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Medical Students' Attitudes and Believes on the Roles of Probability and Statistics in Doing Scientific Research, a Case Study in Vietnam

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Abstract--The importance of scientific research has become more evident everyday among the factors that directly related to the better performance of the emerging countries in 21st centuries. For health care and medicine, scientific research has played a significant role in the development of any organizations in general and the professional development of any practitioners in particular. For these reasons, the authors of this article aims to study medical students' attitudes, believes on the roles of probability and statistics in scientific research in the curriculum issued by Thai Nguyen University of Medicine and Pharmacy (TUMP), Vietnam. The survey was carried out with support of virtual technology with 220 students who were successfully graduated and experienced with the probability and statistics subject at TUMP. Research methodology includes literature review of current curriculum, training materials and reports on the learning and teaching of probability and statistics subject at TUMP, online questionnaires implementation, in-deep interviews and various observations of educational activities and environment at Thai Nguyen University of Medicine and Pharmacy.

Keywords--attitudes, believes, medical students, scientific research, probability, statistics.

Introduction

Medical researchers have taken an important role in higher education institutions, research institutes, hospitals, industry and medical research agencies. As a science-based medical workers, it is a crucial requirement in conducting scientific researches to develop new, or improve existing, drugs, treatments or other medically-related products. However, at present, there has been not much research evidences to support the most clinical practice in healthcare, and many health professionals are unable to critically approach to the best quality researches. There is thus a need to ensure that in the future all health practitioners and health workers should be competent in doing their own scientific researches which are relevant and important to their practice. As a result, this some will have the ability to carry out research creating supporting products, serving in their area of expertise ([Astin et al., 2002](#); [Gore et al., 2012](#)).

There are a variety of statistical procedures and techniques that have been shown to be useful and widely used in medical research and practice ([Sahai, 1999](#)). Using statistics in research in medicine in particular and in biomedical sciences in general will contribute to an accurate assessment of health problems and diseases, and at the same time, it will determine the correlation, causal relationship, effects of environmental factors on the health and disease of the community. In particular, biostatistics is applied mathematics, which uses mathematics to study and analyze medical and biological problems. It is the mathematization of biology and human's health problems. This is the way they have made biostatistics universal and gradually easily approach to its nature ([Do Ham et al., 2007](#)). Biostatistics is well recognized as an essential tool in medical research, clinical decision making, and health management. It is a fact that deficient basic biostatistical knowledge adversely affects research quality ([Swift et al., 2009](#)). However, biostatistics knowledge of medical students is a worldwide problem. The majority of faculty members and graduate students do not apply biostatistics concepts in a scientific way while conducting research ([Swift et al., 2009](#)).

Few doctors are able to use the statistical knowledge and skills they learned in university ([Miles et al., 2010](#)). Anecdotal evidence suggests that aspects of research skills, including probability and statistics, are not the most common subjects in the curriculum. Many students cannot see the relevance of these subjects to their future job as a medical doctor and consequently find little motivation in learning and applying it ([Freeman et al., 2008](#)). Students can appreciate the value of such teaching to their future careers if there is any evidence of how graduate students can use probability and statistics in their scientific research. Furthermore, a greater understanding of how graduate students use probability and statistics in scientific research can be used to generate the content and the method of delivery this subject at higher education institutes.

Materials and Method

Research objectives

This article studies the attitudes, beliefs of medical graduated students on the subject of probability and statistics in scientific research. It explores how they understood the roles of probability and statistics, their confidence in application of knowledge and skills learnt at the university and their evaluation of the values of this subject in scientific research. The authors expect to provide relevant findings and recommendations for curriculum improvement at Thai Nguyen University of Medicine and Pharmacy (TUMP), Vietnam.

Timeframe and subjective

Due to Covid pandemic, the authors conducted online survey from February 2021 until December 2021 with participation of 220 students who graduated from Thai Nguyen University of Medicine and Pharmacy (TUMP), Vietnam. The interviewees have undertaken this subject during their education at TUMP, then they were asked to share their attitudes, beliefs, and application of the probability and statistics in their current practice. The reason that we selected students who had been and have been studying graduate programs as participants in this survey was that doing scientific research is a part of the graduate training program and this has been also a condition that has been required to complete the educational curriculum. In addition, they were the university graduates, so some of them have done scientific research at college or after graduation. They have had many opportunities to be exposed to scientific research and have opportunities to apply their knowledge of probability and statistics to scientific research.

