ORIGINAL ARTICLE

Project-Based and Case-Based Learning of Statistics in Undergraduate Nursing Students-Islamabad: A Mixed Method Study

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Author`s Contribution

[3] Conceived the topic and review the study
[1,2,4,5] Interpretation, collected the data, data analysis.

Article Info

Received: Jan 28,2017
Accepted: Mar 13, 2017

How to Cite this Manuscript

Ishtiaq M, Iqbal N, Malik N, Rubab H, Hashim M Project-Based and Case-Based Learning of Statistics in Undergraduate Nursing Students-Islamabad: A Mixed Method Study. Ann. Pak. Inst. Med. Sci. 2017; 13(1):61-67.

Funding Source: Nil
Conflict of Interest: Nil

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ABSTRACT

Objective: To assess the learning of statistics by using project based and case-based learning strategy in undergraduate nursing students-Islamabad.

Methodology: A mix method study was carried out from May 2016 to August 2016 on undergraduate nursing students in a private nursing college of Islamabad. Study participants were 85 nursing students which were exposed to project based learning and case based learning tutorial methodology in biostatistics course. Homogeneity of teaching content and lecturer was ensured in both groups. Supplementary interventions were given to both groups. Quantitative data on demographic variables was collected through short questionnaire by the researchers and student's performance data was taken from exams and assignments results sheet. Two focus group discussions were carried out. Discussion was recorded and transcribed by the researchers. Themes from the data were generated. Quantitative data was entered and analysed via SPSS Version 16.0. Ethical approval and informed consent was obtained.

Results: Mean age of BSN students was 23.60 years (±1.28) and PRN students was 28.28 years (±4.26). Mean study hours other than class per week for BSN were 4.29 with (±1.59) and PRN 4.10 (±1.30). One way ANOVA results indicated that there were significant difference in Midterm and University Examination between the results of project based (PRN) and case based (BSN) learning groups. Students who studied more than 4 hours per week at home have higher score in all evaluation criteria.

Qualitative results indicated that students thought that project based learning contributed in ownership of projects, self-directed learning, innovative and effective learning. While in case-based learning group presented that easy to learn and closely supervised by the teachers.

Conclusion: Biostatistics is a hard to learn but, if teachers make it interesting through use of variety of teaching strategies, it can be a fun in learning.

Key Words: Undergraduate, Nursing, Biostatistics, Interactive Tutorial

Introduction

The founder of modern nursing Florence Nightingale was also famous as a social statistician[1] but nurses of modern era seldom found connection between nursing and statistics. Nurses are afraid of this subject and most of the nursing students consider the statistics subject as difficult, having lot of mathematics and irrelevant to their professional career.[2] The researcher's experience of teaching this subject indicated that most of the nursing students have negative feelings and attitude about this subject. In an attempt to make nurses enable nursing

regulatory and educational institutions of Pakistan designed and implemented the three credits statistics subject in undergraduate nursing programs.[3] This subject is taught in year three of Generic BSN Program, year-two of PRN-BSN program.

Undergraduate students usually consider statistics difficult to understand and less interesting. The situation becomes worse when it comes to the nursing students. The teacher of statistics must make this subject interesting through using different strategies to ensure students' interest, learning and achievement of course objectives. Teacher must present the knowledge and information of statistics in such a way that students found it relevant, practically applicable and very important to their area of interest.[4] Research studies presented many instructional strategies effective for teaching statistics like problem-based learning[5], team based learning[6], lectures[7] and short project.[8]

To enhance students' motivation and positive attitude towards statistics, studies stressed to revised content list of statistics subject and use innovative teaching methodologies to promote statistics understanding and ultimately utilization of research findings in patient care.[9-11]One of the study[12] suggested use of multiple strategies for teaching biostatistics course to health care professionals are more effective. Another study supported this argument by stating, through use of variety of teaching method will improve students' performance, level of interest and attitude towards statistics. This will not only increase statistical literacy but also inculcate the critical thinking related to statistics and interpreting research findings.[13] Studies suggest that students learn through practice and performance on their own, knowledge should be specifics to the context of learning, they receive real-time feedback on errors.[14]

