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TEACHING PROBABILITY AND STATISTICS IN MEDICAL UNIVERSITIES WITH A FOCUS ON DEVELOPING SCIENTIFIC RESEARCH COMPETENCE FOR STUDENTS

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THE RESEARCHER'S PUBLICATIONS
RELATED TO THE DISSERTATION TOPIC

1. Do, T. H. N., & Nguyen, H. C. (2021). Training skills in collecting, processing, and analyzing data in scientific research for medical university students through the course on Probability and Statistics. *Journal of Educational Science (Vietnam Institute of Educational Sciences)*, (38), 23-27.

2. Nga, D. T. H., Chau, N. H., & Tinh, T. T. (2022). Medical students' attitudes and beliefs on the roles of Probability and Statistics in doing scientific research: A case study in Vietnam. *International Journal of Health Sciences*, 6(S1), 334-342. https://doi.org/10.53730/ijhs.v6nS1.4774

3. Do, T. H. N., Truong, T. H. T., Nguyen, M. D., Nguyen, N. M., & Nguyen, H. M. (2022). Application of Probability and Statistics in scientific research by medical students at Thai Nguyen University of Medicine and Pharmacy. *Journal of Science and Technology (Thai Nguyen University)*, 227(9), 24-32. https://doi.org/10.34238/tnu-jst.5388

4. Do, T. H. N., Nguyen, T. T. H., Tran, T. T., Pham, V. C., & Vu, T. T. (2023). Developing a framework of research competencies for medical students in Vietnam. *European Chemical Bulletin*, 12(S1), 2923-2936. https://doi.org/10.31838/ecb/2023.12.s1-B.293

INTRODUCTION

1. Reason for choosing the reserach topic

1.1. Forming and developing scientifc research competence for students is an important task of medical universities

One of the important goals and tasks of universities, especially medical universities, is to train students with scientifc research competence (SRC). This is clearly reflected in the Higher Education Law. Specifically, the Higher Education Law stipulates the State's policy on developing higher education: *"Link training with research and the application of science and technology; strengthen cooperation between higher education institutions and scientific research organizations and enterprises."* (Point 4, Article 12, Chapter I). Additionally, the Higher Education Law outlines the general goals of higher education: *"Train learners with political and ethical qualities; with knowledge, professional practice skills, SRC, and the application of science and technology appropriate to the level of training; with health; with creativity and professional responsibility, capable of adapting to the working environment; with a sense of serving the people."* (Clause b, Point 1, Article 5, Chapter I) and clearly defines the goals of scientific and technological activities as: *"Form and develop SRC for learners; identify and nurture talents, meeting the requirements of high-level human resource training."* (Point 2, Article 39, Chapter V).

This demonstrates that higher education not only focuses on providing knowledge and professional practice skills but also highly values the SRC of learners and consistently invests in developing this competence.

In particular, for medical universities, alongside the task of training highly qualified healthcare personnel, scientific research is always emphasized and closely linked with training. This is clearly reflected in the mission and tasks of these universities.

Thus, forming and developing SRC for students is one of the important tasks of universities in general and medical universities in particular.

1.2. Scientific Research Competence of Students

In the field of medicine, developing the SRC of students plays a crucial and indispensable role. SRC helps healthcare professionals not

only grasp basic medical knowledge but also conduct medical research, evaluate results, and contribute to the development of the global medical field. This competence also helps them better understand pathologies, organize medical research, and conduct research effectively.

Many studies have shown that healthcare professionals with strong SRC are more adaptable to changes in the medical field. SRC helps them better understand pathologies, organize medical research, and evaluate research results. This leads to improved diagnosis, treatment, and management processes, as well as ensuring patient safety.

To develop SRC for students, training is important. However, in many medical universities, the study of Probability and Statistics (PS) is often separate from the practical application of medical research. The separation between theoretical knowledge and practical application can create difficulties when students try to apply statistical concepts to actual medical research.

The lack of SRC in medical training can have several consequences: Medical students may lack confidence when participating in medical research due to limited statistical knowledge and skills; a lack of SRC can hinder the improvement of diagnostic and treatment methods, affecting the quality of patient care; healthcare professionals with weak SRC may miss opportunities to contribute to the global development of medicine. The ability to innovate and make progress in medicine may be limited; medical students may feel disinterested in learning PS because they do not see its practical application in their future roles in the medical field.

