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DYNAMICS OF BIOSTATISTICS LEARNING: CHALLENGES AND OPPORTUNITIES TO IMPROVE TEACHING EFFECTIVENESS FOR NURSING STUDENTS

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Abstract
Biostatistics is an important subject in nursing education because it contributes to clinical decision-making and health research. However, many nursing students find biostatistics difficult because they are not directly used in nursing practice. This study aims to explore the dynamics of biostatistical learning to improve teaching approaches in the future. The study uses a Mixed Methods Research (MMR) design with an explanatory sequential approach which is carried out in two stages. The first stage involved 94 nursing students to measure satisfaction and concentration in learning. Quantitative results revealed that 80.9% of students were satisfied, although dissatisfaction arose from unclear goals and inappropriate lecture times. In addition, 72.3% of students had moderate concentration, with peer conversation invitations being the main challenge. In the second stage, a Focus Group Discussion (FGD) with 8 students explored these findings further. The integration of qualitative and quantitative data identifies key themes, namely clarity of learning objectives, lecture time, classroom atmosphere, technology support, and teaching effectiveness. These findings emphasize the need for better teaching strategies and time management to improve student satisfaction, focus, and understanding of biostatistics. Addressing this dimension will increase the effectiveness of biostatistics education for nursing students.

Keywords: biostatistics, learning concentration, learning satisfaction, nursing students' learning

Introduction

It is anticipated that graduates from the nursing study program will be skilled not just in patient care but also in advancing nursing science using a data-informed approach and in a problem-based learning framework (Kelleci et al., 2018). As future researchers, students should be able to recognize pertinent nursing issues, devise well-structured studies, and competently analyze data to effectively advance

the nursing science (Ibrahim et al., 2022). The successful execution of this research is contingent on a solid grasp of biostatistics, which is fundamental in data analysis and evidence-based decision making.

Biostatistics is useful in nursing education for developing skills in data evaluation and information processing necessary for clinical judgment and evidence-based nursing (Coronado-Vázquez et al., 2020; Truglio-Londrigan & Slyer, 2018). Nursing students require training on data evaluation for patient care in both research and clinical settings. Informed students were more competent in interpreting scientific literature, enhancing research-informed clinical decisions and improving biostatistical nursing practice.

Mastering biostatistics is a challenge for the majority of nursing students, who view it as a difficult and irrelevant subject. This is often the outcome of a disconnect between the material and clinical tasks (Winahyu, 2023). As a result of this negative perception, students struggle to overcome a lack of motivation, which in turn hinders their ability to grasp the critical biostatistical concepts indispensable for research and clinical practice.

Nursing students hace come from different academic backgrounds, which impacts their preparedness for studying biostatistics. Some students have backgrounds in certain math or statistics subjects, while others do not. The differences in students' backgrounds influences their grasp on the concepts, and the impact of the instruction (Tomak & Cıvanbay, 2022). Hence, the teaching of biostatistics needs to consider the differences students have and strive to address all of them.

Some of the issues students have to deal with while studying biostatistics include lack of motivation to learn, meaningful interaction while learning, and not seeing the relevance of the content to the field of nursing. Many students feel as if there is a lack of a connection with the teaching content because it does not seem closely related to their nursing practice (Babaahmadi et al., 2021; Li et al., 2024; Ocakoğlu et al., 2019). This lack of connection can undermine their grasp of statistical concepts and their ability to use this knowledge in actual clinical practice.

Issues within the motivational dimensions of the biostatistics course framework also include phenomena such as vague learning outcomes as well as scant classroom time dedicated to the subject, which may impede the student's understanding (König et al., 2021). Additionally, the lack of vigorous and well-structured teaching methods can hinder the effective grasp of the material (Ordak, 2024). Taken together, these elements greatly impede the effective teaching of nursing biostatistics.

An important aspect of overcoming the challenges of learning biostatistics is to understand the clinical relevance of the material (Ocakoğlu et al., 2019). Besides, biostatistics is not only important for academic studies, but is also fundamental for clinical decision-making based on data. For example, evaluating patient data can assist in identifying health patterns, forecasting treatment results, and enhancing care management. Therefore, it is critical to underscore the relevance of nursing statistics to nursing to heighten student engagement (Iqbal et al., 2021; Ordak, 2024; Troy et al., 2021).

