

ATTITUDE AND ACADEMIC PERFORMANCE OF MEDICAL STUDENTS IN RESEARCH-CENTERED TEACHING METHOD

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ABSTRACT

Man's instinct for exploring is the most natural way to enhance motivation and, consequently, cognition. In the research-centered teaching method, developed after many years of teaching experience, the principles mentioned in textbooks are not presented directly; instead, the lecture begins by posing an initial question about how scientists have discovered a certain principle. Students are encouraged to explore a way to reach the answer and voluntarily suggest a proposal. The lecturer refines their views from scientific, methodological and ethical aspects, guides their thoughts towards a conclusion, and introduces their proposals' related references. The session then continues with customary lecturing.

This investigation-which was carried out to evaluate the effects of the initial research-centered teaching stage in the beginning of every session-assessed the medical student's attitudes by using a questionnaire, and their knowledge by taking an examination including a test exam, research essay and class attentiveness from 1993-95. The results indicated that 84.3% of the 562 students obviously preferred the research-centered method to a customary way to lecturing. Statistical analyses were carried out on students' attitude variables in cognition, enthusiasm, anxiety, and not interested categories. It was concluded that cognition is in favour of the research-centered method which, by way of exploratory thinking is related to increased enthusiasm among the students ($p= 0.001$). Mean scores for research exam and class attentiveness were also higher in this group compared with those who chose only customary lecturing ($p<0.05$).

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INTRODUCTION

The purpose of this article is to introduce the research-centered teaching method whose main objective is to develop exploratory thinking, in order to enhance motivation.

It is acknowledged that lack of motivation is one of the current problems in education, and identifying factors that can increase motivation and practical application of them is one of the most important objectives in knowledge transmission and the learning process. The fact that problem-

based learning is a way which can either motivate or demotivate students is one of the most widely accepted merits of it. For the students to become more responsible for their own education and to learn the necessary techniques for its implementation, as an end in itself and not just as protection against examinations, it is necessary to be nurtured into this kind of independent behaviour.²

All facts have a history behind them. If the lecturer is aware of the origin of each topic and poses the original questions researchers had faced to the students, he can transfer

Research-Centered Teaching Method

his knowledge through the research-centered method, hence their exploratory thinking and reasoning would be activated.

The advantage of this teaching method is related to man's instinct for exploring. As soon as infants are born, whatever abilities they have will be used by them to explore and even control their environment. They also use their curiosity to find out the world and learn about it.¹ In later years as students, they are certainly curious about how the fact they are learning has first been discovered, but because in customary lecturing the information is usually presented to them directly, they have no questions since all the answers appear in the content of the lecture; therefore, learning is with less motivation and without concurrent thinking (reception learning). Physiology leads our attention to the fact that a major part of the brain in which analysis occurs is not possibly involved during reception learning and this important part of the brain may gradually become unavailable.

The teaching process

Many years of teaching physiology, together with an interest in research and thinking with students in class led to

the development of the research-centered teaching method. In this method,³ instead of presenting the principles which appear in textbooks, an initial question is presented to the students, asking them to think about a way for reaching the answer and suggest a proposal for it voluntarily. The aim of this method is not only to get access to the information the class has available, but also to consider the direction to reach such information, activating their exploratory thinking and reasoning in the process. During the teaching process, the student's suggestions would need scientific, methodological, and ethical guidance which is explained by the lecturer. After the lecture, students can find confirmation of their proposals in the references. This initial research-centered stage is performed for half an hour at the beginning of every session (100 minutes), the rest of which continues with customary lecturing, an inactive and teacher-centered method with which the students have been familiar for years.

An example for approaching the research-centered teaching method is presented in Fig. 1. The same fact could be taught through reception learning by the following statement: "Morphine administration activates pain suppression which

Title: Search for an endogenous mechanism for control of pain
Subtitle: Descending pain control mechanism

Lecturer: Do you think that as a strong analgesic, morphine is an inhibitor for sure?

Volunteer: Yes

Lecturer: Are you positive about it?

Volunteer: Morphine can be a stimulator of an inhibitory system.

Lecturer: Describe a model representing your idea. I will draw whatever you say.

