

## There is much scope for explorative learning and long-term memory in active teaching process

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### ABSTRACT

**Background:** Introducing RCTM (Research-Centered Teaching Method) by the author, showed the method provokes enthusiasm and anxiety, correlated with cognition. By linking the broaden-and-build theory and emotional intelligence theory, it becomes apparent that the knowledge and use of positive emotions constitute an important skill set for effective functioning.

**Purpose:** To investigate the effects of provoked students motivations on their learning and recall was the purpose of this study.

**Methods:** Renal Physiology was actively taught to 70 medical students, instructed to answer thoughtful questions asked by the lecturer and other students in class. It was emphasized that participation in the acid-base balance session is of great importance, due to the complexity and its management. Reinforcing them by few grades and assuring them to be skillful physicians when they face such problems in future. Before the midterm exam, a questionnaire was distributed, asking to write down the topic they recall most precisely, and choosing the reasons. The final exam was held one month later.

**Results:** Acid-base balance was the mentioned topic, and teaching method was the most correlated factor among the reasons of their recollection ( $r < 0.773$ ). The grade for 'Students' Questions' was the highest among the questions categories. In the final exam the grades of acid-base balance questions were raised significantly ( $p < 0.015$ ).

**Conclusions:** The improvement of students academic achievements were possibly due to the context of reinforcing their positive emotions in class.

**Keywords:** MEDICAL STUDENTS, ACTIVE TEACHING METHOD, POSITIVE EMOTIONS, LEARNING, LONG -TERM MEMORY

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### Introduction

There is much to be done in the fields of physiology and psychology to explore the determining factors in learning and long-term memory. The conditions of perception and cognitive processing by the brain are influenced by either intra-personal aspects such as curiosity, emotions, and concentration, and environmental factors like method of teaching, and applied reinforcement. The author's previous study on comparison of *Research-Centered Teaching Method* (RCTM) and conventional lecturing (1) showed that RCTM provokes enthusiasm and anxiety, and their correlations with cognition is: Cognition = (0.27) enthusiasm - (0.15) not interested + (0.08) anxiety, and  $F = 20.59$  ( $p < 0.0001$ ).

Interestingly, long-term memory was significantly affected by positive emotions (2).

"The broaden-and-build theory (3) assumes that positive emotions are useful in several ways. They guide present behavior, by broadening one's attention and cognition, setting the stage for creative, explorative, and innovative pursuits. Moreover, positive emotions build personal and social resources to help individuals achieve better lives in the future. Like the broaden-and-build theory, emotional intelligence theory marks the intersection between two fundamental components of psychology: the cognitive and the emotional systems. By linking the two theories, it becomes apparent that the knowledge and use of positive emotions constitute an important skill set for effective personal and social functioning." (3).

## Method

The present study was designed to study the effects of student motivation on their learning and recall. Renal physiology was taught in 7 sessions by 2 different methods of active teaching (80%) and lecturing (20%). Active teaching included students' collaboration, for example teaching important contents through drawing and analyzing curves step by step, RCTM, and also students themselves answering other students' thoughtful questions.

To motivate the students for the difficult subject of acid-base balance, it was emphasized in the 1<sup>st</sup> and 5<sup>th</sup> sessions that attending the last 2 sessions' discussion about acid-base balance is of great importance. Students were also informed about the complexity and the clinical aspects of the topic, and the life threatening complications that acid-base disorders produce for patients. They were assured that by active participation, they would be qualified enough to deal with these problems.

Three weeks after the end of the course, a formal examination on renal physiology was taken from the students. The exam consisted of 70 Taxonomy types 2 and 3 questions. Taxonomy 3 questions were consisted exclusively of questions on acid-base balance. Also, acid-base questions were asked only in the form of Taxonomy 3 questions. A few minutes before this examination, a questionnaire was presented, in which the students were asked to write down the topic they recalled most precisely. The questionnaire also contained 12 statements, 7 about the reasons of their recall and 5 about the reasons of their class attendance, from which they had to choose the most applicable statement(s).

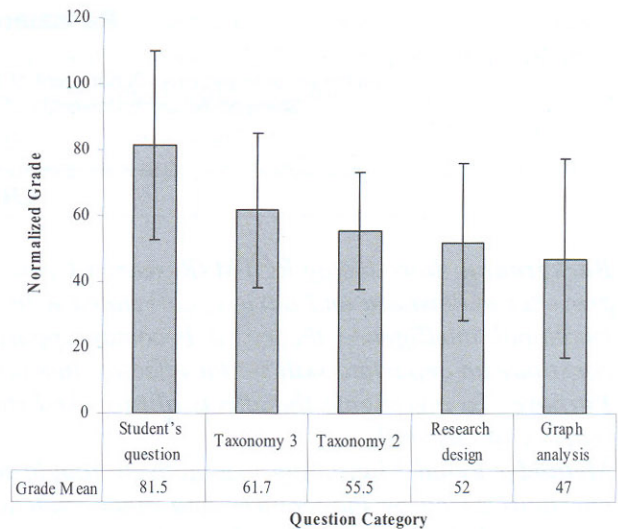
The final exam, in which renal physiology was also included, was held one month later. This second exam again contained Taxonomy types 2 and 3 questions, in which Taxonomy 3 questions were solely on acid-base balance and the questions for all other topics were designed in Taxonomy 2 format.

