

PERCEPTION OF MEDICAL STUDENTS OF THEIR KNOWLEDGE ABOUT BIOSTATISTICS AND EPIDEMIOLOGY AND THE IMPACT OF PARTICIPATORY TEACHING METHODS

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ABSTRACT

Objective: Our study aimed to assess the perception of medical students about their knowledge of biostatistics and epidemiology before and after applying participatory teaching methods for teaching these topics.

Materials and methods: It was a correlational study conducted at Khyber Girls Medical College Peshawar, with a sample size of two hundred and ten. Using a simple random sampling technique, the students of fourth year M.B.B.S were taught the course Epidemiology and Biostatistics. The methodologies included a participatory teaching method, using a two-step approach. The first step aimed to make the students understand the basic concepts of Epidemiology and Biostatistics, with hands-on activity on how to use different websites to interpret the information. The second step involved database analysis with the production of a scientific report. In the end, a nine-item pre-validated questionnaire was used to check the difference of perception among the students, before and after the activities.

Results: A significant improvement in student's perception of their knowledge related to the taught subjects was found in certain areas which included the importance, usefulness, and basic concepts of Epidemiology and Biostatistics. The remaining items of the questionnaire didn't show any significant difference.

Conclusion: Participatory teaching had a strong impact on students' perception of understanding Epidemiology and Biostatistics.

Keywords: participatory teaching methods, biostatistics, Epidemiology

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INTRODUCTION

Epidemiology and Biostatistics are considered to be the pillars of medical research. Clinical reasoning and decision-making have to be justified with evidence-based research. Yet the most challenging part for the educationists and researchers is to make the undergraduate students acquire the required skills in these subjects.¹

There are two schools of thoughts related to the teaching strategies for these important topics. Some educationists think that the teaching should be focused on concepts, while others have emphasized the importance of acquiring the skills of calculations and analysis with an

in-depth understanding of the key concepts.

A few studies have shown that graduates of medical schools realize that statistics is an important subject, yet they find it very difficult rather they hardly understand the terminologies and interpretation of the statistical methods applied in various studies.² Because of the complicated nature of the subject and lack of proper training and teaching of Biostatistics, students use inappropriate methods to analyze the results. This affects the quality of the research studies that they conduct later on in their professional life. Insufficient knowledge of the subject also leads to erroneous calculation of the sample size, creating bias in the study.³

The focus of teaching biostatistics has changed from the cognitive domain to the affective and psychomotor domains. In other words, the approach to teaching these components should be multidimensional rather than involving only a single domain.⁴

Studies have shown the importance of students' attitudes toward the subject of biostatistics and how it affects their learning outcomes. Results of a meta-analysis

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showed that students at a medical school tend to show a positive attitude towards biostatistics if taught appropriately. At the same time, many studies have shown a change of attitude, and interest in research after finishing the courses. It can be inferred that the mathematical skill along with the student's attitude towards the subject affects the performance in biostatistics.⁵

Another exploratory study with focus group discussions showed that students expressed their need to learn about the subject during the early years of their degree program. According to the students, they lack confidence in the field of research and Biostatistics because of insufficient training in the respective fields.^{6,7}

Most of the students considered that the teaching strategies applied to learn the basic concepts should be small group discussions so that there is more interaction between student and teacher. Free access to full-text articles should be available along with the virtual environments. A lot of importance was given to the methodologies allowing the content into practice.⁸

With rapidly evolving teaching strategies, it has become inevitable to consider research beyond theoretical reflections. The pedagogical design should focus more on explaining the virtual methodologies. The use of technological tools and learning the methods to use them efficiently is the need of the day. The focus should not only be on the technologies, rather it should involve face-to-face activities along with virtual/distant learning techniques.⁹

Our study has focused on the teaching experience of Epidemiology and Biostatistics, which involved participatory teaching methodologies incorporating technological tools.

The objective of our study was to see the perception of medical students about their knowledge of biostatistics and epidemiology and observe the impact of participatory teaching methods for teaching these topics.

