

Original Article

Application of Pop Quiz Method in Teaching Biostatistics to Postgraduate Midwifery Students and Its Effect on Their Statistics Anxiety, Test Anxiety and Academic Achievement: A Quasi-Experimental Study with Control GroupSoraya Moradi¹, Elham Maraghi^{2,*}, Azar Babaahmadi¹, Shima Younespour^{3,*}¹Student Research Committee, Ahvaz Jundishapur University of Medical Sciences, Ahvaz, Iran.²Department of Biostatistics and Epidemiology, Faculty of Health, Ahvaz Jundishapur University of Medical Sciences, Ahvaz, Iran.³Dentistry research Institute, Tehran University of Medical Sciences, Tehran, Iran.

ARTICLE INFO

ABSTRACT

Received 21.04.2021
Revised 20.05.2021
Accepted 01.06.2021
Published 19.06.2021

Key words:

Pop Quiz;
Biostatistics;
Statistics anxiety;
Test anxiety;
Midwifery

Introduction: Anxiety in students is a challenge of educational systems. The present study was conducted to investigate the efficiency of Pop Quiz (unannounced formative tests) in teaching biostatistics to postgraduate midwifery students and its effects on their statistics anxiety, test anxiety and statistical analysis skills.

Methods: This quasi-experimental study conducted during the first semester of the academic year of 2019-2020 in the Faculty of Nursing and Midwifery, Ahvaz Jundishapur University of Medical Sciences. The MSc midwifery students were divided into two separate classes. One of the classes was randomly selected for educational intervention (Pop Quiz). Teaching via the lecture method considered as control method. Test anxiety and statistical anxiety questionnaires were completed by the students in both groups before the educational intervention, during and at the end of semester. The final exam score considered as the statistical skills score. Data were analyzed in SPSS 22 using Fisher's exact test and GEE model.

Results: Thirty eight MSC midwifery students (12 in intervention group and 26 in comparison group) were recruited in this study. The mean and standard deviation of the exam score of students in lecture and Pop Quiz groups were respectively 14.43 ± 3.80 and 15.95 ± 2.79 ($P=0.182$). The patterns of change in test anxiety score differed significantly over time between the two teaching methods ($P = 0.003$). Although, there was a decreasing trend in mean score of statistics anxiety scores in Pop Quiz group in comparison with lecture based group, but there were not statistically significant differences.

Conclusion: Applying Pop Quiz to teaching biostatistics reduces test anxiety and statistics anxiety and increases statistical analysis skills in postgraduate midwifery students.

Introduction

In recent decades, with the needs arisen for revising conventional teaching methods, the application of active and novel methods of

teaching medical sciences has been promoted in educational systems. Test anxiety in medical universities' students is a challenge of educational systems (1). Test anxiety is

*.Correspondence : e.maraghi@gmail.com, Co-correspondence: shima.younespour@gmail.com

characterized by physical, cognitive and behavioral symptoms during preparation for examinations and its interference with preparing for and taking a test is problematic (1, 2). Previous studies suggest significant relationships between any kind of anxiety and learning (2).

Inventing educational methods and improving previous approaches constitute the goals of educational centers and institutions. Student evaluation can be therefore investigated from new perspectives. The final education step in conventional teaching, evaluation was used only to decide on promoting graduates to higher levels. As an integral part of the teaching-learning process in modern educational systems, evaluation is performed by teachers to select appropriate teaching methods and direct the learning of graduates rather than classifying them (3).

Evaluation objectives include determining the levels of capability and preparedness in students, laying plans to correct defects in previous contents and identifying student strengths and weaknesses (4). Some researchers suggest evaluation as an educational tool exerts positive effects and values of the appraised materials (5, 6). As a formative assessment in educational centers, Pop Quiz comprises short tests that are given to students without prior notice at irregular intervals during the semester and at the beginning of a class. The teacher provides students with answers immediately after these tests, which can be designed in diverse forms, including multiple-choice, short-answer, sorting, fill-in-the-blank and essay (7, 8). Studies on the role of Pop Quiz based evaluation in learning suggests its effects on identifying defects in the previous content and encouraging students to study more and prepare for the final examination (9-12).

