approach (Factor 2) and organized studying (Factor 3). The loadings and the factor structure coefficients are presented in Table 1.

Reliability

The internal consistency of the overall questionnaire was 0.73. The Cronbach's alpha for the three factors ranged from 0.74 to 0.82. As a result, the questionnaire was judged to be internally consistent and therefore reliable [Table 1].

Based on the EFA results, we developed three new variables (deep approach, surface approach and organized studying). One-way analysis of variance indicated that there were no statistical significant differences between the groups [Table 2]. Consequently, we treated the data as one unified sample.

Paired Samples t-test Results

Paired samples *t*-test results revealed statistically significant differences in the surface approach and organized studying before and after the clinical practice. After the clinical practice students seem to adopt a less surface approach and appear more organized in their study; there was a slight increase in the deep approach, although not significant [Table 3].

Paired samples *t*-test result indicates that the students with a late study pace (who have failed in more than eight classes so far) scored lower in the surface approach and higher in organized studying after the clinical practice comparing to their scores before the clinical practice; there was a slight increase in the deep approach, although not statistically significant [Table 4]. Interestingly, there were no statistical significant differences before and after the clinical practice for the students who reported an "appropriate" study pace (those who had failed in <8 classes so far); deep approach ($t = 0.61$, $P = 0.53$), organized studying ($t = 0.52$, $P = 0.59$), surface approach ($t = 0.64$, $P = 0.52$).

The clinical practice appears in advantage for medical students who study medicine as a first degree. Paired samples *t*-test

Table 1: Factor pattern coefficients for the three factor solution of the Finnish version of the approaches to learning inventory (adjusted from the ETLQ), using PCA. Alpha-Cronbach and split-half reliability coefficients. The order of questions does not correspond to that in the original questionnaire

No	Questions	Factor loadings			h^2
		1	2	3	
1	I try to relate new material, as I am reading it, to what I already know in that topic	0.76			0.59
2	I look at evidence carefully to reach my own conclusion about what I'm studying	0.74			0.62
3	I try to relate what I have learned in one course to what I learn in other courses	0.73			0.55
4	When reading I try to find out for myself exactly what the author means	0.72			0.55
5	When I'm writing and communicating ideas, I think over how well I got my points across	0.54			0.44
6	If I've not understood things well enough when studying, I try a different approach or a study method	0.53			0.30
7	Ideas I've come across in my academic reading set me off on long chains of thought	0.44			0.40
8	I have usually set out to understand for myself the meaning of what we have to learn instead of repeating things	0.30			0.17
9	Much of what I've learned seems no more than lots of unrelated bits and pieces in my mind		0.85		0.76
10	Topics are presented in such complicated ways I often can't see what it meant		0.82		0.69
11	I've often had trouble making sense of the things I have to remember		0.79		0.66
12	Often I have to learn over and over things that don't really make sense to me		0.70		0.49
13	On the whole, I've been systematic and organized in my studying			0.87	0.80
14	I organize my study time carefully to make the best use of it			0.81	0.68
15	I put a lot of effort into my studying			0.81	0.72
16	I carefully prioritize my time to make sure I can fit everything in			0.31	0.19
	K.M.O=0.81				
	Bartlett test of sphericity=605.26, P=0.000				
	Percentage of the total variance	20.3	18.2	15.5	
	Eigenvalues	3.2	2.9	2.4	
	Alpha-Cronbach	0.80	0.74	0.82	
	Split-half	0.71	0.81	0.81	

Factor 1: Deep approach, Factor 2: Surface approach, Factor 3: Organized studying, PCA: Principal components analysis, ETLQ: Experiences of Teaching and learning Questionnaire

Table 2: Analysis of variance of mean scores of approaches to learning reported by medical students before the clinical practice in the cardiology clinic

Before clinical practice	Mean (SD)						F	P
	Group 1	Group 2	Group 3	Group 4	Group 5	Group 6		
Deep	4.0 (0.77)	3.8 (0.83)	3.4 (0.75)	4.1 (0.53)	3.8 (0.45)	3.8 (0.66)	1.7	0.13
Organized studying	3.4 (1.29)	3.7 (0.94)	3.0 (1.24)	3.7 (0.89)	3.7 (0.83)	3.4 (1.13)	1.0	0.41
Surface	2.8 (0.66)	2.8 (0.89)	3.3 (0.85)	2.8 (0.70)	3.3 (1.07)	2.8 (0.80)	0.84	0.51

SD: Standard deviation

Table 3: Paired samples *t*-test, mean scores and SDs for the deep, organized studying and surface approach reported by medical students before and after the clinical practice

	Pre mean (SD)	Post mean (SD)	T	P
Deep approach	3.8 (0.73)	3.9 (0.57)	0.85	0.39
Organized studying	3.4 (1.08)	3.8 (1.21)	1.8	0.05
Surface approach	2.9 (0.89)	2.5 (0.91)	2.6	0.01

SD: Standard deviation

Table 4: Paired samples *t*-test, mean scores and SDs for the deep, organized studying and surface approach reported by medical students who have failed in more than eight classes so far

	Pre mean (SD)	Post mean (SD)	T	P
Deep approach	3.2 (0.74)	3.7 (0.74)	1.5	0.15
Organized study	2.7 (1.01)	3.7 (0.77)	2.0	0.065
Surface approach	3.1 (0.60)	2.2 (0.41)	3.2	0.007

SD: Standard deviation

analysis revealed that students who study medicine as a first degree were less surface and more organized in their learning, after the clinical practice comparing to their scores before the clinical practice; there was a slight increase in the deep approach although not statistically significant [Table 5]. The clinical practice was not of benefit for students who held a prior degree in a subject relevant to medicine ($P > 0.05$); there were no statistically significant differences in any of the approaches to learning before and after the clinical practice (deep approach: $t = 62$, $P = 0.56$, organized study: $t = 54$, $P = 0.62$, surface approach: $t = 0.26$, $P = 0.80$). Possibly, a degree in a subject medicine close to may have provided them with previous knowledge and learning experiences that enable them to meet effectively the demands of the clinical practice.

