

## Analyzing and Comparing the Effects of two Teaching Methods, Student-Centered Versus Teacher-Centered, on the Learning of Biostatistics at SBMU

Navideh Nasiri Oskouei<sup>1</sup>, Farah Saemian<sup>2,\*</sup>

<sup>1</sup>Biostatistics Department, Faculty of Paramedical Sciences, Shahid Beheshti University of Medical Sciences (SBMU), Tehran, Iran.

<sup>2</sup>language Department, Faculty of Paramedical Sciences, Shahid Beheshti University of Medical Sciences (SBMU), Tehran, Iran.

\* Corresponding author: Email address: saemianf@yahoo.com (Farah Saemian)

### ABSTRACT

Because of its widespread needs in different scientific fields, Statistics and Probability theory have gained great importance and medical students as well as students of other medically related disciplines including nursing need to use them especially in their research projects in undergraduate, graduate and postgraduate schools. This article deals with the question of finding the most effective way of teaching the necessary statistical skills to these students so that they can acquire more statistical knowledge and develop better problem solving and decision making strategies. This semi-experimental study has been carried out to compare the effect of teacher-centered and student-centered methods on nursing students' learning of Biostatistics. The sample includes all the undergraduates of nursing School at SBMU (2006-2007). The sampling method used is convenience and includes 118 subjects. The teaching method is the dependent variable and the amount of material absorbed by the students, their age, marital status, type of housing, average of high school diploma, the grade average of the previous semester, number of family members and their prior experience are the independent variables. The grades of the students in the final exam, was taken as measure of amount of material absorbed by the students. The analysis was carried out using SPSS16 and the statistical tests used were t-test, ANOVA, and correlation test. The data revealed that the average of the students receiving student-based instruction was higher than the other students. However, no statistically significant difference was observed between the control and the experimental group in terms of the amount of teaching material learnt. The data also indicate that marital status, employment status, type of housing and prior experience all have statistically significant effect on the final grade, but none of them along with the teaching method exhibits a significant interaction with the final grade. Also the amount of material learnt by each student is almost directly correlated with his/her average of the previous semester ( $r_p=0.402$ ,  $p<0.001$ ) and inversely weakly correlated with his/her age ( $r_s=-0.220$ ,  $p=0.017$ ). Thus one can conclude that student-centered instruction is as effective as the teacher-centered instruction and other factors besides the method of instruction have a significant impact on the student's learning.

**Keywords:** Teaching method; Biostatistics; Teacher-Centered; Student-Centered

### INTRODUCTION

Failure to achieve educational purposes is one of the main educational problems in Iran. Generally the aim of education is to instruct creative, innovative and educated people, but unfortunately the aim of education, especially pre-university education, is to transfer knowledge to students' mind without giving them a chance to be creative or have a thoughtful approach to the teaching materials; consequently, the students hand the information over in tests and

immediately forget it or keep it in their minds as information which will be finally obsolete. Usually such information is of no use for learners and cannot have a significant role in the society's development [1].

The same atmosphere prevails in the universities. That is, to achieve educational goals different methods are used, but none of them is superior to the others and they are not exclusive of one another. But the best strategy, in fact, is the use of

a combination of different methods. Of course, this combination depends on different factors including the type and number of students, the teaching materials, the instructor's personality and so on [2,3]. Moreover, teaching and learning are two active processes happening simultaneously and dependent on each other [4].

From the point of investigation and application, we can't rely on a research that is not statistically based. Since statistics has a vital role in medicine, and as medical students are not good at it and mathematics, teaching it in an effective and successful manner is the aim of every instructor [5].

Lecturing is the main teaching method used in medical occupations, and helps the student to gain a lot of information but it doesn't teach them strategies such as problem-solving or change of attitude [6]. To solve This problem, researchers have proposed many innovative methods the most important of which is motivation-inducing method [6,8] in which teacher-centered method gives its way to student-centered method [7, 8, 9]. The required conditions for having student-centered classes are as follows: 1-Two or three students work on the same subject. 2-The students choose the subjects themselves. 3-They mention the source of the data, the aim and the type of the statistical analysis, the results and the conclusion. 4-They present the results in a poster or slide or on a computer. 5-The time of presentation is from 5 to 10 minutes [8].

In a study entitled "the impact of Schmidt's teaching method on motivation to study statistics (2006)", Schmidt's method, a student-centered method, was used for the experimental group (students of Health and Exercise at Exeter University) and the control group included students from another university. Both groups were taught statistics for a semester and their motivation was measured. The result of the study indicated that the teaching methods as well as sex had no effect on the learners' motivation. Moreover, no statistically significant interaction was found between the teaching method and sex. Though motivation varies during the course of time, no change was observed in the learners' motivation to study mathematics in both groups [5].