Statistics is often known as a boring course among medical students. Given the importance of statistics and the need for medical science's students to learn it, finding appropriate and efficient teaching-learning methods is crucial. The role of biostatistics is well known as an essential tool in medical research, clinical decision making and health management (13). Anxiety in medical students usually emerges as statistics anxiety and test anxiety in the semester they are passing statistics course. Statistics anxiety appears as severe anxiety, unpleasant thoughts, mental confusion and psychological tension and arousal in the face of the concepts, issues, educational situations and assessment contexts that are related to statistics (14). Higher the anxiety over learning statistics generally yields lower scores for such students (15). Using Pop Quiz based evaluation as a simple yet scientific and efficient method in the teaching process can be considered a step forward. To the best of our knowledge, no studies have been conducted yet to promote statistical analysis skills and reduce test and statistics anxiety in postgraduate midwifery students.

The present research was aimed to investigate Pop Quiz based evaluation and compare its efficiency with that of end-of-semester evaluation in teaching biostatistics to postgraduate midwifery students.

Materials and Methods

2.1. Study design

The present study is a quasi-experimental study conducted during the first semester of the academic year of 2019-2020 in the faculty of Nursing and Midwifery of Ahvaz Jundishapur University of Medical Sciences. MSc midwifery students admitted in the fall semester of the 2019-20 academic year were recruited. One faculty member taught the same content of

statistics to both the control (lecture based teaching) and intervention groups based on the topics approved by the Iranian Ministry of Health and Medical Education. The exclusion criteria consisted of being admitted in academic years other than 2019-20, unwillingness to participate in the study and being absent from over three sessions. The control (lecture based teaching) group comprised 26 postgraduate students in Midwifery and the experimental group consisted of 12 postgraduate students in Counselling in Midwifery.

2.2. Sampling and data collection

The MSc midwifery students were divided into two separate classes by the education office of the faculty of Nursing and Midwifery. One of the classes was randomly selected by the biostatistics' teacher to serve as the intervention group (Pop Quiz). Biostatistics was taught in both groups (12 students in the lecture based teaching group and 26 students in the Pop Quiz group) by the same faculty member based on the headings approved by the Ministry of Health and Medical Education. The headings of the different branches (midwifery, midwifery's consulting) were the same. The researchers tried to maintain the respondents' confidentiality and observed all ethical considerations.

2.3. Measurements

Demographic information form included 3 items: age, marital status and employment status. Demographic information form was completed by all of participants in the beginning of the study. The test anxiety and statistical anxiety questionnaires were then completed by the students in both groups before the educational intervention, during and at the end of semester.

2.3.1. Sarason's Test Anxiety Questionnaire

Test anxiety was measured using the 25-item test anxiety scale developed by Sarason. The items were scored with Yes or No, with higher scores

denoting a higher test anxiety. A score of 25 showed severe test anxiety and zero the lack of test anxiety (16).

2.3.2. Statistics Anxiety Scale (SAS) Questionnaire

Statistics anxiety was measured using the 30-item Persian statistical anxiety scale (SAS) designed in five subscales by Rekabdar et al. in 2008. The items were scored on a five-point Likert scale including never, rarely, sometimes, often and very often. A Cronbach's alpha of 0.94 confirmed the internal consistency of this scale. The subscales entitled "anxiety over statistics application", "anxiety over analyzing and interpreting statistics", "anxiety over the statistics exam", "anxiety over the statistics tool" and "fear of statistics teacher" (17).

2.4. Designing the educational intervention

In the first session all the students in both classes complete the statistical anxiety scale, the test anxiety scale and demographic information forms, including age, the interval in year between the undergraduate and postgraduate programs, the score of statistics at the undergraduate level, marital status and employment status.

At the beginning of the fourth to the final sessions, a test was held without prior notice in the intervention group as per the material taught in the previous session. Immediately after handing in the test sheets, the students received the questions along with their correct answers. Both the groups completed the statistical anxiety scale and the test anxiety scale in the first, sixth, eighth and tenth sessions. The final examination comprising the same questions was held in both groups on the same time and place. The final test scores served as the basis for evaluating the effect of Pop Quiz on statistical analysis skills (learning) in each groups.