A study[8]reports enhanced student learning through the use of projects in their area of interest. Projects allow students to work in small groups[7] and enrich learning experience.[5]Data generated by students themselves in the class room helped them to learn statistics in a better way and build their interest in subject. Students were more involved in learning statistics through projects.[15] Students learn statistics only if they actually practice statistics through hands on activities or appropriate computer based software followed by discussion.[16] A study[17] of undergraduate nursing´s perceptions before and after an applied statistics course in team based learning (kind of project-based learning) and conclude that although students have reported the change as positive, the agreement about relevance of statistics in their careers was only moderate. A study on nursing students[18]advised the use of active learning strategies and real life data facilitate the knowledge and skills necessary for statistical thinking and literacy as well as an understanding for how evidence applies to practice. Another study[19] found that the students who were in a project-based course had statistically significant higher scores than those in the control group

The Results of study[20]reported that CBL has positive effect on learning and students learning through CBL score high grades as compare to control group. Another study[21] adds that the case method of teaching can provide a very natural way of helping learners to learn by using the basic human capacity to learn from cases and scenarios.

In most of the studies reviewed where CBL has been used, teachers and students regard CBL as an interesting learning strategy.[22] CBL is acknowledged for its innovation in integrating theoretical concepts and practical implication of any discipline.[23]

A study argues that authentic cases stimulate the acquisition of knowledge, skills, and attitudes in a safe learner-centered environment.[24]

Results of a study[25] presented that case study approach was found to be effective in facilitating learning. This was indicated by an increase in critical thinking skills, increased theory, practice integration and increased growth in presentation skills. Another study found that CBL was preferred by students (89%) and faculty (84%) across schools and learner levels.[26]

Evidences from the literature described the importance of both project based and case based learning among student of various discipline and level. Few studies as mentioned above highlighted their effectiveness in nursing particularly. In Pakistan studies on use of both strategies in other subjects related to medicine and nursing are available but the researchers did not found any study relevant to use of these strategies in biostatistics subject to the best of their knowledge in Pakistan. The researchers are interested to compare the effectiveness of project-based learning and case-based learning of statistics among undergraduate nursing students. The purpose of study is to assess the learning of statistics by using project based and case-based learning strategy in undergraduate nursing students-Islamabad.

Methodology

A mix-method; concurrent embedded study was carried out from May 2016 to August-2016

Undergraduate nursing students of Generic BSN year-III and Post-RN BSN year-I of the Shifa College of Nursing were study population.

The entire target population was taken in this study. There was 85 participants; 40 from Generic BSN year-III and 45 from Post-RN BSN-I.

Universal sampling technique was applied to select the sample.

Student who was not able to attend two or more than two classes was excluded from study because he/she missed some important concepts and discussions.

Interventions: Two main interventions were applied to the students of both programs which were supplemented by the couple of other interventions. These interventions

were applied on eight small groups in each program. It was ensured that each group have operationally defined active and slow learning students to ensure the homogeneity amongst the groups. This was done through feedback from previous teacher (semester-I subject teachers) and students performance in semester-I in respective year and program. Same course objective and content was covered by the same teachers. Teachers had more than three years of experience of teaching this course and had master degree in credits. Students from both programs appeared in same papers at a same time.

Intervention Group (Project-Based Learning):

Eight groups of Post-RN BSN students were randomly assigned pre-designed short project topics. Students were introduced to each topic first through power point based lecture. A questionnaire consists of both quantitative and categorical variables were designed with the help of students. Students were given task to collect the data. Students were asked to choose appropriate variables from their projects' data to apply relevant formula and test. Possible interpretation of the results was discussed by the students and later on by teachers. By this way students learned the different concepts of descriptive and inferential statistics within the scope of same project. This intervention focused on active participation from students' side and just facilitator role from teachers.

Control Group (Case-Based Learning (CBL):

Statistics to the students of Generic BSN-III were taught through lectures which were followed by case-based tutorials. CBL tutorial was designed by the teachers from required text books. After each lecture students exposed to teachers' supervised CBL tutorials in groups. Each group consisted of 5-6 students. Students gave chance to interact with each other and ask for help from teacher where needed. By the end of each CBL tutorial each group shared their answers and justify the application and interpretation of statistical concepts. After that teachers shared answer key and answer the students' questions.