1.3. Challenges and Limitations in Teaching Probability and Statistics

One major issue in teaching PS to medical students is the mismatch between the teaching content and the actual research needs. SRC is a crucial part of the professional development of healthcare professionals. However, the content of PS courses often does not fully reflect the requirements and practical applications in the medical field.

The challenges in teaching PS to medical students sometimes stem from the lack of effective teaching methods. Many courses focus on conveying theoretical knowledge with little emphasis on helping students apply this knowledge in practice. Traditional teaching

methods can cause a loss of interest and lack of confidence in students in using PS for medical research.

Another issue faced by medical students is the lack of basic knowledge in PS. Some students may not have a strong background in mathematics and statistics, leading to difficulties in understanding and applying complex concepts in this field. This can create inequalities in accessing knowledge and conducting medical research.

In summary, the current issues in teaching PS to medical students include the mismatch between teaching and research needs, the lack of effective teaching methods, and the basic knowledge gap among students. To address these issues, it is necessary to improve the curriculum and provide support to students to develop their SRC in the medical field.

Given these challenges and consequences, the research on **"Teaching Probability and Statistics in medical universities with a focus on developing scientifc research competence for students"** is an important task to address the current state of medical training and the need for SRC.

2. Research objectives

The objectives of this study are:

1) To identify the components of SRC that can be formed and developed for medical university students through PS teaching.

2) To propose measures to develop SRC for medical university students through PS teaching.

3. Research tasks

To achieve the above objectives, we need to accomplish four tasks:

1) Propose a scientifc research competences framework in the medical field and study the manifestions of some SRC components that can be formed and developed for medical university students through PS teaching.

2) Investigate the current state of PS teaching and learning; the attitudes and capabilities of medical university students in applying PS to medical research.

3) Propose measures for organizing PS teaching in medical universities to develop SRC for students.

4) Experiment with the proposed measures: Test the feasibility and effectiveness of the proposed measures.

4. Scientific hypothesis

If the constituent SRC components and appropriate measures for organizing PS teaching are identified to form and develop these SRC components for medical university students, then medical university students will effectively apply PS knowledge to solve practical medical research problems to serve humanity.

5. Research subject and object

5.1. Research subject

The PS teaching and learning process in medical universities.

5.2. Research object

SRC and measures for organizing PS teaching and learning with the orientation of forming and developing SRC for medical university students.

6. Research scope

The PS teaching and learning with the orientation of developing SRC for students in medical universities. The survey scope includes three universities: Thai Nguyen University of Medicine and Pharmacy; Thai Binh University of Medicine and Pharmacy; Hai Phong University of Medicine and Pharmacy.

7. Research methods

7.1. Theoretical research method

Study documents: Teaching theory; research theory; mathematics education; psychology; PS curriculum and textbooks; related research works (scientific studies, theses, dissertations, specialized topics, ...); domestic and international documents, books, newspapers, magazines, internet information, ... serving the research topic of the dissertation.

7.2. Non-experimental methods

7.2.1. Survey - observation method

- Investigate the awareness of lecturers and students about the importance of medical research and the role of PS in medical research.
- Investigate the current state of SRC of medical students.
- Observe some PS classes in medical universities to investigate the actual PS teaching and learning process.

7.2.2. Expert method

Consult and seek opinions from experts.

7*.2.3. Mathematical Statistics Method*

Process survey and observation results.

7.2.4. Case study method

Study some specific cases.

7.3. Experimental method

Organize pedagogical experiments with medical students to test the feasibility and effectiveness of the proposed pedagogical measures.

8. Contributions of the dissertation

8.1. Theoretical contributions

- Contribute to affirming the role of SRC in the medical field and the role of PS in medical research.
- Clarify the theoretical basis of SRC, SRC in the medical field, and the development of SRC for medical university students through PS teaching.
- Identify a scientifc research competences framework in the medical field.

8.2. Practical contributions

- Identify the constituent SRC components that can be formed and developed for medical university students through PS teaching.
- Propose some measures for organizing PS teaching to develop SRC for medical university students.

9. Theses to defend

1/ The content of scientifc research competences framework in the medical field.

2/ The feasibility and effectiveness of the pedagogical measures in PS teaching to develop SRC for medical university students in medical universities.