Written informed consent form was obtained from all participants included in the study. Ethical code: IR.AJUMS.REC.1397.737

2.5. Statistical analysis

Continuous variables are reported as range and mean \pm SD. Categorical data are expressed as number (percentage). The Shapiro-Wilk test was used to examine the normality distribution of the quantitative variables. The Fisher's exact test was used to investigate the relationships between the qualitative variables and groups. The Mann-Whitney U test was used to compare student's age between intervention and control (lecture based teaching) groups. We used Generalized estimating equation (GEE) models to examine the associations between educational intervention types (pop quiz and lecture) and

change in test and statistics anxiety scores over time of study. The level of $P < 0.05$ considered as statistical significance. The data were analyzed in SPSS 22 software.

Results

3.1. Demographic characteristics results

Thirty eight MSC midwifery students (12 in intervention group and 26 in lecture based teaching group) were recruited in this study. Baseline characteristics of the participants are summarized in Table 1. Participants' age (mean \pm SD) was 26.80 ± 4.52 years and 27.25 ± 6.01 in intervention and comparison groups, respectively. There was no significant difference in the students' characteristics in two groups.

Table 1. Students' characteristics

Characteristic	Lecture Group (n=12)	Pop Quiz Group (n=26)	P
Age; year			
Mean \pm std.Dev	27.25 ± 6.01	26.80 ± 4.52	0.873
Employment status; n (%)			0.453
Employed	2 (16.7)	8 (30.8)	
Unemployed	10 (83.3)	18 (69.2)	
Marital status; n (%)			0.734
Single	6 (50)	15 (57.7)	
Married	6 (50)	11 (42.3)	

3.2. Results for final exam scores

The mean exam score of students in lecture and Pop Quiz groups were respectively 14.43 ± 3.80 and 15.95 ± 2.79 . Although the mean exam score in Pop Quiz group was higher than lecture group, there was not statistically significant difference ($P=0.182$).

3.3. Changes in test anxiety

Mean test anxiety score decreased significantly during the study period in Pop Quiz group. The mean of test anxiety score at the first session was 8.50 ± 3.98 in intervention group. At the end of study, test anxiety score reduced to 6.16 ± 4.54 . According to the results of GEE analyses, the

patterns of change in test anxiety score differed significantly over time between the two teaching methods ($P \text{ method} \times \text{time} = 0.003$) (Table 2).

3.4. Changes in statistics anxiety

Mean score of different scopes of statistics anxiety for each group were presented in table 2. According to the results, there was a decreasing trend in mean score of anxiety in Pop Quiz group. In each session mean score of anxiety in lecture group was higher than mean score in Pop Quiz group. According to the results of GEE analyses, the patterns of change in test anxiety scores in all scopes, over time,

between the two teaching methods had no statistically significant difference (Table 2).

Discussion

Test anxiety is one of interest for those involved in medical science's teaching. Test anxiety refers to a type of restlessness before,

during and after examinations (1). In addition to this challenge, students' experience of facing the anxiety specific to some courses such as biostatistics (with a different structure) is a concern for teachers. Pop Quiz is an evaluative

Table 2. Results of statistics and test's anxiety in the two groups

Characteristic	Lecture Group (n=12)	Pop Quiz Group (n=26)	P*
Test anxiety			
Test anxiety score			0.003
Session 1	9.05 ± 4.45	8.50 ± 3.98	
Session 6	9.43 ± 4.17	7.58 ± 3.70	
Session 8	9.90 ± 4.73	6.33 ± 6.03	
Session 10	10.95 ± 4.38	6.16 ± 4.54	
Statistics' Anxiety			
Anxiety of statistics application			0.848
Session 1	15.36±5.77	12.27±5.96	
Session 6	14.15±4.35	11.90±3.91	
Session 8	16.00±5.40	11.16±4.89	
Session 10	13.61±5.93	10.50±4.45	
Anxiety of statistical analysis and interpretation			0.269
Session 1	19.10±5.70	18.27±6.13	
Session 6	19.10±5.70	18.20±6.11	
Session 8	22.75±6.76	17.00±6.87	
Session 10	20.80±7.11	16.10±7.27	
Statistics test's anxiety			0.235
Session 1	18.77±6.06	12.00±6.32	
Session 6	14.10±5.21	12.09±5.18	
Session 8	17.12±4.22	11.75±5.69	
Session 10	17.04±6.26	11.20±4.44	
Statistics tool's anxiety			0.606
Session 1	13.90±5.68	10.45±5.20	
Session 6	12.10±4.88	10.27±3.60	
Session 8	15.43±4.81	11.08±6.24	
Session 10	14.33±5.25	10.50±3.95	
Statistics teacher's anxiety			0.244
Session 1	10.95±4.76	8.00±3.52	
Session 6	8.80±3.57	7.30±2.49	
Session 8	9.25±3.35	8.16±4.26	
Session 10	9.95±4.82	7.00±2.49	
Total Statistics' Anxiety Score			0.469
Session 1	82.27±27.80	60.27±28.45	
Session 6	68.25±20.67	59.18±16.99	
Session 8	80.56±22.57	59.16±26.20	
Session 10	75.76±25.79	55.30±20.80	