In another study in Hungary in 2006, statistics was taught to students of Agriculture in small groups. This method had many advantages: 1-It made the students active by persuading them to use the statistical rules 2-The students were forced to gain experience through statistical applications. In fact, they eagerly and correctly used the statistics rules and definitely learned more by doing and presenting the statistics than by just studying for their exams. Additionally, the passive students who just listened to the discussion learned more than before. The only disadvantage of this method was that just one student in the group was involved in doing the statistics and the others were passive learners [7].

In 2004 the results of a study entitled "Learning Statistics by Doing Statistics" showed that a team project with written or oral presentation could help the learners with better learning of statistics, writing and reading. In addition, the learners' evaluation of this method was noticeably positive [9].

In another study entitled "A comparison of Learning Preferences and Perceptions of Students for Statistics Concepts and Techniques (2004)", two groups of students with different nationalities and cultures were studied to find their preferable teaching and learning methods. One of the groups included undergraduates of Darling Downs in Australia, and the other consisted of undergraduates at Apex College in Nepal. These two groups were at the same educational levels and were taking the same course. They were just of different origins and culture. The data revealed that both groups preferred learning statistics through visual aids (i.e graphs, pictures, shapes....), but their nationality and culture had no statistically significant effect on their preferable learning strategy [10]. In another study carried out to compare the effect of student-centered versus teacher-centered method on nursing students' learning, it was not only found that both methods were equally effective but also the hypothesis that learning in small groups can be more effective than lecturing was statistically rejected [11, 12].

Mahbobeh Karimi et al (2005) performed a comparative study of lecturing and group discussion on nursing students' learning in Ahwaz,

Iran. They compared the effect of two methods on the students' learning and retention of information by teaching the course "Nursing and Pediatric Diseases". The results showed that learning in both groups improved and was found to be statistically significant. Learning through lecturing method was better than group discussion, but the amount of retention was found to be statistically significant and better in group discussion than the lecturing method. So, group discussion was found to be an effective method in activating the students and increasing their thinking and retention strategies [15].

Effective learning is mainly due to effective teaching presented with creative methods in a pleasant teaching environment. Since statistics is a young field in our country, our aim is to present it by methods which can lead to its greater application in medical science. In this study Biostatistics was taught to two randomly selected samples of students using lecturing (a teacher – centered method) and student-oriented tutorials (a student-centered method).

## **MATERIALS AND METHODS**

This is a semi-experimental research which investigates the effect of two teaching methods, student- centered versus teacher-centered method, on nursing students' learning in 2006-2007. The subjects were randomly divided into control and experimental groups receiving teacher-centered and student- centered methods respectively. The teaching methods used are as follows:

### **1-Teacher-centered method**

In this method the instructor has the main educational role and the students are passive receivers of the materials presented by the instructor. Using his/her verbal skills, the instructor gives an introduction about the teaching material and the aim of the course. Then he/she presents the main teaching material while considering all lecturing principles. Later he/she gives the obtained conclusions and the answers to the statistics problems given at the beginning of the session. Finally, the statistics problems are solved by the students and under the supervision of the teacher.

### **2-Student-centered method**

In this method, the teacher gives its way to the student who is responsible for his/her leaning and the teacher has the role of a facilitating manager who is also the source of information. At the beginning of the semester the subjects are divided into small groups of three or four students. The volunteer groups are asked to prepare a certain part of the course "Biostatistics" for the next session, but one of the students in each group is required to present the material. At the beginning of each session, and before any presentation by the student, the instructor gives a statistical problem related to the teaching item to the students to make them involved in its solution. Later the instructor talks about the items that are not probably mentioned by the students, makes a conclusion and finally solves the problem with the help of the students.

The course for both the control and the experimental group is a 1.5 credit course for two consecutive semesters. At the end of the second semester a written test of 35 multiple choice questions was given to both groups and their grade was taken as a measure of their learning. Then their grades were compared in terms of their personal characteristics.

## **RESULTS**

Out of 118 students who took the course biostatistics during the two semesters, 64 took it in the first semester and 54 in the second. 59 of them (the control group) were taught the course using the teacher-centered whereas the other 59 students were instructed using student-centered method (student-oriented tutorials). At the beginning of the semester the students were given a test to measure their knowledge in statistics, but none of them could give a correct answer to the questions.