10. Structure of the dissertation

In addition to the introduction, conclusion, references, and appendices, the content of the dissertation includes 4 chapters:

Chapter 1. Theoretical basis

Chapter 2. Practical basis

Chapter 3. Some pedagogical measures for organizing PS teaching to develop SRC for medical university students

Chapter 4. Pedagogical experiment

Chapter 1
THEORETICAL BASIS

1.1. Overview of research related to the dissertation topic

Some works by foreign authors

We have studied over 20 research works by foreign authors related to the issue of teaching SP in the field of Medicine. These works primarily address the role of PS in Medicine, the challenges in applying PS in practice, and solutions for teaching and applying PS.

Some works by Vietnamese authors

In Vietnam, research on the application of PS in Medicine is still limited. We have collected and reviewed nearly 30 documents related to the topic. Among these, some works have discussed teaching PS in medical training institutions, such as *Teaching PS at Medical Universities* (2014) by Dao Hong Nam; *Teaching Probability and Statistics in the Orientation of Medical Application for Medical and Pharmaceutical Students* (2015) by Nguyen Thanh Tung.

Overall, these works have somewhat addressed the issue of teaching PS. Although none of these works specifically aim to develop SRC in medical students through teaching PS, they provide initial suggestions for our study. These works have guided our approach and resolution of the topic, and we have integrated these ideas in an open dialogue spirit.

1.2. General issues of scientific research in Medicine

1.2.1. Scientific research

1.2.1.1. The concept of scientific research

Scientific research is a process that uses rational scientific methods and techniques to collect and analyze data to answer questions related to scientific truths, draw scientific conclusions, solve problems, and expand human knowledge about the world.

1.2.1.2. The process of scientific research

The process of conducting a scientific research project generally follows six steps: *1/ Selecting a topic; 2/ Developing a research outline and plan; 3/ Collecting and processing data; 4/ Writing the final research report; 5/ Evaluating the project; 6/ Publishing the research results.*

1.2.1.3. Scientific research methods

Theoretical research methods

Experimental research methods

Non-experimental research methods

1.2.2. Scientific research in Medicine

Medicine is a vast and diverse field characterized by: 1/ Focus on humans; 2/ High applicability; 3/ Involvement of experts; 4/ Multidisciplinary nature; 5/ Use of scientific research methods.

All the basic research methods mentioned above are used in medical research. However, due to its specific characteristics, medical research focuses more on experimental and non-experimental research methods in addition to theoretical research. Both experimental and non-experimental research methods often use statistical methods to achieve high-quality research results.

1.3. Statistics and Probability in Medical scientific research

PS is a crucial tool in scientific research, helping to evaluate data integrity, identify differences between groups, and find relationships between variables. The use of PS ensures the reliability of results and minimizes analytical errors and erroneous conclusions.

1.3.1. Probability

Probability is not a specific step in the scientific research process, but its statistical significance is embedded in each step of the quantitative research process.

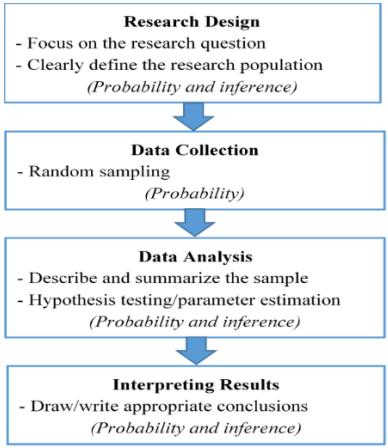

Figure 1.1. Quantitative research process

1.3.2. Statistics

The full process of statistical research:

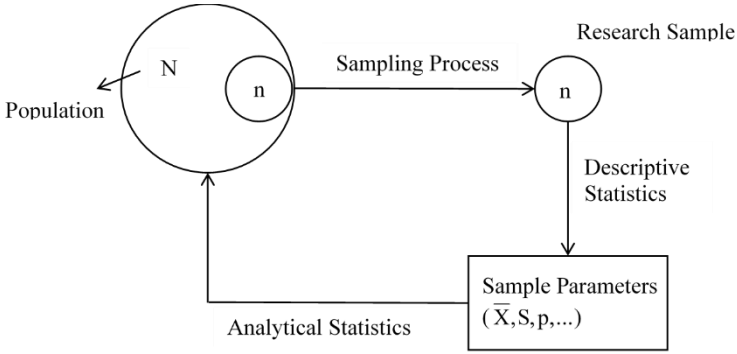

Figure 1.2. Comprehensive statistical research process

1.4. Scientific research competences framework in Medicine

1.4.1. Scientific research competence in Medicine

1.4.1.1. Competence

Competence is the ability to apply knowledge, experience, skills, attitudes, and interests to act appropriately and effectively in various life situations. Competence is formed through learning, experience, and practice. It represents the enhancement of multiple skills combined with creative thinking, adaptability to changes, and effective problem-solving.