Proper use of technology can notably improve the teaching and learning of biostatistics, particularly for nursing students. The implementation of mobile learning tools, statistical software, and even e-learning platforms can foster active

and participative learning (Ali & Khan, 2018). Visualization of information, completion of statistical exercises, and use of learning materials can all be done at the students' own pace and schedule. With the appropriate technology, students can gain greater insight and mastery over the more complex learning outcomes tailored to the rigorous demands of nursing education.

As for this particular research, the primary focus is to examine the biostatistics learning experiences of nursing students, the teaching and learning difficulties they encounter, and ways to make teaching more effective and learning easier. This study focuses on student motivation, understanding, and instruction to develop optimal strategies for teaching biostatistics. By achieving these objectives, the research hopes to improve student understanding and strengthen the role of evidence-based practices in nursing.

Method

This study utilizes an MMR or Mixed Methods Research approach with an explanatory sequential design. This design has two main phases: the quantitative stage and the qualitative stage. In the quantitative stage, data was collected from the respondents to measure the student learning satisfaction and concentration using a structured questionnaire with a Likert scale. The research instrument has undergone a validity and reliability test. The study population consists of students from X University, particularly those enrolled in the Nursing Science Program and the Biostatistics course for the year 2024.

This research has obtained approval from the Ethics Committee with number 11752/UN22.9/PG/2024, confirming that the research is conducted ethically. The inclusion criteria consist of students who complete Biostatistics and are willing to participate as respondents and provide consent as per the informed consent form. At the same time, the exclusion criteria consist of students who do not satisfy the minimum attendance requirement of 80% and students who did not take part in the evaluative processes, such as taking assignments or exams.

The quantitative stage utilized total sampling and included all students who satisfied both inclusion and exclusion criteria, total 94 students. Participants completed a form with demographic data (age, gender, and class) alongside learning satisfaction and concentration assessment questions. The data collection process occurred under a controlled setting where the researchers provided supervision, ensuring the validity of collected information and mitigating potential technical challenges. Quantitative data analysis was carried out using the univariate method to provide a frequency distribution of each variable.

The qualitative stage was carried out to dig deeper into the quantitative results through in-depth interviews and focused group discussions. The selection of participants was carried out using the purposive sampling technique, taking into account the activeness of the participants in the class, the final score of the Biostatistics course, and the diversity of class origins. A total of 8 participants were selected from quantitative level respondents who were willing to take part in the interview. The qualitative data collection process begins with an explanation of the research and the filling out of informed consent. Furthermore, the interview session was conducted in a conducive atmosphere, recorded, and transcribed word by word to be analyzed using a qualitative content analysis approach.

Qualitative analysis was done by extracting meaning units from the transcripts, coding them to the preliminary theme, and consolidating similar codes into categories. These classifications are then utilized to define a central theme representing the phenomenon under analysis. Data validation is conducted through member checks, confirming with participants the findings and interpretation of the data vis-a-vis their actual experiences. This is supplemented by a discussion from the research team to safeguard the reliability of the outcomes. These qualitative outcomes augment the context and nuances of the quantitative findings.

The fusion of qualitative and quantitative data is conducted in order to achieve a more refined and complete conclusion. The quantitative data is to give a general overview of the activities and relationships of the variables, while qualitative data adds context and deeper insights into the outcomes. With this approach, the study aims to achieve an integrative understanding on learning satisfaction, learning concentration, and student experiences in a biostatistics course. The outcomes are presented in a detailed manner, and are complemented with relevant interview quotations that illustrate the outcomes.

Findings and Discussion

Results are reported in two studies following a Mixed Methods Research approach with an Explanatory Sequential design. The first phase describes results from a quantitative analysis measuring the learning satisfaction level and learning concentration of students in the Biostatistics course, alongside the respondent profile distribution, satisfaction indicators, and learning concentration. After this initial stage, the study moved to a qualitative phase designed to investigate the quantitative results more deeply through in-depth interviews and Focus Group Discussions (FGD) to capture the students' experiences, challenges, and feedback. The combination of these two stages offers a thorough understanding of the studied phenomenon.