Statistical analyses on exam results after normalizing the grades out of 100 were carried out using Kendall's test, t-test, and paired samples test. In addition, factor analysis was performed on the 12 statements of the questionnaire.

## Results

The research population comprised of 70 medical students of Shaheed Beheshti University, 56% of

whom were girls and 44% boys. They attended the renal physiology course in the academic year 2003-2004. The students' grades for different question categories of the first examination were normalized and compared (figure 1).



**FIGURE 1.** Mean and standard deviation of normalized students' grades out of 100 for different question categories. The Kendall's test is significant with  $p < 0.0001$

The grades of different question categories were shown to have significant differences among each other using Kendall's test ( $p < 0.0001$ ). To further explore the differences, paired samples test was utilized, which showed that the grade for "Students' Questions" was significantly higher than that of Taxonomy 3 ( $p < 0.0001$ ). Also, the grade of Taxonomy 3 questions was significantly higher than that of Taxonomy 2 ( $p < 0.014$ ). The single topic of acid-base balance was the most precisely recalled issue mentioned by 51% of the students in the questionnaire. The remaining 49% of the students stated other topics from this course (table 1).

**TABLE 1.** Percent of medical students remembering the different topics taught in renal physiology course.

Topic	Percent Recalled
Acid-base balance	51
Urine concentration	11
Renal blood flow auto regulation	10
Clearance	10
The meaning of "physiology"	6
Other topics	12

Comparison between the two exams showed no difference between grades of Taxonomy 2 questions and also between total grades, but questions of Taxonomy type 3 (acid-base balance) showed a significant raise in the final exam ( $p < 0.015$ ) (table 2).

**TABLE 2.** Mean and standard deviation of normalized students' grades of different question types comparing two different exams with one month interval ( $n=70$ ). Paired t-test is significant only for Taxonomy 3 type of questions ( $p=0.029$ ).

Exam Grades	Taxonomy 3	Taxonomy 2	Total
First	62 ± 23.4	55 ± 17.9	57 ± 21.2
Second	72 ± 36.1	49 ± 23.4	55 ± 23.6

**TABLE 3.** Factor loadings of the 12 statements of the questionnaire after factor analysis. The first factor is related to best recalling the topic, and the second factor is related to student attendance. In general, the first few factors are conclusive.

Statement	Factor loading
<b>FACTOR 1:</b>	
The topic being related to medical sciences	0.773
Using examples for better understanding in the class	0.687
Preferring to learn by exploratory thinking	0.603
<b>FACTOR 2:</b>	
Attending the class as an obligatory task	0.774
Study of lecture notes	0.620
To pass exams	0.541
<b>FACTOR 3:</b>	
Prior curiosity	0.831
Being interested in class attendance	0.583
<b>FACTOR 4:</b>	
Learning in class	0.896
<b>FACTOR 5:</b>	
The topics are not easily found in textbooks	0.814
Deductive reasoning of the topics	-0.546
<b>FACTOR 6:</b>	
Studying textbooks	0.900

In order to determine the most correlated statements, factor analysis was performed on 12 statements of the questionnaire, and showed that the first factor, demonstrating the reasons of best remembering the topic, was related to teaching method and the second factor to students' class attendance reasons. The second factor showed that students had selected "attending the class as an obligatory task" as the most correlated reason for class attendance (table 3).

## Discussion

Considering the fact that in the first examination the highest grade belonged to Students' Questions category, the students seem to pay great attention to questions and discussions raised by their classmates, and this technique could therefore be utilized as an effective teaching and learning tool. Most students have expressed that they remember the topic of acid-base balance more than other topics taught during the 7 session course. This subjective expression of a better recall for the difficult topic of acid-base balance could be attributed to the positive motivation induced in them by the lecturer's motivating talks before the relevant sessions.

The higher grade in the first exam for Taxonomy type 3 questions comprised only of acid-base balance questions, relative to other topics' questions shows a better recall for this topic. This objective result, in accordance with a similar subjective expression by students, can be attributed to the positive motivation produced in students before the sessions. In addition, the significant increase in grades of acid-base (Taxonomy 3) questions in the second exam, not present for other types of questions, shows that the induced motivation have also helped towards maintaining and even studying more this difficult topic in the following month.

Factor analysis of students' responses shows that they consider the teaching method as the most effective determinant in their recalling different topics (factor 1), although they consider attending the class as an obligatory task (factor 2).

It is concluded that inducing positive emotions for the students and reinforcing their self image has a strong effect on their attitude, learning, and recall.

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