There was no statistically significant deference between the control and the experimental groups in terms of age and their grade average in the previous semester (Age: 20.8, 21; average: 15.5 and 15.4 respectively). 91.5 % of them were females and 8.5% were males. 88.1% were single and 11.9% were married. 90.7% were full time students whereas 9.3% had a part time job. 39.8% lived with their families but 60.2% lived in a dormitory. 86.4% took the course Biostatistics for

the first time and the rest had some educational experience in it.

As the data indicate the mean and the standard deviation of the classes receiving the teacher-centered method were 13.71 and 3.25 whereas those of the student-centered classes were 14.02

and 2.75 respectively. Although the student-centered classes' mean was higher than the other groups', no statistically significant difference was observed between the two groups.

**Table1.** mean and the standard deviation of the students' final grade in two semesters

Group	Semester	Number	Mean	Standard deviation
teacher-centered method	First	29	13.10	3.24
	Second	30	14.29	3.57
	Total	59	13.71	3.25
student-centered method	First	35	13.27	2.28
	Second	24	15.12	3.06
	Total	59	14.02	2.76
total	First	64	13.19	3.59
	Second	54	14.66	3.35
	Total	118	13.86	3.00

**Table2.** mean and the standard deviation of the students' final grades in terms of sex

Group	Sex	Number	Mean	Standard deviation
teacher-centered method	female	57	13.74	3.29
	male	2	12.67	0.47
	Total	59	13.71	3.25
student-centered method	female	50	14.21	2.80
	male	9	12.96	2.37
	Total	59	14.02	2.76
total	female	107	13.96	3.07
	male	11	12.91	2.12
	Total	118	13.86	3.00

**Table 3.** mean and the standard deviation of the students' final grades in terms of marital status

Group	marital status	Number	Mean	Standard deviation
teacher-centered method	single	54	13.93	3.12
	married	5	11.33	4.01
	Total	59	13.70	3.25
student-centered method	single	50	14.22	2.82
	married	9	12.93	2.20
	Total	59	14.02	2.76
total	single	104	14.07	2.97
	married	14	12.36	2.92
	Total	118	13.86	3.00

**Table 4.** mean and the standard deviation of the students' final grades in term of their employment status

Group	Employment status	Number	Mean	Standard deviation
teacher-centered method	unemployed	58	13.83	3.12
	employed	1	6.67	-
	Total	59	13.71	3.25

<b>student-centered method</b>	unemployed	50	14.54	2.82
	employed	9	11.15	2.20
	Total	59	14.02	2.76
<b>total</b>	unemployed	108	14.16	2.87
	employed	10	10.70	3.92
	Total	118	13.86	3.00

**Table 5.** mean and the standard deviation of the students' final grades in terms of type of housing

Group	Type of housing	Number	Mean	Standard deviation
<b>teacher-centered method</b>	With family	23	12.35	3.33
	In a dorm	36	14.57	2.92
	Total	59	13.71	3.25
<b>student-centered method</b>	With family	24	13.61	2.30
	In a dorm	35	14.30	3.03
	Total	59	14.02	2.76
<b>total</b>	With family	47	13.00	2.89
	In a dorm	71	14.44	3.92
	Total	118	13.86	3.00

**Table 6.** mean and the standard deviation of the students' final grades in terms of their previous experience

Group	Taking the course for the first time	Number	Mean	Standard deviation
<b>teacher-centered method</b>	yes	54	14.01	3.33
	no	5	10.47	2.97
	Total	59	13.71	3.25
<b>student-centered method</b>	yes	49	14.47	2.61
	no	10	11.83	3.52
	Total	59	14.02	2.76
<b>total</b>	yes	103	14.23	2.89
	no	15	11.38	3.65
	Total	118	13.86	3.00

**Table 7.** the correlation between the students' final grades and the number of the family members, average of high school diploma, average of the previous semester and age

	Final grades			
	Type of coefficient	Value of correlation	<i>p</i>	Significance
<b>Number of family members</b>	Spearman's	0.05	0.61	NS
<b>average of high school diploma</b>	Pearson's	0.052	0.591	NS
<b>Average of the previous semester</b>	Pearson's	0.402	<0.001	S
<b>Age</b>	Spearman's	-0.220	0.017	S

As it can be seen in table 1, the mean and the standard deviation of the students' grades in the first and the second semester were 13.19, 2.59 and 14.66, 3.35 respectively. Using an independent t-

test a statistically significant difference was found between the two groups ( $p=0.008$ ,  $t=2.715$ ). This difference was expected since the mean of their averages in the semester before the experiment

was 15.19 for the students in the first semester and 15.80 for the students in the second. Moreover, this difference was statistically found to be significant ( $p=0.023$ ,  $t=2.311$ ) and due to the intervention variable (the students' average in the semester before the experiment) after the omission of which no statistically significant difference was found between the two groups.