DISCUSSION

The study suggests that the clinical practice in a PBL cardiology department enhances students' learning, although it does not have a clear influence on the development of the deep approach. Students become more organized and less surface after the clinical practice. This was particularly the case for those students who were late in the study pace and those who studied medicine as a first degree. Although there was no statistically

Table 5: Paired samples *t*-test, mean scores and SDs for the deep, organized studying and surface approach reported by medical students who studied medicine as a first degree

	Mean (SD)		*T*	*P*
	Before the clinical practice	After the clinical practice		
Deep approach	3.8 (0.73)	3.9 (0.58)	0.97	0.33
Organized studying	3.4 (1.09)	3.8 (1.24)	2.0	0.04
Surface approach	2.9 (0.92)	2.5 (0.92)	2.5	0.01

SD: Standard deviation

significant increase in the deep approach after the clinical practice, a small increase was apparent in all of the groups of students. Overall, medical students tend to adopt a deep approach rather than a surface approach; this was particularly the case in the post-clinical practice condition comparing to the pre-clinical condition where students had only the experience of a traditional lecture-based curriculum.

The study contributes to the discussion about the merits of the implementation of the PBL in clinical practice. In line with previous studies [12] that report ambiguity about the positive effect of PBL in clinical curricula on students' learning [16-18], the present study indicates no increase in the deep approach but only fall in the scores of the surface approach after students' enrollment in a PBL clinical practice. However, we can be optimistic because our findings indicate a strong statistically significant fall in the surface approach and also some increase of the deep approach (although not significant) across the groups of students. Possibly, the later finding is due to the already high students' scores on the deep approach. Even students who are likely to have already developed appropriate ways to learn and meet academic demands [11], namely, those who had previous qualifications and those reporting good study pace, reported some increase in the deep approach after the clinical practice. Besides, the difference in students' scores on the deep and surface approach becomes larger in the post-clinical practice condition, across groups. The findings also support the suggestion that approaches to learning might change over the 6 years of a medical degree program if suitable efforts and contexts promote such changes [12,30].

In particular, the PBL clinical context seems to be of benefit for the groups of students with the less previous engagement in learning: those who have not got a previous degree and those who were late in the study pace. These students seem to "get" "closer" to meaningful learning, put more effort on learning and organize their study more effectively, improve their quality of studying and distance themselves from memorization in an environment where students develop contextualized understanding through learning by performing tasks and solving problems. This environment reflects the multiple ways in which their knowledge will be put to use in their future professional practice and possibly get students more involved in learning and studying. Organized studying (involving improvement in time management and organized effort), possibly emerges from the survival skills developed in the clinical environment [25] where students are engaged in an active process of personal cognitive construction [16] and take responsibility jointly with their tutors for optimizing their effectiveness in clinical skills acquisition. Increase in organized studying followed by less surface elements in learning is likely to improve students' study pace [31] and academic achievement [13,32].

The findings contribute to the current discussion of curriculum reform in the particular school of medicine suggesting the beneficial effect of students' engagement in PBL clinical practice. This may lead to a suggestion for clinics to be integrated in the curriculum and the clinical practice to start earlier than the 5th year, according to the relevant curricula in most Medical School in Northern Europe and also in the States. We can always tailor learning tasks to students' particular level: "The same clinical case that helps to reinforce important anatomical and physiological principles for a 2nd-year student can also help a 4th-year student consolidate important diagnostic and therapeutic principles" [26].

The statistically non-significant increase in the deep approach after a 3 week clinical practice may imply the need for a longer duration of the clinical practice. Such a suggestion is supported by the low but consistent increase in the deep approach apparent in all of the groups of students after the clinical practice; possibly the time apportioned to activities that promote deep learning may not be sufficient to make students develop a deep approach. Besides, drawing on the open discussion on the merits of the PBL and its effectiveness to stimulate students to adopt deep learning involving the poor implementation of the PBL [16], the study suggests reflection on the impact and progress of the PBL-style education in this clinic.

The good psychometric properties of the Finnish modified version of the ALSI, suggest its appropriateness for assessing approaches to learning in the clinical context as well as across different cultures and educational systems. The overall alpha coefficients were high, at a similar level to those reported by Parpala and Lindblom-Ylänne [29]. Furthermore, the exploration of the structural validity supports the three-factor solution, deep, surface and organized studying; all of the items loaded appropriately on the three factors [28,29].

Further research exploring the implementation of the PBL and particular aspects of the PBL that influence approaches to learning, involving for example, cognitive apprenticeship and learning climate in the clinic [33] and also learning activities that promote particular diagnostic reasoning processes, [34,35] may shed light on aspects of the clinical practice possibly intervening students' further move toward the deep approach. Furthermore, the psychometric characteristics of the inventory used to measure approaches to learning in the present study should be explored with larger samples of medical students to enhance the usefulness of the instrument in educational and psychological research focused on medicine.

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