Values presented as Mean ± std.Dev

*The Interaction of group and measurement time in the generalized estimating equations model.

method that provides feedback on learning levels during an educational program and helps to

identify strengths and weaknesses in learners and reduce their anxiety (18-21). The present study

was conducted to investigate the application of Pop Quiz based evaluation as a simple, scientific and efficient tool to promoting statistical analysis skills and reducing test anxiety and statistics anxiety in MSc midwifery students.

The results showed that taking tests without prior notice increases learning and the final test score as statistical analysis skills in the students. These results are consistent with the effects of Pop Quiz on the scores of Physiology and Statistics respectively reported by Mard et al. and Brown et al. (22, 23).

A reduction observed in the mean score of test anxiety in the intervention group suggested a considerable difference between the two groups. Piroozmanesh et al. achieved similar results using tests without prior notice (24). Jafaei Deloie et al. reported no statistically significant relationships between holding tests without prior notice and anxiety in students in basic medical sciences and lower anxiety levels in the experimental group (Pop Quiz) than in the controls (lecture based teaching) (1). The effectiveness of Pop Quiz in reducing test anxiety was also found in students of the University of Saskatchewan (25).

The present study found reductions in the scores of the dimensions of statistics anxiety in the experimental group, which are consistent with the reductions in the anxiety of learners participating in the teaching process as reported by Quinn, Pan and Tang (26, 27). In 2015, using a multi-dimensional teaching framework was found by McGrath et al. to cause statistically-significant reductions in statistics anxiety in the psychology students of the intervention group (28).

4.1. Limitation

This study has some limitations. No formal sample size estimation was conducted. Therefore, the study may have been

underpowered to detect differences between the interested outcomes in the two groups. There was not a similar study in all aspect to our study to compare our results more concisely. This study is a quasi-experimental study that limits the inference about the effect of the intervention.

Conclusions

Applying Pop Quiz in teaching biostatistics reduces test and statistics anxiety and increases statistical analysis skills in MSc midwifery students.

Author Contributions:

E.M and S.Y were responsible for study design. A.B and S.M performed data collection. E.M performed data analysis. All authors provided critical feedback and helped shape the research, and manuscript.

Funding:

Ahvaz Jundishapur University of Medical Sciences. Project No:97s11.

Acknowledgments:

The researchers wish to express their gratitude to the student research committee of Ahvaz Jundishapur University of Medical Sciences and MSc midwifery students for providing the opportunity to conduct this research.

Conflicts of Interest:

None.

References

- 1.Reza Jafaei Deloie R, Karimi Monaghi H, Haghiri H. Effects of Pop quiz on Test Anxiety in Students of Basic Medical Sciences. Iranian Journal of Medical Education. 2015 Nov 10; 15:286-92.