MATERIALS AND METHODS

It was a correlational study conducted at Khyber Girls Medical College Peshawar, with a sample size of two hundred and ten. Using a simple random sampling technique, the students of fourth year M.B.B.S were taught the course Epidemiology and Biostatistics. After getting ethical approval from the IREB Committee of Khyber Girls Medical College Peshawar, informed consent was taken from the students with the guarantee of anonymity.

The methodologies included a participatory teaching methodology, using a two-step approach. The first step aimed to make the students understand the basic concepts of Epidemiology and Biostatistics, with hands-on activity on how to use different websites to interpret the information. The second step involved database analysis with the production of a scientific report.

During this study, the students were asked to bring their laptops. Initially, a few introductory classes were taken by the faculty of the Community Medicine Department Khyber Girls Medical College. Then there were hands-on training sessions in which the students were divided into small groups comprising three to four students in each group. They were taught to apply different statistical analysis tests used in medical studies. The students also learned to critically interpret the results of different studies. By completing these two practical activities, the most important aspects of the course were carried out.

A nine-item pre-validated questionnaire was used to check the difference of perception among the students, before and after the activities. The questionnaire focused mainly on content related to statistics and epidemiology. The perception of the students about the course and their skills related to the knowledge application was checked by the experts. It was filled by the students voluntarily at the beginning fifteen minutes of the classes on two occasions, followed by on the day of the practical activities which was six months after the beginning of the course, and finally on the last day of this same course, about sixteen weeks later.

The questionnaire consisted of nine items with a rating scale of 1 to 4, 1 being "strongly disagree" to 4 "strongly agree". The first four items gathered information related to the usefulness and importance of the course, the rest of the five items were related to the activities of the students covering the objectives of the course. By the end of the study session, the students appeared in two class tests, comprising of the taught theoretical content and its applications with forty MCQs and five SEQs with a weightage of forty percent MCQs and sixty percent SEQs. The correlation between this theoretical exam and previously conducted practical activities was studied. Eight students were excluded from the analysis as they did not appear in the test exams.

Frequencies were expressed as absolute numbers and percentages. Mean and standard deviation was calculated for the rating scale. For comparison of scores, the Student's t-test was calculated. For independent sample analysis of variance homogeneity, the Levene test was used. To find the correlation between the results of theory exams and hands-on activities, the arithmetic means of the two written exams and the grades in practical exams were calculated. The normality of the grade distribution was checked by the Kolmogorov-Smirnov test, and Pearson correlation was performed to check the correlation analysis. P values of less than 0.05 were considered to be significant.

RESULTS

Perception results In total, out of 210 students, one hundred and ninety-five students participated vol-

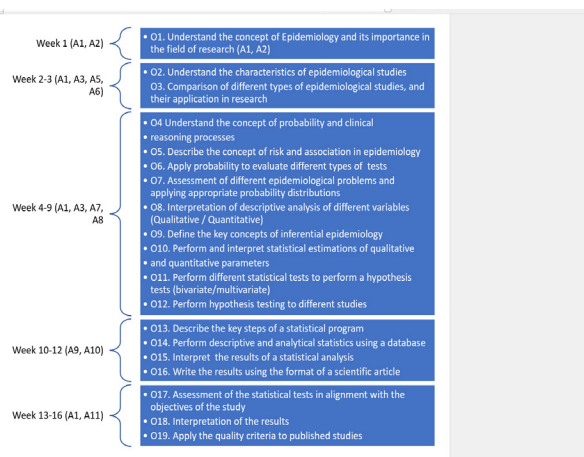


Fig 1: Multi-drug resistance of E. Coli (n= 179)

untarily. They completed the questionnaires before beginning the practical activities (response rate: 94%), and one hundred and thirty-five students did so after finishing the activities (response rate: 77.6%). The majority of the students agreed to the fact that the course conducted in the above-mentioned manner improved their knowledge, leading to a better understanding of the subject. Most of the students answered 3 and 4 which are (“agree”) and (“strongly agree”) respectively. (Table 1)

Average scores were compared as shown in table 2. Item no 1, 2 and 4 showed statistically significant results. Before and after results of students perception regarding their understanding of skills related to the course content tasks, increased significantly as shown in table 3.