Quantitative analysis

The results of this quantitative research describe the level of learning satisfaction and learning concentration of students of the Nursing Study Program, Tanjungpura University in the Biostatistics course. Based on demographic characteristics, out of a total of 94 respondents, the majority were women (80.9%) and were at the age of 20 years (47.9%). The distribution of respondents by class was also almost even, with 46 students from class A1 and 48 students from class A2. These data show a balanced representation in the study population so that the analysis can describe the general perception of students.

The general learning satisfaction analysis revealed that 80.9% of respondents reported being satisfied with the learning process in the Biostatistics course. Indicators such as lecturer friendliness, module availability, and material alignment with the course syllabus received the highest positive rating. However, areas for improvement were identified, especially in the clarity of learning objectives, where 41.5% of students expressed dissatisfaction, and in the allocation of practice time, with 37.2% indicating ineffectiveness (figure 1).

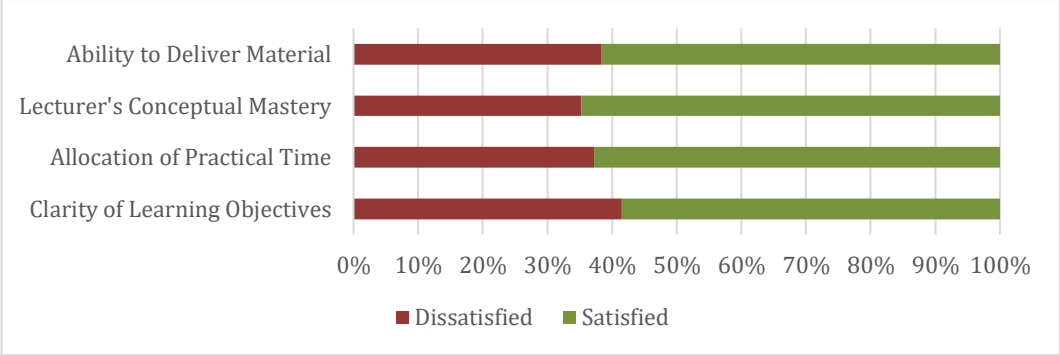

Figure 1. Biostatistics learning satisfaction indicators

Regarding learning concentration, most students (72.3%) were in the moderate category, while 23.4% showed a high level of concentration, and 4.3% had a low level. Distractions such as peer conversation during class (46.8%) and feelings of boredom with material (40.4%) were significant challenges identified. Factors contributing to this disorder include monotonous teaching methods and limited involvement in interactive activities (figure 2).

These quantitative findings highlight areas that need attention, especially in increasing the relevance of learning objectives, optimizing class time allocation, and improving teaching strategies to maintain student engagement and focus. This data serves as a foundation for further exploration through qualitative methods.

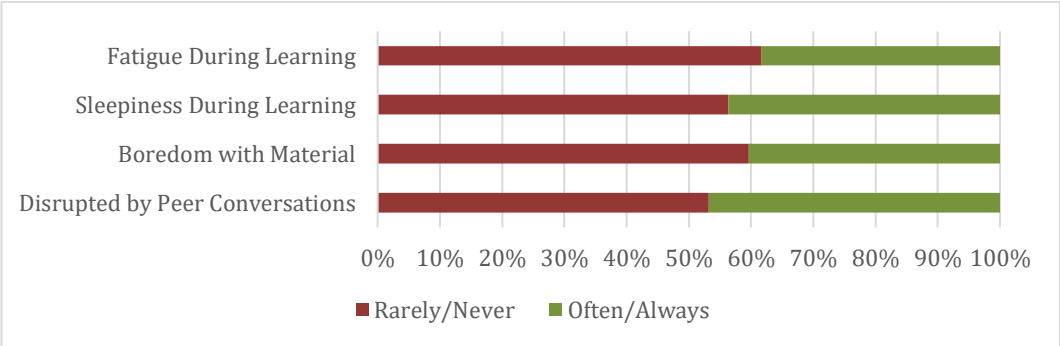

Figure 1. Biostatistics learning concentration indicators

Qualitative analysis

Qualitative analysis aims to dig deeper into quantitative results, especially related to aspects that need to be considered, such as clarity of learning objectives, lecture time allocation, and student learning concentration. Qualitative data were obtained through in-depth interviews and focused group discussions with eight participants representing diverse student characteristics. The results of the analysis produced the main theme that outlined the students' experience in learning Biostatistics.