2. Yazici K. The relationship between learning style, test anxiety and academic achievement. *Universal Journal of Educational Research*. 2017;5(1):61-71.
3. Sharifi HP. Performance Measurement in the Teaching-Learning Process. Conference on Education Reforms. Qom: Tebian Cultural and Information Institute.
4. Zarei E. Effect of descriptive evaluation on creativity and collaboration learning and academic performance of boys and girls in third grade elementary school students in Bandar Abbas. *Journal of Educational Sciences*. 2009; 5:79-92.
5. Doolittle AE. Classroom assessment: What teachers need to know. *JSTOR*;2009.
6. Popham WJ. Classroom assessment: What teachers need to know. Allyn & Bacon, A Viacom Company, 160 Gould St., Needham Heights, MA 02194; World Wide Web: <http://www.abacon.com>; 1999. (Book)
7. Kamuche FU. The effects of unannounced quizzes on student performance: further evidence. *College Teaching Methods & Styles Journal (CTMS)*. 2007 Apr 1;3(2):21-6.
8. Soleimani H, Najafi L. The noticing function of classroom pop quizzes and formative tests in the uptake of lexical items of EFL intermediate learners. *International Journal of English Linguistics*. 2012 Aug 1;2(4):73.
9. Thorne BM. Extra credit exercise: A painless pop quiz. *Teaching of Psychology*. 2000 Aug.
10. Tariq SG, Johnson AM, Thrush CR, Woods MB, Johnson VA, Clardy JA. Pop quizzes: evidence based strategy for medical students. *Journal of Medical Science Educator*. 2007;17(2).
11. Steele JE. Effect of essay-style lecture quizzes on student performance on anatomy and physiology exams. *Bioscene*. 2003;29(4):15-20.
12. Azorlosa JL, Renner CH. The Effect of Announced Quizzes on Exam Performance. *Journal of Instructional Psychology*. 2006 Dec 1;33(4).
13. Ali ZM, Shahabuddin FA, Abidin NZ, Suradi NR, Mustafa Z. Teamwork culture in improving the quality of learning basic statistics course. *Procedia-Social and Behavioral Sciences*. 2011 Jan 1;18: 326-34.
14. Paltoglou AE, Morys-Carter WL, Davies EL. From Anxiety to Confidence: Exploring the Measurement of Statistics Confidence and its Relationship with Experience, Knowledge and Competence within Psychology Undergraduate Students. *Psychology Learning & Teaching*. 2019 Jul;18(2):165-78.
15. Paechter M, Macher D, Martskvishvili K, Wimmer S, Papousek I. Mathematics anxiety and statistics anxiety. Shared but also unshared components and antagonistic contributions to performance in statistics. *Frontiers in psychology*. 2017 Jul 24;8: 1196.
16. Sarason IG. Test anxiety and the self-disclosing coping model. *Journal of Consulting and Clinical Psychology*. 1975 Apr;43(2):148.
17. Rekabdar Q, Soleimani B. Factor Structure of Statistical Anxiety Scale and its Relationship with Individual Characteristics of Students of Islamic Azad University of Abadan. *Educational Science first year Number three 2008* 124-103.103-24. (Persian]
18. Ali I, Iqbal HM. Effect of formative assessment on students' achievement in science. *World Applied Sciences Journal*. 2013;26(5):677-87.
19. Kamuche FU. Do weekly quizzes improve student performance?. *Academic Exchange Quarterly*. 2005 Sep 22;9(3):188-93.
20. Padilla-Walker LM. The impact of daily extra credit quizzes on exam performance. *Teaching of Psychology*. 2006 Oct;33(4):236-9.

21. Shirbagi N. Feedback in formative evaluation and its effects on a one sample of Iranian Primary Students' Achievement in Science. *Pedagogika*. 2007(88):99-105.
22. Brown MJ, Tallon J. The effects of pre-lecture quizzes on test anxiety and performance in a statistics course. *Education*. 2015 Mar 1;135(3):346-50.
23. Mard SA, Larki MS, Neisi N. The Effect of Regular Class Exams on the Final Scores of Body Fluids and Renal Physiology Course. *Educational Development of Judishapur*. 2014 Apr 21;5(1):59-65.
24. Piroozmanesh A, Imanipour M. The Effect of Formative Assessment on Test Anxiety of Nursing Students. *Journal of Medical Education Development*. 2018 Mar 10;10(28):18-26.
25. Lê ML. The use of anonymous pop-quizzes (APQs) as a tool to reinforce learning. *Journal of the Medical Library Association: JMLA*. 2012 Oct;100(4):316.
26. Pan W, Tang M. Examining the effectiveness of innovative instructional methods on reducing statistics anxiety for graduate students in the social sciences. *Journal of Instructional Psychology*. 2004 Jun 1;31(2).
27. Quinn A. Reducing social work students' statistics anxiety. *Academic Exchange Quarterly*. 2006 Jun 22;10(2):167-72.
28. McGrath AL, Ferns A, Greiner L, Wanamaker K, Brown S. Reducing anxiety and increasing self-efficacy within an advanced graduate psychology statistics course. *Canadian Journal for the Scholarship of Teaching and Learning*. 2015;6(1):5.