Supplementary interventions:

Following supplementary interventions were applied to the students of both programs:

1. Soft and hard copy of two required reading books were shared with the students. These books were recommended by the HEC course syllabus.
2. Pre-reading material and lecture notes shared one week before the lecture
3. Lecture in both programs was itself a supplementary intervention in this study just to introduce students about the different concepts of statistics. Because student were first time exposed to this subject so they might not understand directly from planned activities

Data Collection: Demographic data of age, gender, program of study and number of hours studied biostatistics at home were collected via short questionnaire.

Students' performance data was collected from their quizzes, midterm results, mark obtained in case-based and project-based learning assignments and final term results. Midterm and final term exam paper was compiled 50% from the statistics multiple choice questions bank of college and other 50% moderated by an examiner other than the subject teachers (named as external examiner) from given contents. Multiple choice papers were checked through computer based program/software and short answering questions checked by the external examiner. External examiner was not being paid for this and was teaching same subject since two or more than two years to undergraduate nursing students so that he/she had command on subject.

Qualitative data was collected through five open ended questions. 1) What do you like most in Biostatistics Course? 2) What was the least interested in the Biostatistics Course? 3) Do you think teaching strategies used (project or case based learning) should be changed? 4) How do you find these strategies helpful in learning biostatistics? and 5) any other comments.

Data Analysis: Mean ages and mean study hours of the participants were calculated. Frequency and percentage of students in each program and gender were determined. The mean score of each group was calculated from the subject results. The One-way ANOVA was applied on all six evaluation criteria to find the difference between both groups. Chi-Square was applied on two major self-developed marks categories to find significant differences.

Researchers read the qualitative data three times and discussed the underlying themes. Themes were generated from open ended questions. Data presented by category of theme in each group.

Ethical Consideration: Proposal was presented in and approved by Institutional Review Board (IRB) of Shifa International Hospital. A consent form was filled and signed by the participants after explaining the purpose of study, potential benefit and harms. Participation in the study was on the voluntary basis and participants had full right to withdraw anytime during the study. Autonomy and confidentiality was highly ensured. Data kept in locked files both hard and soft copy.

Results

In this study data of six students were excluded because they missed more than three classes. 2 of them were from Case Based Learning group and 4 were from Project Based Learning group. Hence the response rate of this study was 92.94% (79). Finding of this study are based on analysis of 79 students.

Mean age of BSN students was 23.60 years with SD 1.28 and PRN students was 28.28 years with SD 4.26. Mean study hours other than class per week for BSN were 4.29 with SD 1.59 and PRN was 4.10 with SD 1.30. Mean study hours other than class per week were higher for female students (mean 4.56 ±1.18) as compared to male students (mean 3.72 ±1.63).

Number of female students was higher is PRN program while male was in large number in BSN program. Details of program wise gender of students presented in Figure 1

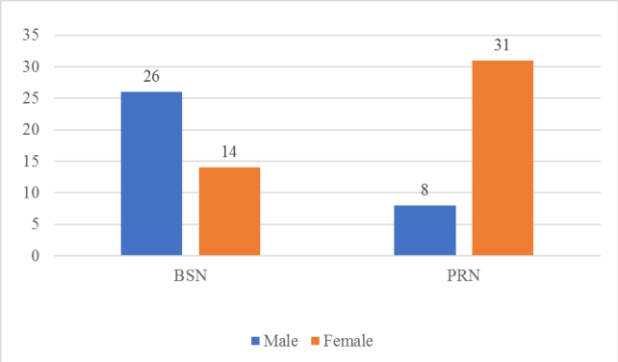

Figure 1. Frequency of program wise gender of nursing students

Numbers of study hours were categorized into two categories; equal to or less than 4 hours and more than 4 hours per week. These categories were analyzed with gender of the participants and found female students studied the biostatistics subject more than four hours per week at home as compared to male students. Frequency and percentage is given in table-1.