Volunteer: Morphine can stimulate a region or nucleus that the pain inhibitory cells begin from and end on the pain pathway.

The top diagram shows a box labeled 'Morphine' with a '+' sign, connected by an arrow to another box. This second box has an arrow pointing to a box labeled 'Pain' with a '-' sign. The bottom diagram is similar, but the box is labeled 'Modulatory System'.

Starting with a simple & known question!

Creating a feeling of confidence!

Adding scientific information to students' proposals!

Encouraging for exploration!

Discussing from the ethical point of view!

Provoking self confidence!

Lecturer: Very well, how do we test this theory?

Volunteer: First we should know about the inhibitory cells and then we should study the effect of morphine on it.

Lecturer: Do you inject morphine to a patient who doesn't have severe pain?

Volunteer: No

Lecturer: Which patients do you select to prove this idea?

Volunteer: The patients whose pain inhibitory pathways are interrupted. I suppose these patients have severe pain and morphine has no effect on it.

Lecturer: Yes, this is the mechanism of central pain that you can study in the textbook...& articles...

Fig. 1. An example of the research-centered teaching method.

is organized by a modulatory system.”

The methods' specifications for the lecturer

The main points to be considered by the lecturer are as follows:

-In addition to the textbook, having knowledge about the objective of the original articles reported about the topic under discussion.

-Knowing about methodology and ethical points that are present in the articles, so that the lecturer can guide the students towards the previously published works.

-Because speaking in class can produce anxiety in students, the lecturer should show positive reactions to the volunteers and should correct mistakes calmly so that their self-confidence will be enhanced.

-By asking constructive questions from the students, they can correct their own mistakes and also other student's mistakes.

-To increase concentration, and to enable the students to become aware of the progress made in class, note taking should be encouraged.

-In the conclusion, the lecturer should introduce articles according to the students' suggestions so that by referring to them, the students believe that they can think like a researcher.

-Many facts can be understood by combining research from different specialities like basic sciences and clinical disciplines. For example, to understand the mechanism of pain in the left arm due to coronary insufficiency, one needs to look at the problem from physiological, anatomical, and clinical aspects. Therefore, the integrated method of education can also be practiced in class.

-Since the content of the lecture offered by this method is not in the textbooks, the students feel the need to be present and they are stimulated by the new material presented to them; therefore, they don't become habituated and bored.

For the student

The students' qualifications necessary to benefit from this method are as follows:

-Being able to concentrate, in order to understand the aim of the discussed questions and develop the necessary skills for exploratory thinking.

-They are free to express themselves and the discussion is continued only by the volunteers, so that hopelessness and anxiety may not possibly interfere with learning.

-To facilitate freedom of expression, the students should respect their classmates' suggestions, even though they may be wrong. There may be points in these mistakes about which further questions can be asked by the lecturer, which leads the students themselves to correct the mistakes.

-Because the objective of this method is to practice exploratory thinking, the students should not study the subject in advance.

-The students be in class on time because listening to the introduction and the primary question that is presented is essential for understanding the process of the lecture. Obviously, silence is also necessary for using this method in class.

-If they are interested, they can look up the reference articles, but the core content of the lecture is from the textbook.

METHODS

The students' enthusiasm for class attendance was the motivation to do this research so that this method could be scientifically evaluated. For the teaching and evaluation to be done naturally, teaching consisted of two stages: an initial (30 minutes) research-centered stage, continued with customary lecturing-which is the method generally used-for the rest of the session. Without the students being aware of the research, subjects of the physiology course were taught with the above method for one semester. Since exploratory thinking is the essence of this method, relying on only a few sessions for the students to gain some expertise in it was clearly not enough. Therefore, evaluation was done after 14 sessions by an official university examination, and their academic performances were obtained. A questionnaire was used to obtain the students' attitudes.

The subjects of the study consisted of all participating students with a variety of individual differences in interest, intelligence, emotion, and knowledge. Therefore, in this investigation volunteers were not selected due to the following reasons:

-the volunteer's attention and consequent learning would have been affected as a result of their awareness of the ongoing study.

-the students' enthusiasm, an important factor in the method, could not have been evaluated.