Average scores of item 5 to 9 has been shown in the table no 3. The lowest score has been shown for item no 7 (average 2.33 ± 0.58 points), followed by item no 5 2.45 ± 0.57 . After carrying practical activities these two scores showed significant improvement.

Table 1: Perception of students regarding the importance and usefulness of the subject

Mention the agreement status with the following statements:	Before n=135	After n=195
Epidemiology and Biostatistics are important for Medicine as a science	n=130 96.3%	n=189 97%
I believe that the knowledge and skills I have acquired in this course are fundamental for my professional performance in Medicine	n=118 87%	n=181 92%
I understand the relationship between Epidemiology and Biostatistics	n=128 94%	n=191 97%
I understand the main concepts of Epidemiology and Biostatistics	n=120 88%	n=190 97%

Table 2: Perception of students of their task related to the course content

Read and understand scientific articles	Before n=135	After n=195
Perform a basic statistical analysis	n=112 83%	n=191 97%
Sort the data of a statistical analysis	n=100 74%	n=180 92%
Write the results of a statistical analysis	n=90 67%	n=168 86%
Interpret the results of the statistical tests	n=119 88%	n=179 92%

Table 3: comparison of mean and standard deviation values before and after the practical activities completion

Read and understand scientific articles	Before n=135	After n=195	P-value
1.Epidemiology and Biostatistics are important for Medicine as a science	2.44 ± 0.52	2.60 ± 0.55	0.03
2.I believe that the knowledge and skills I have acquired in this course are fundamental for my professional performance in Medicine	2.66± 0.51	2.81 ± 0.55	0.02
3.I understand the relationship between Epidemiology and Biostatistics	2.26 ± 0.52	2.40 ± 0.54	0.05
4.I understand the main concepts of Epidemiology and Biostatistics	2.17 ± 0.47	2.31 ± 0.50	0.02
5.Read and understand scientific articles	2.84 ± 0.52	3.01 ± 0.53	0.12
6. Perform a basic statistical analysis	3.12 ± 0.66	2.99 ± 0.52	0.002
7.Sort the data of a statistical analysis	2.78± 0.67	3.07 ± 0.58	0.01
8. Write the results of a statistical analysis	3.18 ± 0.68	3.34 ± 0.69	0.05
9. Interpret the results of the statistical tests	3.01 ± 0.62	3.11 ± 0.64	0.07

DISCUSSION

Epidemiology and statistics are the backbone of research. During the initial years of medical school, teaching these subjects is a very difficult task. Yet it is very important to acquire knowledge related to statistical skills, to understand the importance of evidence-based medicine, and to understand the quality of scientific articles.¹⁰ Exploration of learning experience related to epidemiology and biostatistics, which is a part of the M.B.B.S course was possible with the help of the above study. With the evolution of medical education from traditional to integrated systems of teaching, theoretical knowledge has been applied to real-life situations. In other words, the practical implications of real-life scenarios of clinical cases are considered more important than just theoretical knowledge. Keeping this in mind the students' perception was evaluated regarding the effects of practical activities on the skills related to the subject.¹¹

The initial hands-on activity was conceptual. A website showing simulated epidemiological content was used. The second activity mainly concentrated on the analysis of the given statistical data and calculations using the software. The aim of these two activities was to balance the aspects of concepts and calculations while teaching and learning.¹² Afterward, a questionnaire was shared to find out what the students believed they had learned during the course. Between 75 and 80% of the students thought that they were able to carry out the basic statistical test and understand a scientific article. With the introduction of the practical activities, it was observed that students showed improvement in the following areas:¹⁰

Before starting this course and introducing the participatory teaching methodology, 90% of the students believed that Epidemiology and Biostatistics are important in Medicine. 85.6% of the students thought that whatever they learn during the course, would serve them in their professional life in the future. The importance of the course is reflected by the scores. After finishing the practical activities, the scores improved significantly in the above-mentioned items.¹¹ A study conducted in New Zealand showed that more than 95% of the study participants agreed that biostatistics is an important tool to learn research. In our study the question addressing the importance of statistics without combining it with epidemiology showed lower scores, suggesting that integrating statistics with epidemiology can help in the improvement of students' perception.¹²