Table-1. Frequency (%) of gender vs hours of study other than routine classes

Gender	Hours of study other than routine classes	
	Equal and less than 4 hours	4.1 hours and above
Male	21 (61.80)	13 (38.20)
Female	18 (40)	27 (60)
Total	39	40

There were six different types of evaluation strategies were used in both groups. The results of these evaluation criteria was measured and recorded in terms of percentage of marks obtained by the each student. One way ANOVA was used to find the mean score differences among groups. Its results indicated that there were significant difference in Midterm and University Examination between the results of project based (PRN) and case based (BSN) learning groups. No difference was found in Quiz-II, Home Assignments and Final term examination in both groups. Details of the differences are presented in table-II.

Results of One-way ANOVA depicted the significant difference in all evaluation criteria with respect to study hours. Students who studied more than 4 hours per week at home have higher score in all evaluation criteria. Details of the results are presented in table-III.

Students score was categorized into two main categories 1) ≤ 70% and 2) >70%. A Chi-square was applied to find the difference between groups. It showed Pearson Chi-Square value 5.570 with df 1 and p-value 0.018. It means there is significant difference between project based and case based groups.

Table II: One Way ANOVA evaluation criteria and program of study (between groups)

Evaluation Criteria	df	Mean Square	F	p-value
Quiz-I	1	137.07	0.52	0.47
Quiz-II	1	15.45	0.07	0.79
Home Assignments	1	70.04	1.28	0.26
Midterm Exam	1	3537.27	25.54	0.00
Final Term Exam	1	30.44	0.20	0.66
University Exam	1	447.98	5.50	0.02

Table III: One-Way ANOVA number of study hours and evaluation criteria

Evaluation Criteria	df	Mean Square	F	p-value
Quiz 1	1	1771.346	7.242	0.009
Quiz 2	1	1132.319	5.620	0.020
Home Assignments	1	293.966	5.661	0.020
Midterm Exam	1	2639.250	17.577	0.000
Final Term Exam	1	1559.419	11.629	0.001
University Exam	1	1513.081	22.353	0.000

There was majority of students (38.50) in project based learning group who had less than 70% score as compared to case based groups (15.00%). Results of program of study with comparison of developed categories given in table IV

Table IV: Frequency (percentage) of program of study and score categories

Program of Study	Score Categories		Total
	Equal and above 70%	Less than 70%	
BSN (Case Based Group)	34 (85.00)	6 (15.00)	40
PRN (Project Based Group)	24 (61.50)	15 (38.50)	39
Total	58 (73.40)	21 (26.60)	79

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Qualitative Results: After listening the audio recording verbatim was written. Verbatim was read by the three researchers to check for any transcription error. Transcription errors were corrected. Themes from the

verbatim were generated by the two researchers which were later on verified by the other two researchers. There themes were also discussed with qualitative research expert to check accuracy.

Some general themes of both groups are;

Perception about Subject: Students perception about subject was changed from more negative and boring to somewhat positive and interesting. Initially student thought this is very much difficult, boring and full of long formulas and calculations but when they study this subject their perception changed.

"Now we started learning this subject with curiosity and this is going to end soon. This subject should be distributed over the year……"

Small Group: Students thought the groups were still too large it should be further divided into group of only 3 or four students. *"It is difficult to get involved all the members so we suggest group should be small."*

Value addition in learning: Students perceived some indirect benefits in learning through this subject. These benefits were;

- Learn to manage a group and group dynamics.
- Few concepts can be understandable easily from peer as compared to teachers.
- Improve interaction with teachers and group members.
- Use of technology like computer for software use and scientific calculator for calculation.

Future recommendation about strategies: Although project based group scored less marks but they strongly recommended that this strategy should remain continued with some improvement in it. Case based group suggested to add some other strategies like use of computer based tutorials etc.

The themes were categorized according to the teaching strategy or program of study. These were project based and case based learning category.

Project Based:

Interesting calculation: Most of the students found it interested because of different calculations used in this course. The students designed project on their favorite and pertinent topics which further enhances their interest in project.

"Calculations on data sets were very much interesting to do and learn"

Ownership of project: Students showed keen interest in data collection and applying all possible tests on that data set. They used to say on our data this test can be performed and this cannot be.

"We developed our own short questionnaire and collected the data. This data help us to learn theoretical concepts in a practical way……..our project data has significant results"

Innovative and Effective strategies: Group discussion revealed that students found this strategy as innovative and very much effective in learning process.