-the probable reduction in research validity due to the mentioned differences.

Objective

Determining the correlation between the research-centered method and the degree of students' emotion, enthusiasm, and academic performance.

The students' appreciation of this method was investigated by means of a descriptive-analytical research project, the participants of which were medical students of seven different physiology classes during 4 semesters, in academic years 1993-95. The number of students in these classes ranged from 13 to 173 with a total of 562 students, 35% of whom were female and 65% were male. The students' attitudes were obtained by means of a 65-item questionnaire, containing 23 items concerning their basic information and 42 statements regarding their attitudes. The latter was done by asking the students about the extent to which they agreed with certain statements. These 42 statements were divided

Research-Centered Teaching Method

from a psychological point of view, into four categories of “cognition”, “enthusiasm”, “anxiety”, and “not interested”. From now on, the term “category” refers to these.

The session to be chosen for the questionnaire distribution was selected randomly among the last five ones in a semester. The students were asked to code their questionnaire with a six digit number to avoid writing their names. These codes were noted down in front of each student’s name by their representatives who kept the lists away from the lecturer until after marking. When results of exams were announced, the lists were uncoded with the consent of the students and their representatives.

The students’ knowledge was evaluated at the end of the course based on three types of examination questions: true-false questions for topics taught by customary lecturing hereafter called text exam (80 points); essay questions related to the initial research-centered teaching stage hereafter called research essay (20 points), which showed the exploratory thinking skill of students by testing their ability to design a research towards finding a solution for a proposed problem;

and class attentiveness questions that were included in the text exam (2 points).

Statistical analysis was composed of factor analysis, correlation analysis, multiple regression analysis, Mann-Whitney test, and t-test.

RESULTS

The results showed that 84.3% of the students preferred the research-centered teaching method, and 8.4% were in favour of the customary way of lecturing they have always known; the remaining who chose a different combination of the two were excluded from the research-centered method statistical analysis.

Factor analysis, which determines the most correlated statements as separate factors, was performed for each of the 4 categories, resulting in 4, 5, 2 and 4 factors for categories “cognition”, “enthusiasm”, “anxiety”, and “not interested”, respectively (Tables I-IV).

To investigate the relationships, if any, between each two

Table I. The resulting factors from factor analysis on the students’ attitudes about “cognition”.

Factor	Statement	Factor loading
1	Thinking in this class opens the way to think about other subjects	0.750
2	Enjoying the discussion participation	0.816
3	Preferring to learn by exploratory thinking	0.808
4	Enjoying the concentration and silence of the class	0.785

Statements have been selected on the basis of their highest factor loading in each factor.

Table II. The resulting factors from factor analysis on the students’ attitudes about “enthusiasm”.

Factor	Statement	Factor loading
1	Regretting the end of the course	0.689
2	High interest to attend the class	-0.967
3	Feeling sorry to be late for the class	0.775
4	Referring to the articles after each session	0.719
5	Studying to obtain the maximum grade	0.646

Statements have been selected on the basis of their highest factor loading in each factor.

Table III. The resulting factors from factor analysis on the students’ attitudes about “anxiety”.

Factor	Statement	Factor loading
1	Feeling anxious about participation in the discussion and speaking in the class	0.746
2	Feeling anxious about being ridiculed after the class	0.733

Statements have been selected on the basis of their highest factor loading in each factor.

Table IV. The resulting factors from factor analysis on the students' attitudes about "not interested".

Factor	Statement	Factor loading
1	Low interest to attend the class	0.645
2	Being satisfied about not hurrying to attend the class	0.761
3	Preferring to learn by reception learning	0.637
4	Studying to obtain the minimum pass level	0.772
5	Not attending the class because of work	0.859

Statements have been selected on the basis of their highest factor loading in each factor.

Table V. Correlations between factor scores of the first factors of four investigated categories.

	Cognition	Enthusiasm	Anxiety	Not interested
Cognition	1			
Enthusiasm	0.270 <i>p</i> = 0.000	1		
Anxiety	0.077 <i>p</i> = 0.063	0.001 <i>p</i> = 0.987	1	
Not interested	-0.150 <i>p</i> = 0.000	-0.48 <i>p</i> = 0.270	-0.040 <i>p</i> = 0.359	1

Table VI. Mean values of medical students' responses to the statement with the highest factor loading of the first factor of each category vs. the desired teaching method.