1.4.1.2. Scientific research competence

Scientific research competence is the ability to apply existing knowledge and research results to explore new scientific subjects; select and use appropriate research methods; apply rational scientific techniques to collect, process, and analyze data; interpret results to draw scientific conclusions and propose solutions to practical problems effectively.

1.4.1.3. Scientific research competence in medicine of medical students

Scientific research competence (SRC) in Medicine is the ability to apply interdisciplinary knowledge and previous research results to explore new medical subjects to meet practical needs; select and use

appropriate medical research methods; apply rational scientific techniques to collect, process, and analyze data; interpret results to draw new scientific conclusions and propose solutions to solve practical medical problems effectively.

The SRC of medical students is the ability to apply interdisciplinary knowledge learned, previous research results to explore and solve medical issues to meet practical needs; select and use appropriate medical research methods; apply rational scientific techniques to collect, process, and analyze data; interpret results to draw scientific conclusions and propose solutions to solve practical medical problems effectively.

1.4.2. The necessity of scientific research competence

Medicine is closely related to human life. The results of medical research serve human health practically. These results need to be published by the most valuable scientific research. Therefore, doctors and healthcare professionals need the competence to understand the research processes and critically evaluate the scientific literature to support their professional practice.

1.4.3. Scientific basis for developing the scientific research competences framework in medicine

The scientific research competences framework in medicine is based on the scientific foundation of research and practical experiences in the medical field. The basic scientific foundations include: 1/ Basic competence standards for general practitioners and the output standards of medical training programs; 2/ The logical sequence of a scientific research process; 3/ Awareness of and adherence to ethical principles in research activities; 4/ The importance of disseminating and applying research results and the necessary skills for writing and publishing scientific research papers.

1.4.4. The scientific research competences framework

We propose a scientific research competences framework in medicine, consisting of six groups:

1. Competence in using appropriate scientific research methods to study medical issues

2. Competence in searching, evaluating, and using scientific literature related to medicine

3. Competence in collecting and analyzing medical data

4. Competence in drawing conclusions based on data and evaluating the reliability of research results

5. Competence in adhering to ethical principles in scientific research

6. Competence in writing scientific research reports and presenting research results.

1.5. Basic SRC components of students formed and developed through learning PS

We propose six components of scientific research competence that need to be trained and developed for students in medical universities through teaching PS:

SRC Component 1: Data collection competence

SRC Component 2: Data management and reliability evaluation competence

SRC Component 3: Data analysis presentation competence

SRC Component 4: Statistical analysis competence

SRC Component 5: Competence in using statistical software

SRC Component 6: Competence in drawing conclusions based on statistical analysis and evaluating reliability.

1.6. Teaching PS for medical students in the orientation towards developing SRC

1.6.1. Competence-based teaching

Competence-based teaching has several characteristics:

Teaching perspective: focusing on students and teaching content.

Learning objectives: emphasizing the formation of qualities and competencies through knowledge, skills, attitudes, and personal psychological attributes.

Teaching content: core, specialized knowledge and skills to achieve the defined outcomes.

Teaching methods: encouraging active learning, focusing on self-study, experimental activities, practical exercises, and real-world experiences.

Diverse teaching organization forms.

Diverse learning environments.

Learning interaction: combining individual learning with group cooperative learning.

Learning outcome assessment: evaluating the ability to apply learned knowledge and skills to solve practical problems in life and the field of study.

Diverse, flexible learning methods.

1.6.2. Teaching PS in the orientation of developing SRC for medical students

The goal of teaching PS contributes to providing students with necessary professional knowledge and skills to perform well as doctors and develop scientific research competence.

Methods and organization: integrating modern teaching methods, including lectures, problem-based learning, questioning, discussions, practical exercises, project-based learning, and self-study.

PS content: used in medical research; combining theory with practice.

1.6.3. Required outcomes for teaching PS in the orientation of developing SRC for medical students

Required outcomes:

1/ Meeting the requirements of forming SRC for students according to training goals.

2/ Students are confident in the SRC trained through teaching and learning PS.