"These strategies made this boring subject interesting. We had thought what is use to this subject in nursing but after doing this short project in our own field we realized this has importance. These concepts we are applying routinely in our job like displaying patients' temperature in the form of line graph and studying its trends our different shifts"

Self-Directed Learning: It helped to motivate the students for self-directed learning. These projects were totally lead by the student under the supervision of teachers so student determined their own direction of learning.

"We used to visit teacher occasionally to just report what has been done and what we are going to do next. In our group one student, who was passive in most the group activities of other subject, became more enthusiastic and active in doing the tasks of this group activity."

Difficulties faced in project: Students were not exposed to this type of project so they found it a bit difficult. Students verbalized some difficulties faced while using this strategy which were;

- Selection of variables and appropriate test application was a hard to decide
- Data collection was difficult because of being a novice in this field
- Another major problem was in group only few students were actively participating in each step of project while other was just relying on them.

Case Based Group:

Closely supervised by the teacher: The scenarios was given by and closely supervised by the teachers. Seek immediate help from teachers.

"Do not worry teacher are here to help us. We used to ask frequently sir what to do next?"

Easy to learn the concepts: Students thought it was easy to learn difficult concepts through solving provided cases in groups.

"When we start tutorial we knew that this scenario is specific and relevant to the topic we studied today so directly apply the formulas and had results."

Challenges faced: Like early described group this group also faced some challenges while applying this strategy. Challenges were;

- Hard to find the relationship between different scenarios. They consider each scenario specific to only one concept.

"This scenario is only for t-test……. Sir, Can we have another scenario for correlation we have done t-test tutorial?"

Discussion

In this study students secured low marks in project based group as compared to case based group which is in contrast of a Brazilian study[19] which found that the students who were in a project-based course had statistically significant higher scores than those in the control group

Study revealed that students had lot of interest in the project based learning strategy. The finding of interest in this strategy in also supported by a Malaysian study[7] and study from Oman[8]

Ownership of project and deeply involving data collection and analysis of the project is reported by this study is coherent with Netherland study[15] and another study[16]of Project based strategy was applied in data collected by the students and students gain the knowledge and practiced it on real data. This finding is congruent with American study.[18]

Case based group scored high marks as compared to project based group in this study. This result in similar to the Netherland study[20] finding which found that through CBL group score high grades as compare to control group.

Students supported the use of cases for learning concepts of biostatistics was very valuable for them; this was coherent with the study from Australia.[22]

Additional benefits of these strategies were reported by the study participants. Similar kind of benefits were presented by the South African study[25] which stated that by an increase in critical thinking skills, increased theory, practice integration and increased growth in presentation skills.

Although age of the participants was consider as factor which might affect the study results but quantitative data results indicated that project based group participants had mean age 28.28 years but scored low score in different evaluation criteria as compare to case based group which had mean age 23.60 years.

Even though quantitative analysis indicated significant difference between both groups but qualitative analysis supported use of project based learning as a better strategy than case based learning.

In this study home assignment as a teaching learning strategy has been use so it might have influence on the outcome of study.

Although it was considered to expose both groups to supplementary interventions uniformly but their effects on study results cannot be ignored. There might have been any significant effects of these interventions which was not asked and analyzed in this study.

There might have been some errors in planning of project based strategies which might lead the students to achieve low score as compared to cases which were mostly taken from recommended text book. These cases was designed and reviewed by the experts in the field of statistics so they were easily understandable for students.

This study also had some limitations. Little literature cited and referred in this study were not within last five years due to its unavailability in electronics data base and manual search. Teachers were not specialized in statistics so some tutorial's implementation errors might have occurred during study. To minimize these possible errors a subject specialist was consulted on need basis. Researchers used this study approach for the first time so results might be interpreted with cautions.

It is recommended that study should be conducted while exposing both the groups with both types of strategies. Designing of projects should be either pilot tested before using it in tutorials.

Conclusion

Biostatistics is a hard to learn but if teachers make it interesting through use of variety of teaching strategies it can be a fun in learning. Use of variety of strategies to teach and learn statistics by undergraduate nursing students can enhance their learning and understanding and develop interest in the subject. Quantitative results support the case based learning as good strategies but students thought project based learning has more benefits. Both the strategies had some additional benefits parallel to learning content.

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