Survey method

The authors have designed questionnaires to collect information from the 220 graduated students. The interviewees are persons who undertaken this subject during their education at TUMP, then they were asked to share their attitudes, beliefs, and application of the probability and statistics in their current practice. In addition, the authors also conducted interview and discussions with 5 participants to learn more about their understanding and skills of the probability and statistics at TUMP.

Data analysis and interpretation

We conducted the analysis after receiving 157 valid responses from 220 students invited to the survey (accounted for 71.36%). Version 16 of the Statistical Package for the Social Sciences (SPSS) program was used for statistical analysis. Numerical variables were reported as mean \pm standard deviation. A Chi-square test was used for assessment of the association between different categorical variables (when needed). The statistical significance was based on a p value < 0.05 .

Results and Discussion

Among one hundred and fifty-seven graduate students participated in the study, the samples included people who were specialist level II (5/157), specialist level I (89/157), master (28/157) and residency (house physician) (35/157). The percentage of male was 46.5% (62 out of 157). The mean age was 35.23 years (SD = 5.44, range = 27–46) and the mean year of university graduation was 2012 (SD = 2.914, range = 2006–2018).

Students' attitudes towards scientific research

When being asked about the level of interest in scientific research activities, 85.4% (134/157) of participants said that they have been interested and very interested in scientific research. However, only 42.7% (67/157) of participants have regularly participated in scientific research activities and/or regularly read, refer to scientific articles in their current work. There was 45.9% (72 out of 157) who had ever performed or participated in scientific research activities when they were university students. The rest was not interested in scientific research activities at that time.

Students' belief on the role of probability and statistics in scientific research

Being aware of the role of probability and statistics in scientific research, 96.1% (151/157) of the participants agreed that probability and statistics plays an important role. 42% (66/157) of participants also considered very important to their research performance. 83.4% (131/157) of the participants said that the scientific research they have been doing is related to collecting, processing and analysis the data. 38.2% (60/157) of them used their knowledge of probability and statistics in scientific research when they were at the university. They all agreed that the research activities including Identifying and effectively exploiting data sources, Designing the samples, Collecting the database, Thorough understanding of the database, Managing the database (encoding, processing raw data), Describing the database (summarizing the database using descriptive statistical quantities and presenting the database in words, tables, and graphs), Analyzing the database (deducing the results for the whole population) and Interpreting the results of the statistical analysis. Proficient in using statistical software is necessary (important) in their scientific research (Table 1), especially 49.3% (73/148) considered it very important.

Students' difficulties in application of probability and statistics into scientific research

When being asked about their confidence in collecting, processing and analysis the database (Q10), only 33.8% (53/157) of participants answered that they have been confident, the rest has been less confident and has not been confident. They had difficulty at almost all steps of the statistical process (Table 1). A chi-square test was performed to find the difference between students who graduated from college before 2012 and after 2012 but did not show any significance, and they also did not find any differences in the regard of gender.

Table 1
The necessity and difficulty of applying probability and statistics in scientific research

Activity	The necessity of probability and statistics for scientific research		Difficulty level of probability and statistics for scientific research	
	Mean (n=157)	Std. Deviation	Mean (n=157)	Std. Deviation
Identifying and effectively exploiting data sources	4.36	0.962	3.22	0.889
Designing the sample	4.36	0.994	3.24	0.850
Collecting database	4.36	0.994	3.24	0.850
Thorough understanding of statistical database	4.32	0.956	3.16	0.881
Managing database	4.33	0.957	3.20	0.882
Describing database	4.39	0.965	3.09	0.957
Analyzing database	4.42	0.968	3.22	1.002
Interpreting the results of the statistical analysis	4.42	0.968	3.11	0.961
Proficient in using of the statistical software	4.23	0.967	3.26	0.935

*Very necessary = 5; Necessary = 4; Less necessary = 3; Unnecessary = 2; Very unnecessary = 1

**Very difficult = 5; Difficult = 4; Less difficulty = 3; Not difficult = 2; Very not difficult = 1

Most of the participants thought that:

- “If I know more about Probability and statistics I would be more confident in applying it to my scientific research”(Q12, 83/157)
- “It is not enough for me to apply in my scientific studies”(Q12, 47/157)
- A few of them thought that:
- “It is useful for me to apply in my scientific studies” (Q11, 18/157)
- “It is not useful for me to apply in my scientific studies” (Q11, 5/157)