1.7. Conclusion of Chapter 1

The history of the issue shows that there has been no research on teaching PS in the orientation of developing SRC. We have proposed a competences framework including six groups of components. At the same time, we have proposed six components of scientific research competence that can be formed and developed for students through teaching PS. Through theoretical research, we have clarified some theoretical issues as a knowledge basis for practical research and suggested some measures in the next chapter.

Chapter 2
PRACTICAL BASIS

2.1. Subject and scope of practical research

The purpose of practical research is to evaluate the current state of teaching and learning PS for students in medical universities in the orientation of developing SRC as a basis for proposing teaching methods.

The subjects of the practical research are the current teaching and learning conditions of PS in medical universities.

The scope of the practical research includes the following: university students' awareness of the necessity of scientific research; the role of statistical knowledge in the formation and development of SRC for students; and the current state of teaching and learning PS in medical universities aimed at developing SRC for students.

The practical research involves lecturers and students from three universities: Thai Nguyen University of Medicine and Pharmacy; Thai Binh University of Medicine and Pharmacy; Hai Phong University of Medicine and Pharmacy.

Research period: From February 2020 to April 2022

2.2. Research methods for practical basis

2.2.1. Research variables and data collection methods

Research variables:

- Students' awareness of the necessity of scientific research in medicine

- Students' awareness of the role of PS in scientific research and its application in research

- Students' ability to apply PS knowledge in medical research

- The current state of teaching PS aimed at developing SRC by lecturers

- Course outlines and textbooks on PS for medical university students

Data collection methods:

1/Surveys; 2/ Interviews; 3/ Small group discussions; 4/ Focus groups; 5/ Observations; 6/ Observations of teaching and guiding

scientific research; 7/ Assessing students' thinking and feedback; 8/ Document analysis

2.2.2. The process of studying the practical basis

It includes the following five steps: Step 1. Identifying the research subjects; Step 2. Designing data collection tools for research variables; Step 3. Collecting data; Step 4. Processing data; Step 5. Drawing conclusions

2.2.3. Research Sample

The research sample consists of 356 university students in medical fields and 11 lecturers teaching PS at three universities: Thai Nguyen University of Medicine and Pharmacy; Thai Binh University of Medicine and Pharmacy; Hai Phong University of Medicine and Pharmacy.

2.3. Research results on the current situation

2.3.1. Awareness of medical university students about the necessity of scientific research in medicine and the role of PS in medical research

Investigated through two forms: 1/ Surveys; 2/ Student interviews

Survey results: Most students are aware of the importance of scientific research in medicine and want to participate in research activities. Interview results: Most students understand the role of PS in medical research.

2.3.2. Some aspects of the current SRC of medical university students

Investigated through four forms: 1/ Surveys using quizzes to apply statistical knowledge in research; 2/ Surveys; 3/ Student interviews; 4/ Observing students' actual research activities

Main difficulties and limitations: 1/ Difficulty in understanding and applying statistical theory to practical research; 2/ Inability to choose appropriate statistical methods for different situations; 3/ Lack of ability to logically and clearly explain and present results in reports; 4/ Inadequate skills related to data collection and sampling; 5/ Poor ability to assess the reliability of results

2.3.3. Current state of teaching PS by lecturers oriented towards developing SRC for students

Investigated through three forms: 1/ Surveys; 2/ Observations of classroom teaching and learning by lecturers and students

Findings:

+ There is no close connection between PS theory and medical practice

+ Limited support for students in applying PS to research projects

+ Insufficient practice, especially in guiding students to apply PS in medical research

+ Students have limited exposure to statistical software

2.3.4. Issues related to course outlines and textbooks on PS for medical university students

Investigated through document analysis

Findings:

- The content of PS courses in different universities is similar, ensuring basic knowledge of PS.

- PS courses in the universities are taught over 2 credits, with different allocations for theory and practice hours.

- Textbooks on PS at the three medical universities contain similar main content, but are heavily theoretical with limited practical application.

2.4. Conclusion of Chapter 2

The results of the research on the current state have reaffirmed the findings presented in Chapter 1, and provide a solid basis for us to propose several measures for teaching PS in the orientation of developing SRC for medical university students.

Chapter 3

SOME MEASURES FOR TEACHING PROBABILITY AND STATISTICS TO DEVELOP SCIENTIFIC RESEARCH COMPETENCE FOR MEDICAL UNIVERSITY STUDENTS

3.1. Orientation for proposing measures for teaching Probability and Statistics to develop scientific research competence for medical university students

Orientation 1: Teaching measures must ensure the learning outcomes for medical students at universities.