After thoroughly searching through multiple websites, the authors were hardly able to find any publication that was based on students' perceptions of the course. Though there was some research done on the usage of websites and some others on blended teaching methodology in medical schools.¹³ In a study conducted by Smucny and Epling, a website was used to develop di-

agnostic reasoning.¹⁴ The participants of that study, rated it better as compared to other teaching activities, with the same objective. In another study, an online six weeks' course was tested on medical students. The course was related to the subject of surgery with lectures and videos as well as other activities. This course acquired quite good results as far as the perception of the students was concerned. In another study done on medical students, two groups were formed. One group went through face-to-face teaching methodology only. In the second group, a virtual blended methodology combining online with face-to-face teaching was used. The end result was the same as far as the grades were concerned. The students securing better results preferred the blended teaching methodology. From these results, it can be concluded that this kind of methodology can be a practical and effective alternative way of teaching rather than the traditional class for teaching statistics.¹⁴

The participatory method of teaching not only improves the area of knowledge but also helps the students to improve their soft skills which ultimately leads to better learning outcomes.¹⁵ A study conducted in Switzerland, involving more than 700 students, analyzed the perception of students regarding the use of didactic websites in the taught courses. Seventy-five percent (75%) of the students responded as "agree" or "totally agree" with its usefulness for improving their understanding.¹⁶

Moreover, 87% of the students expressed a high degree of satisfaction with the use of the websites. This leads us to the conclusion that these tools can be of great help in terms of the student's learning processes.¹⁷ In another study the students of a bachelor's degree program were assessed regarding various activities in statistics. The students' perception was that they learn better when there is more collaboration and involvement among the students. Similar results were obtained from our study.¹⁸ Not only the blended methodology of teaching improved students' learning but also enhanced their teamwork quality. During this process, the presence of a facilitator is very important to resolve any issues arising during the class.¹⁷ This will have a positive impact on the cognitive skills and attitudes of the students. In Biostatistics use of computers and different software is of vital importance. However, after a thorough literature search, we were able to find one study conducted in Italy, on the use of a teaching tool the EpiInfo package. The results of the study conducted on three hundred health professionals showed that the use of EpiInfo in teaching statistics facilitates the researchers to perform the investigations more easily and leads to a better understanding of the key concept of analytical studies. The software has free access, easy to use, along with the endorsement of recognized international institutions making it more user-friendly.¹⁹

CONCLUSIONS

The medical students perceive that the knowledge related to Epidemiology and Biostatistics should be taught using

a participatory teaching methodology. After completing the practical activities, it was observed that there was a marked improvement in student's perception of their ability to perform the analysis and interpret the results.