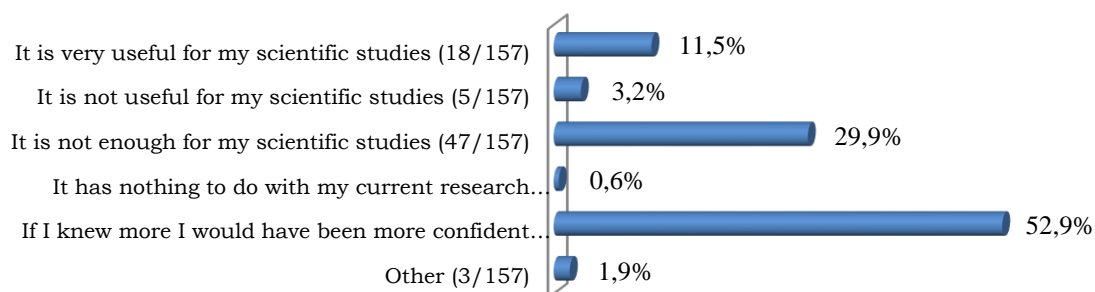


Figure 1. Assessing the usefulness of the knowledge of probability and statistics taken in the University to students' scientific research

Values of probability and statistics at the University

Regarding the attitude towards the subject of Probability and Statistics, the answers showed that most of the participants did not realize the role and usefulness of this subject at the time of studying this subject at the University. In addition to the assessment of Probability and statistics as a difficult subject, they studied this subject only for the purpose of test and examination (Figure 2)

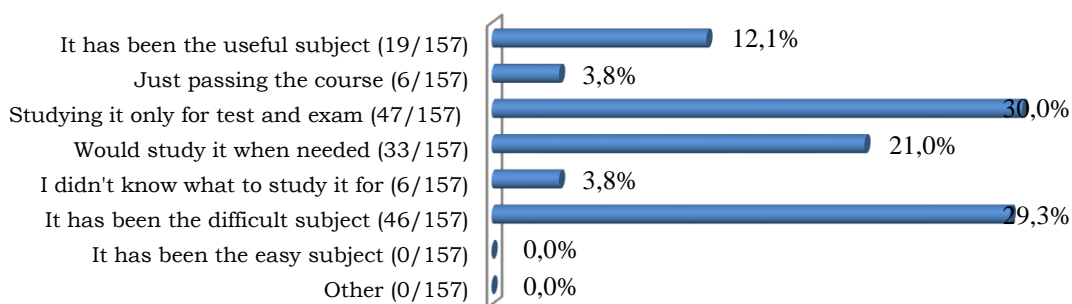


Figure 2. Attitudes of students when studying probability and statistics in the University

Table 2
Reviewing of lectures in probability and statistics (Q15)

“Mainly learning formulas and calculating available numbers” (151/157)
“Did not see the application role of probability and statistics in scientific research” (75/157)
“The application role of probability and statistics in scientific research has been clearly seen”(20/157)
“Difficult to understand, difficult to apply”(98/157)
“Easy to understand, easy to apply”(5/157)
“No practical” (150/157)
“With practical”(5/157)

Table 3
How to make probability and statistics in the University more useful (Q16)

“Lectures must be associated with industry practice” (60/157)
“Strengthening practice with real datasets”(110/157)
“Needing to add more content to the lesson”(15/157)
“Learning to calculate formulas less, interpreting the meanings of Probability and statistics more”(129/157)
“Focus on Analyzing datasets and interpreting the statistical analysis results” ((88/157)
“Using statistical software instead of manual calculations”(96/157)

Conclusion

The percentage of participants who have been interested and very interested in scientific research activities is very high (83%) and they all find the usefulness of probability and statistics for scientific research. This findings of cases at Thai Nguyen University of Medicine and Pharmacy (TUMP) are similar to other studies on the role of probability and statistics (Sahai, 1999; Ercan et al., 2008). However, the number of participants who were confident in applying probability and statistics to data collection, processing and analysis was not high. Most of them said that they do not have enough knowledge and skills to apply and “If I know more about Probability and statistics I would be more confident in applying it to my scientific research”. Similar results can be found in the study (Swift et al., 2009). They had difficulty at almost every stage of the statistical process, from the steps of planning, selecting data sources, designing samples to analyzing and interpreting the results of data analysis.