Orientation 2: Teaching measures contribute to providing students with basic knowledge of PS, based on the PS content in the undergraduate health science education framework.

Orientation 3: Teaching measures aim to form and develop SRC for students.

Orientation 4: Teaching measures must ensure feasibility and appropriateness for the target audience.

3.2. Some measures for teaching Probability and Statistics to develop SRC for medical university students

3.2.1. Measure 1: Training medical students on how to apply Probability and Statistics knowledge to scientific research

a) Basis and significance of the measure

Teaching PS with the aim of developing SRC for students requires first equipping students with knowledge and skills according to the learning outcomes. Specifically:

Lesson Title	Training Content	Students' SRC
Sampling Theory	How to apply Probability and Statistics knowledge to data collection and evaluation	SRC1; SRC2.
Sampling Theory	How to apply Probability and Statistics knowledge to data collection and evaluation	SRC2; SRC3; SRC6
Parameter Estimation; Hypothesis Testing; Correlation Regression Theory	How to apply Probability and Statistics knowledge to statistical analysis	SRC4; SRC6

b) Content and implementation method

Focus on training students on how to apply PS knowledge to scientific research through the following seven steps:

Step 1: Estimate research sample size

* *Objective:* Students can estimate the sample size in scientific research. Students recognize the role and significance of estimating sample size in scientific research; forming and developing SRC1.

Step 2: Identify research data

* *Objective:* Students classify and identify different types of variables in research. Students distinguish between research variables and research subjects. Students recognize the role and significance of identifying research data in scientific research; forming and developing SRC2, SRC6.

Step 3: Identify the distribution of research variables

* *Objective:* Students classify and identify the distribution rules of research variables. Students can check the normal distribution of research data. Students recognize the role and significance of identifying the distribution of research variables in scientific research; forming and developing SRC2, SRC3, SRC5, and SRC6.

Step 4: Describe statistical data

* *Objective:* Students can present data in tabular form and represent data using charts and graphs in scientific research. Students recognize the role and significance of summarizing and representing statistical data in scientific research; forming and developing SRC3, SRC5, SRC6.

Step 5: Estimate statistical parameters

* *Objective:* Students can determine confidence intervals to estimate parameters of variables in medical research. They can also explain the content and significance of these confidence intervals; forming and developing SRC4, SRC6.

Step 6: Test statistical hypotheses

* *Objective:* Students identify the form of the test and correctly determine the statistical hypothesis. Students can identify test criteria and the test's critical region to accurately conclude the issues to be tested in medical research. Students recognize the role and significance of testing statistical hypotheses in scientific research; forming and developing SRC4, SRC6.

Step 7: Analyze correlation and build linear regression equations for statistical prediction

* *Objective:* Students can evaluate the correlation between random variables in research data. Students can build experimental regression lines for prediction in medical research. Students recognize the role and significance of correlation analysis and building experimental linear regression lines in scientific research; forming and developing SRC4, SRC6.

3.2.2. Measure 2: Enhancing practical application of Probability and Statistics in medical research

a) Basis and significance of the measure

To enhance SRC, students need practical experience. This measure proposes two content areas for students to practice.

b) Content and implementation method

Content 1: Practicing data collection, processing, and analysis according to the process of medical research

Based on the analysis of documents and the complete analysis of the statistical research process, the following data collection, processing, and analysis procedure is proposed to develop SRC for medical university students through six steps: 1/ Identify the problem and set goals; 2/ Plan and method; 3/ Collect data; 4/ Describe data; 5/ Analyze data; 6/ Conclude. Additionally, the design of practical activities for data collection, processing, and analysis aims to develop SRC for medical university students in teaching PS, including six steps: 1/ Identify the research problem; 2/ Propose data collection plans; 3/ Plan data collection, processing, and analysis; 4/ Propose student activities; 5/ Organize presentations; 6/ Propose evaluation.

A practice sheet for students has been described.

Content 2: Project-based learning linked with scientific research

The proposed steps are: Step 1. *Determine the topic and project goals; Step 2. Develop an implementation plan; Step 3. Implement the project;* Step 4. *Present project products and refine knowledge;* Step 5. *Propose evaluation of students' practical results.*

An example of a project in the "Sampling Theory" chapter has been illustrated.