Category	Mean		<i>p</i> value
	Research-centered 91%	Customary only 9%	
Cognition	0.477	0.213	0.001
Enthusiasm	0.401	0.319	0.275
Anxiety	0.597	0.596	0.986
Not interested	0.027	0.064	0.328

Mann-Whitney test showed a similar conclusion. *n*= 521.

of the categories, factor scores for the first factors were selected and correlation and regression analysis were performed on them. The significant correlations among them were between "enthusiasm" and "cognition", and "not interested" and "cognition" (*p*<0.0001) (Table V).

Multiple regression analysis, among the first factors, was carried out in which cognition was considered as a dependent variable. The resulted equation is as follows: cognition= 0.27 enthusiasm-0.15 not interested + 0.08 anxiety (*p*<0.0001).⁴

According to the t-test, comparison of the students' responses to the statement with the highest factor loading of the first factor of each category, presented in Tables I-IV,

showed that only "cognition" among the students preferring the initial research-centered stage was significantly higher than those who preferred customary lecturing only (*p*=0.001) (Table VI).⁵

It was also shown that the mean scores concerning research exam and class attentiveness were higher among the method's supporters than among the "customary only" ones (*p*<0.05) (7.50±6.06 and 1.38±0.65 vs. 5.61±6.10 and 1.18±0.67, respectively), and there was no significant difference between them in the text exam (51.25±11.68 vs. 48.79±13.3).

The comparisons were carried out between the scores of students who had a positive response to the statement: "Feel-

Research-Centered Teaching Method

ing anxious about participation in the discussion and speaking in the class.” ($r = 0.746$) (59.7%), and that of students with other responses (40.3%) (7.40 ± 6.13 , 51.50 ± 11.79 , and 1.35 ± 0.65 vs. 7.02 ± 6.03 , 50.30 ± 12.14 , and 1.32 ± 0.65 for research essay, text exam, and class attentiveness score, respectively). The t-test did not reveal any significant difference between their exam scores in its different sections.

DISCUSSION

Much work has been done on the different factors related to motivation and curricular success. Piaget believed that motivation and acquisition of knowledge are opposite sides of the same coin.¹ On the basis of the degree with which our emotions interfere with or intensify our ability to plan or think, to get involved in training to pursue a long-term goal, solve problems and the like, they define the limits of our capacity to use our innate mental abilities, and consequently determine how we lead our lives. And to the degree to which we are motivated by feelings of enthusiasm and pleasure in what we do or even by an optimal degree of anxiety, they propel us to accomplishment.⁶ The results, obtained from factor analysis, with details presented in Table VII, showed that this teaching process had a great role in the students’ cognition.

It is shown that students’ attitudes toward thinking and enjoying discussion participation had been very effective in forming the cognition category.

Considering different types of stress described by Selye,⁷ who introduced the word “eustress” for facilitative anxiety and “distress” for debilitating anxiety, it is shown that anxiety may not always have a debilitating effect on academic

performance. When highly-anxious students were examined, some of them showed a mastery in turning distress into eustress, and achieved successful results. The anxiety they had experienced had been of a facilitative quality compared to a debilitating one, and the relationship between high anxiety and high academic performance, and high-anxiety and low academic performance, has been investigated.⁸

In the present study, it was found that among the many factors related to cognition, the 3 categories of enthusiasm, anxiety, and not being interested, described 11% of cognition changes (R Square= 0.11, F= 20.594, Significance of F= 0.0001). It is notable that the relationships of enthusiasm and not interested with cognition were obtained in this study with coefficients of (+0.27) and (-0.15) respectively. In this regard, a coefficient of (+0.08) for anxiety can possibly show that it is of the facilitative type and its relationship with cognition, therefore, might be noticeable although it was not statistically significant. Specifically, the mean scores of anxious students in research essay, text exam, and class attentiveness were even slightly higher although the differences were not found to be statistically significant (7.40 ± 6.13 , 51.50 ± 11.79 , and 1.35 ± 0.65 vs. 7.02 ± 6.03 , 50.30 ± 12.14 , and 1.32 ± 0.65 , respectively).