Table 2 shows the mean of the females ( $n=107$ ) to be 13.96 and that of the males ( $n=11$ ) to be 12.91. In order to examine the interaction of sex and teaching method with the students' final grades, a two-way ANOVA was used but no statistically significant difference was found between sex and teaching method on one hand, and their interaction on students' final grades on the other. The data in table 3 indicate that the average of the single students' grades was 14.07 whereas that of the married ones was 12.36. In order to investigate the effect of marital status and the teaching method and their interaction with the students' final grades, a two way ANOVA was used. The marital status was found to have a statistically significant effect on the students' final grades ( $p=0.029$ ,  $F=4.88$ ) but no interaction of both marital status and teaching method was found with the final grades.

The mean of the unemployed students ( $n=108$ ) was 14.16 and that of the employed ones ( $n=10$ ) was 10.70. In order to find out the effect of both employment status and teaching method and their interaction with the students' final grades a two-way ANOVA was used. The data revealed a statistically significant effect of employment on the students' final grades ( $p=0.001$ ,  $F=12.08$ ) but employment and teaching method together had no significant effect on their final grades.

The means of the students ( $n=47$ ) living with their families and the students ( $n=71$ ) living in a dormitory were 13 and 14.44 respectively. A two-way ANOVA was used to examine the effect of type of housing and the teaching method and their interaction with the students' final grades. Of the two variables, only the type of housing had a statistically significant effect on their final grades ( $p=0.009$ ,  $F=7.33$ ), but the interaction of these two variables had no statistically significant effect on the students' final grades.

The means of the students' final grades who were taking Biostatistics for the first time ( $n=103$ ) was 14.23 whereas that of the students taking it for the second time or more ( $n=15$ ) was 11.38. To analyze the effect of the teaching method and the students' previous experience and their interaction with the students' final grades, a two way ANOVA was used and the data revealed a statistically significant effect of previous experience on the students' final grades ( $p<0.001$ ,  $F=13.67$ ), but no statistically significant interaction of the two factors with the final grades was observed.

Since the number of family members didn't follow a normal distribution, Spearman's correlation coefficient was used to find the relationship between the final grades and number of family members but no statistically significant correlation was found. Also, no statistically significant correlation was found between the final grades and the students' average in their high school diploma. On the other hand, use of the same statistical analysis showed a statistically significant almost direct correlation between the students' average in the previous semester and their final grades ( $r=0.402$ ,  $p<0.001$ ). Moreover, since the students' ages didn't follow a normal distribution, using spearman's correlation coefficient, a statistically significant inverse weakly relationship was found between the students' ages and their final grades ( $r=-0.220$ ,  $p=0.017$ ).

## **DISCUSSION**

Although the mean of student-centered classes (14.02) was higher than that of the teacher-centered classes, no statistically significant difference was found between the two groups. The results of the present study confirm the findings of the studies [5,11,12] but they don't accord with the result of the study [15] in which the degree of learning was found to be better in student-centered classes.

The data also manifested that marital status, employment status, the type of housing and students' previous experience in Biostatistics all had a statistically significant effect on students' final grades, but none of them along with the

teaching method had a significant interaction with the students final grades. On the other hand, the final grades were positively correlated with the students' averages in the previous semester ( $r=0.402$ ,  $p<0.001$ ) but they were in inverse significant correlation with the students' ages ( $r=-0.220$ ,  $p=0.017$ ).

With the regard to the data given above, we can conclude that there is no statistically significant difference between the two teaching methods in terms of students' learning and in fact, other factors including the teaching method are responsible for their effective learning. We also think that teaching Biostatistics just for two or three hours during the first academic year is a short period during which students become slightly familiar with Biostatistics and have no chance to have enough practice in doing statistical problems and learning statistical analyses.

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Moreover, students don't have to learn sophisticated mathematical calculations and formula; instead, it is quite satisfactory to teach them how to use statistical methods in their practices.

Since Biostatistics is an important course for all college students, especially graduates, postgraduates and medical students, more research has to be done to compare the degree of learning and retention of statistical information in terms of student and teacher-centered methods particularly after the first semester.

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