3.2.3. Measure 3: Strengthening students' use of statistical software

Training students in the use of R statistical software with two practical topics has been proposed. To illustrate, we used a research dataset named obesity - a dataset on body fat (obesity). This data is contained in c:\works\obesity.

See more at https://rpubs.com/DoNga/891653

Training students in using R statistical software through four practice steps:

Step 1: Install and activate required command packages

* *Objective:* Students are proficient in installing and activating the command packages needed for medical research; forming and developing SRC5.

Step 2: Read statistical data

* *Objective:* Students are proficient in reading statistical data in R software; forming and developing SRC1, SRC5.

Step 3: Describe and summarize data using graphs

* *Objective:* Students are proficient in describing and summarizing data using R software in medical research; forming and developing SRC2, SRC3, SRC5.

Step 4: Analyze statistical data

* *Objective:* Students are proficient in analyzing statistical data using R software in medical research; forming and developing SRC3, SRC4, SRC5, SRC6.

3.3. Conclusion of Chapter 3

Based on the results obtained from theoretical and practical analysis, with the desire to form and develop SRC for medical university students, we have proposed three measures for organizing PS teaching, specifically:

Measure 1: Training medical students on how to apply Probability and Statistics knowledge to scientific research.

Measure 2: Enhancing practical application of Probability and Statistics in medical research.

Measure 3: Strengthening students' use of statistical software.

Chapter 4
PEDAGOGICAL EXPERIMENT

4.1. Objectives, requirements, tasks, and principles for organizing pedagogical experiments

4.1.1. Objective of the experiment

To verify the validity of the scientific hypotheses presented in the thesis and to test the feasibility of the pedagogical measures proposed in Chapter 3.

4.1.2. Requirements for the Experiment

- Ensure objectivity and honesty.

- The content of the experimental program should be close to reality and suitable for medical students.

4.1.3. Tasks of the pedagogical experiment

- Prepare lesson plans and design the experimental program.

- Conduct experimental teaching using the proposed teaching methods.

- Collect and analyze experimental results to evaluate effectiveness and confirm the feasibility of the proposed measures.

4.1.4. Experimental procedure: 1/ Select experimental teaching content; 2/ Choose the experimental subjects; 3/ Organize the experiment; 4/ Evaluate the experimental results; 5/ Conclude.

4.1.5. Duration of the experiment: Conducted twice over two years, from May 2022 to March 2023.

4.1.6. Experiment Participants

First-year medical students at Thai Nguyen University of Medicine and Pharmacy.

4.2. Content, methods, and evaluation of the experiment

4.2.1. Experimental content

The content of the Probability and Statistics course includes six lessons:

1/ Probability formulas.

2/ Random variables and probability distributions.

3/ Sample theory.

4/ Estimating parameters of random variables.

5/ Hypothesis testing.

6/ Correlation and regression theory.

+ Enhanced practical content and project-based teaching.

Specific distribution: Theory: 15 periods; Discussion: 7 periods; Exercises: 7 periods; Practice and group activities: 16 periods; Major assignments and self-study: 60 hours.

4.2.2. Teaching methods

Integrated teaching methods proposed in Chapter 3, using teaching methods such as lectures, Q&A, problem-solving, group discussions, project-based teaching, and educational software.

4.2.3. Evaluation of results

4.2.3.1. Evaluation basis and content

+ Evaluation Basis:

1/ The program's output standards and the course's output standards.

2/ The scientifc research competences framework proposed in Chapter 1.

+ Evaluation Content:

1/ The knowledge acquired by students and their ability to apply this knowledge in medical research.

2/ Students' progress in learning and applying knowledge in scientific research.

3/ Students' positive attitudes towards the course and their ability to solve specific situations in scientific research.

4.2.3.2. Evaluation of experimental results

+ Evaluation Methods:

We evaluate both quantitatively and qualitatively through: 1/ Formative evaluation; 2/ End-of-course evaluation.

+ Evaluation Criteria:

1/ Knowledge; 2/ Skills; 3/ Attitude; 4/ Competence.

+ *Evaluation Forms:*

1/ Written tests: Regular tests and research competence assessments.

2/ Practical assignments: Evaluation of the application of Probability and Statistics knowledge in projects and scientific research topics.

+ *Evaluation Tools:* Mathematical statistics.