Snyder^{9,10} believes that hope is another important factor in success and that optimistic and hopeful students not only choose higher goals, but also know how to achieve them persistently, less anxiously, and with less emotional disturbance.

In this regard, the statement “I like to do research in my professional field in the future.” ($r = 0.457$) might reflect the concept of “hope” in the students’ minds (Table VII).

Among the results of the large amount of research car-

Table VII. The statements which have formed the resulting factors from factor analysis on students’ attitude about “cognition”.

Statement	Factor loading
FACTOR 1:	
Thinking in this class opens the way to think about other subjects	0.750
I believe I can think like a researcher	0.655
A method of thinking is taught along with teaching	0.639
I have learned to think better	0.637
I have learned a good part of the lesson in class	0.410
FACTOR 2:	
I enjoy participation in the discussion	0.816
I enjoy thinking	0.800
FACTOR 3:	
I prefer the teaching method by the way of exploratory thinking	0.808
I am not satisfied with the research-centered teaching method	-0.582
I like to do research in my professional field in the future	0.457
FACTOR 4:	
I enjoy the concentration and silence of the class	0.785
I enjoy listening to others’ discussion with the lecturer	0.739

Statements have been sorted on the basis of their factor loadings in each factor.

ried out on self-efficacy, is the result of an experiment that shows subjects with induced high perceived self-efficacy exhibit little stress, whereas those with induced low perceived self-efficacy experience a high level of stress, with increased endogenous opioid activation. Therefore, a person's abilities can be deeply affected by his or her belief in those abilities.^{11,12}

A number of subjects of the present study had stated that "I believe I can think like a researcher." ($r=0.655$), "I attend the class regularly because a method of thinking is taught along with teaching." ($r=0.639$), and "I prefer the teaching method by the way of exploratory thinking." ($r=0.808$) (Table VII). "Self-efficacy" might be inferred from the above mentioned statements.

Only the degree of cognition was higher in students favouring the research-centered method relative to that of the supporters of "customary only" ($p=0.001$); the degrees of "enthusiasm" and "not interested" were not significantly different between the two groups and especially the amount of anxiety was nearly the same in both groups (Table VI), obviously because all the participants were somewhat influenced by the teaching conditions.

Comparison of the mean score of students supporting the research-centered teaching method versus "customary lecturing only" (7.50 ± 6.06 vs. 5.61 ± 6.10 , and 1.38 ± 0.65 vs. 1.18 ± 0.67 , for research essay and class attentiveness score, respectively) showed that those who were in favour of the method were more attentive in class and gave answers to the research questions ($p<0.05$); however, the above group's effort for learning the overall content of the course, although higher, did not show a statistically significant difference (51.25 ± 11.68 vs. 48.79 ± 13.3 for the text exam).

CONCLUSION

From the results of the present study, it can be concluded that in the initial research-centered teaching stage, cognition is of prime importance compared to the other three categories. This method provokes enthusiasm among students which can significantly trigger cognition and result in a high academic performance; the ultimate aim of every lecturer. On the other hand, students' responses to the statements show that this method might have possibly promoted facilitative anxiety "eustress", "feeling of self-efficacy", and enabled them to perceive an intellectual ability. The "hope" for gaining such an ability might have acted as a motivator influencing their academic performance.

The two scores of research exam and class attentiveness were higher in supporters of the research-centered teaching method, compared to the other group who favoured only customary lecturing.

The delicate cooperation of the two brain hemispheres will not be benefited from if the educational system chooses only to use reception learning. In this situation, too much

stress is put on the logical thoughts of the left hemisphere to an extent that one may stop providing any input to the right hemisphere. Not using this part of the brain would not allow the creative and analytical hemisphere to be involved in the thinking process; this is because the established patterns are considered to be adequate.¹³

It can be stated that the research-centered teaching method, by its very nature, will have left and right hemispheres operate for both the teacher and the learner. Therefore, it can be described as "teaching and learning involving both hemispheres."

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Research-Centered Teaching Method

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