Perhaps, students have only realized the usefulness of probability and statistics in scientific research when they have had directly applied them to their research rather than studying this subject at the university because when they had been studying probability and statistics at the University, they had evaluated this as a secondary subject that only needs to be studied in the direction of tests and examinations or just need to pass the subject. In addition, although some participants had been aware of the values of the subject, they had not been expected to use it and/or would studied when it would be needed. These findings were also found in similar studies. It is also necessary to review the curriculum, teaching methodologies, and lectures on probability and statistics at the university. Most participants considered probability and statistics to be a difficult subject, mainly learning formulas, calculating available data and no practice.

Recommendations

Based on the findings of the survey, it is highly recommended to the university to review and revise both the content and the methods of delivery this subject. *Review the detailed curriculum, the syllabus of probability and statistics subject.* About the curriculum: The subject of probability and statistics has been taught to undergraduate students whose major is General Medicine at Medical University according to the Higher Education Framework program of the General Practitioner training approved by the Faculty of Medicine, Thai Nguyen University of Medicine and Pharmacy (TUMP) and followed Circular No. 01/2012/TTBGDĐT on January 13, 2012 by the Minister of Education and Training. Probability and statistics is a course belonging to the group of foundation education, is taught in a duration of 4 units with the following contents: Supplementing mathematical knowledge for probability and statistics and knowledge of probability and statistics (Table 4) (Undergraduate education program in health sciences, general medicine training, TUMP, 2012).

Table 4
TUMP's curriculum

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- (1) Probability: The content of the probability section includes two chapters:
- Chapter 1: Classical Probability.
 - Chapter 2: Distribution law of random variables.
- (2) Statistics: In statistical content, including chapters:
- Chapter 1: Theory of samples.
 - Chapter 2: Estimating statistical parameters
 - Chapter 3: Statistical Hypothesis Test
 - Chapter 4: Correlation and regression.
-

Most of the content of the curriculum is based on the practical approach to the profession, but the content compiled in the textbook is still academic and mainly focused on calculation. The advantage of the curriculum is high accuracy but easy to cause difficulties in generating motivation for students. The statistics given in lectures and textbooks sometimes contain medical content, but they are still heavily theoretical, applied in a patterned way, without exercises or practice for students to understand the meaning of the statistics. Therefore, students are not motivated to participate in learning and applying in their practice.

The exercises in the lectures and textbooks are mainly for practicing calculations such as calculating mean values, confidence intervals, comparing means, variances or ratios, etc., but have not taught students how to collect data and understanding the meaning of statistics, not paying attention to developing the ability to analyze situations as well as build statistical problems from numbers. Actual data (on websites, health pages). The findings of this study do not provide sufficient evidence to inform the development of a detailed syllabus for teaching statistics to medical undergraduates. However, from the suggestions of the participants, there are some recommendations that can make teaching Probability Statistics in the University more effective, such as:

- Lectures must follow the training profession.
- Lectures must be associated with industry practice
- Strengthening practice with real database
- It is necessary to select (reduce, add) the lesson content to suit the training profession.
- Learning to calculate formulas less, interpreting the meanings of Probability and statistics more.
- Focus on Analysing database and interpreting the statistical analysis results.
- Using statistical software instead of manual calculations.

The software will support calculations to reduce manual calculation time. So why don't we include them in the lecture. However, if for the sake of statistical software, we only teach students how to calculate using software instead of teaching manual calculation formulas, then it is a mistake. Because doing so, students will find it more difficult to visualize the parameters of statistics and not understand the nature and meaning of statistics. Therefore, we should only teach the use of software in connection with teaching the basic formulas of statistics.

This study is a reference for medical universities to have more references to review the subject of Probability and Statistics, how to make it more meaningful, in line with the educational trend that increasingly requires innovation and quality improvement in the direction of practical application and the necessity to develop students' competencies in the current situation of education.

Limitations

Due to COVID pandemic the authors were not able to conduct in deep interviews ,observations with larger sample. The authors did the interview, observation and discussion with only 5 students and conducted online survey from February 2021 until December 2021 with participation of 220 students who graduated from Thai Nguyen University of Medicine and Pharmacy (TUMP), Vietnam.

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