4.3. Implementation of the experiment

The pedagogical experiment was conducted in two phases:

	Time	**Experimental Class**	**Control Class**
Phase 1	08/5/2022 - 26/8/2022	YK53C; YK53E	YK53K; YK53B
Phase 2	03/10/2022 -12/3/2023	YK55D	YK55B
Instructor		Author of the thesis	Le Thi Huyen My

The pedagogical experiment was conducted according to the procedure outlined in section 4.1.4.

In the first phase, experimental teaching included measures 1, 3, and part of measure 2 proposed in Chapter 3 (section 3.2) for classes YK53C and YK53E. Observation of control classes YK53K and YK53B.

In the second phase, teaching included measures 1, 2, and 3 with an improved lesson plan for class YK55D. Observation of control class YK55B. The teaching process was similar to the first phase.

4.4. Experimental results and evaluation

We used the following evaluation methods: formative assessment through case studies; end-of-course course evaluation through competence tests, including written tests and practical research assignments (compared with the control class).

4.4.1. Formative assessment

Using case study methods, conducted with 10/144 students in the first phase and 5/74 students in the second phase. The case study students actively used Probability and Statistics to conduct specific medical research, such as data collection, processing, analysis, and evaluation, thereby scientifically answering research questions.

4.4.2. End-of-course evaluation

Evaluating results through a competence test, consisting of two parts: a written test and a practical assignment.

Comparative results showed that although experimental class students were not yet proficient, they were able to apply Probability and Statistics knowledge to basic scientific research processes. Experimental class students could determine sample sizes, select samples, use statistical software (R) for data processing and analysis, and interpret statistical results. They could also summarize issues and present reports scientifically.

This indicates that students are gradually forming and developing the research competencies proposed after learning Probability and Statistics. These results support the feasibility of the proposed pedagogical measures in Chapter 3.

4.5. Conclusion of Chapter 4

Through two phases of pedagogical experiments conducted with classes YK53 and YK55 at Thai Nguyen University of Medicine and Pharmacy, the results indicate that the proposed teaching measures for Probability and Statistics have initial feasibility and effectiveness.

CONCLUSION

After conducting the research on *Teaching Probability and Statistics in medical universities with a focus on developing students' scientific research competence*, we achieved the following results:

1. Reviewed research works on teaching Probability and Statistics related to health sciences, especially in medical universities, and analyzed existing results to draw significant conclusions about the relationship, role, and impact of Probability and Statistics on developing research competencies for medical students in Vietnam.

2. Surveyed the current state of teaching, learning, and applying Probability and Statistics from various perspectives: teachers, students, course content, teaching methods, and the application of Probability and Statistics in medical research, indicating that more attention is needed in teaching and learning Probability and Statistics with a focus on applying it to professional practice, particularly in developing students' research competencies.

3. Based on the output standards of the medical training program, the competences framework for general practitioners, and the characteristics of medical research, the thesis proposes a scientific research competences framework with six competence components, including six sub-competencies related to applying Probability and Statistics knowledge in research. The thesis focuses on developing these competencies through reorganizing some content, innovating teaching methods, organizing teaching and learning, and supplementing teaching measures related to practical medical research situations, enhancing students' practical application of Probability and Statistics in medical research.

4. Proposed three teaching measures for teaching Probability and Statistics to help medical students develop scientific research competence: Measure 1: *Training medical students to apply basic PS knowledge in research*; Measure 2: *Enhancing practical application of PS in medical research*; Measure 3: *Increasing the use of statistical software* to motivate and facilitate students' learning of PS, gradually developing their ability to apply this knowledge in specific medical research issues. As a result, students not only master and proficiently apply PS knowledge in practical research but also form scientific

thinking and develop self-study and SRC during the course. From there, it forms the foundation of knowledge and professional competence during the medical training process.

5. The results of the two phases of pedagogical experiments demonstrate the feasibility of the proposed teaching measures. These measures initially show effectiveness in achieving the goal of teaching PS to develop medical students' SRC.

These results indicate:

- The research tasks have been completed, and the research objectives have been achieved:

1/ Identifed six components of the scientific research competence to be developed for medical students in teaching PS.

2/ Developed three teaching measures for teaching PS to approach research competence through practical application in specific medical research situations.

- The research hypotheses are correct, reasonable, and scientifically significant.

Although the research on Teaching Probability and Statistics in medical universities with a focus on developing students' scientifc research competence has yielded certain results, scientific research is never conclusive. We hope that this research will continue to inspire future studies.