REFERENCES

- Zhang Y, Shang L, Wang R, Zhao Q, Li C, Xu Y, et al. Attitudes toward statistics in medical postgraduates: Measuring, evaluating and monitoring. *BMC Med Educ.* 2012; 12(1). <https://doi.org/10.1186/1472-6920-12-117> PMID: 23173770
- Milic NM, Masic S, Milin-Lazovic J, Trajkovic G, Bukumiric Z, Savic M, et al. The importance of medical students' attitudes regarding cognitive competence for teaching applied statistics: Multi-site study and meta-analysis. *PLoS One.* 2016; 11(10). <https://doi.org/10.1371/journal.pone.0164439> PMID: 27764123
- Fielding S, Poobalan A, Prescott GJ, Marais D, Aucott L. Views of medical students: what, when and how do they want statistics taught? *Scott Med J.* 2015; 60(4):164±9. <https://doi.org/10.1177/0036933015608329> PMID: 26403572
- Iglesias M, Lozano I, MartõÁnez M. La utilizaciõÁn de herramientas digitales en el desarrollo del aprendizaje colaborativo: anaÁ lisis de una experiencia en educaciõÁn superior. *Rev Docencia Univ.* 2013; 11(2):333±351.
- Valencia N, Huertas A, Baracaldo P. Los ambientes virtuales de aprendizaje: una revisiõÁn de publicaciones entre 2003 y 2013, desde la perspectiva de la pedagogiõÁa basada en la evidencia. *Rev Colomb Educ.* 2014; 66:73±102.
- Epiville [Internet]. Epiville.ccnmtl.columbia.edu. 2018 [cited 16 February 2018]. <http://epiville.ccnmtl.columbia.edu/about.html>.
- CDC [Internet]. Centers for Disease Control and Prevention. 2018 [cited 16 February 2018]. <https://www.cdc.gov>
- Smucny J, Epling JW. A web-based approach to teaching students about diagnostic reasoning. *FamMed.* 2004; 36(9):622±4. PMID: 15467936
- Bernardo V, Ramos MP, Plapler H, De Figueiredo LFP, Nader HB, AncEão MS, et al. Web-based learning in undergraduate medical education: Development and assessment of an online course on experimental surgery. *Int J Med Inform.* 2004; 73(9±10):731±42. <https://doi.org/10.1016/j.ijmedinf.2004.06.002> PMID: 15325330
- Milic NM, Trajkovic GZ, Bukumiric ZM, Cirkovic A, Nikolic IM, Milin JS, et al. Improving education in medical statistics: Implementing a blended learning model in the existing curriculum. *PLoS One.* 2016; 11(2). <https://doi.org/10.1371/journal.pone.0148882>. PMID: 26859832
- Rubio Hurtado MJ, Ruiz-Bueno A, MartõÁnez-Olmo F. Students' perceptions of the usefulness of learning activities for the development of competencies. *Rev Investig Educ.* 2016; 34(1):221±40.
- Mannocci A, Bontempi C, Giraldi G, Chiaradia G, de Waure C, Sferrazza A, et al. Epilinfo as a research and teaching tool in epidemiology and statistics: strengths and weaknesses. *Ig Sanita Pubbl.* 2012; 68(1):85±96. PMID: 22507994
- Gore A, Chavan P, Kadam Y, Dhumale G. Application of biostatistics in research by teaching faculty and final-year postgraduate students in colleges of modern medicine: A cross-sectional study. *Int J Appl Basic Med Res [Internet].* 2012; 2(1):11. <https://doi.org/10.4103/2229-516X.96792> PMID: 23776801
- Weissgerber TL, Garovic VD, Milin-Lazovic JS, Winham SJ, Obradovic Z, Trzeciakowski JP, et al. Reinventing Biostatistics Education for Basic Scientists. *PLoS Biol.* 2016; 14(4). <https://doi.org/10.1371/journal.pbio.1002430> PMID: 27058055.
- Appleton DDR. What statistics should we teach medical undergraduates and graduates? *Stat Med.* 1990; 9(9):1013±21. <https://doi.org/10.1002/sim.4780090903> PMID: 2244075
- Peters TJ. Comment on Appleton DR 'What statistics should we teach medical undergraduates and graduates?'. *Stat Med.* 1990; 9:1023±27.
- Batanero C, Contreras M, Roa R. El sentido estadõÁstico y su desarrollo. *NuÁmeros.* 2013; (1991):7±18.
- Stanisavljevic D, Trajkovic G, Marinkovic J, Bukumiric Z, Cirkovic A, Milic N. Assessing attitudes towards statistics among Medical students: Psychometric properties of the Serbian Version of the survey of attitudes towards statistics (SATS). *PLoS ONE.* 2014. <https://doi.org/10.1371/journal.pone.0112567> PMID: 25405489
- Artino AR, La Rochelle JS, Durning SJ. Second-year medical students' motivational beliefs, emotions, and achievement. *Med Educ.* 2010; 44(12):1203±12. <https://doi.org/10.1111/j.1365-2923.2010.03712>. PMID: 21091760

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AUTHOR'S CONTRIBUTION

Following authors have made substantial contributions to the manuscript as under

Afridi A: Conceiving idea, Data collection, statistical analysis.

Naqvi SSQ: Literature search, writing up the article & statistical analysis.

Mahmood A : Data collection, literature search, Bibliography

Authors agree to be accountable for all aspects of the work in ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved.



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