Clarity of Learning Objectives Students reveal that learning objectives are often clearly communicated, but less related to relevant practical applications. For example, some students find it difficult to understand how the material taught can be applied in the final project research. One of the participants stated:

> *Tujuannya jelas, tapi kami kadang bingung bagaimana menghubungkannya dengan skripsi atau penerapan nyata dalam keperawatan (The goal is clear, but we are sometimes confused about how to relate it to a thesis or real application in nursing).* (P6)

This limitation is an obstacle to student motivation and understanding. They propose that lecturers provide more examples of real applications, especially those relevant to the final project and the world of work in the field of nursing.

The duration of lecture time, especially practicum, is considered important but often not optimal. Students feel that the time given is too short to understand complex material, such as the use of statistical software (SPSS). Participants stated that additional time is needed for the practicum to be able to learn data analysis thoroughly.

> *Waktu praktikum sering terasa kurang, terutama ketika kami harus belajar teknik analisis yang berbeda dengan kasus yang kompleks (Practicum time often feels lacking, especially when we have to learn different analysis techniques with complex cases).* (P4)

However, the length of practicum is also a challenge for students who understand the material faster, so they feel that time is wasted while waiting for other students.

Students' learning concentration is often disturbed by environmental factors and teaching methods. Students mentioned that invitations to chat from friends and a less interactive classroom atmosphere made it difficult for them to focus. In addition, boredom and fatigue during learning also often appear, especially when lecturers use a one-way approach. One of the participants stated:

> *Kadang saya bosan karena pembelajaran terlalu monoton, jadi mudah sekali terganggu (Sometimes I get bored because learning is too monotonous, so it's easy to get distracted).* (P7)

Students proposed that lecturers use more interactive learning methods and involve small group discussions to maintain focus during lectures.

Students really appreciate the modules and learning materials provided by lecturers, especially when the materials are designed in detail and relevant. However, some students feel that the delivery of materials such as presentation slides (PPT) is often late, so they do not have enough time to prepare themselves before lectures.

> *Kalau modulnya bagus dan lengkap, kami lebih mudah memahami. Tapi, kalau PPT datang mendadak sebelum ujian, itu menyulitkan (If the modules are good and complete, it is easier for us to understand. But, if the PPT comes suddenly before the exam, it is difficult).* (P3)

In addition, technical constraints such as slow devices during laptop-based exams are also a challenge. Students suggest the use of Computer-Based Testing *(CBT)* to improve exam efficiency and reduce technical barriers.

Integration of quantitative and qualitative results

The integration of quantitative and qualitative data provides an understanding that although most students are satisfied, there are important aspects that need to be improved, such as the clarity of learning objectives, practicum time management, classroom atmosphere, technology support, and the effectiveness of lecturer teaching (table 1).

Table 1. Integrated findings across key learning themes

Tema	Quantitative analysis	Qualitative analysis	Conclusion of Integration
Clarity of Learning Objectives	41.5% of students are not satisfied with the clarity of learning objectives.	Students feel that learning objectives are less associated with practical applications, such as final project research and relevance to the nursing profession.	Although the learning objectives have been conveyed, students need real examples and an emphasis on the relevance of the material to improve understanding and motivation to learn.
Time and Classroom Management	37.2% of students dissatisfied with practicum time; 46.8% distracted by peer conversations; 40.4% bored during class.	Students call insufficient time for complex materials; monotony in teaching methods causes boredom and distractions.	Flexible time allocation with optional sessions for practicum; interactive teaching methods like small group discussions.
Technology Support	46.8% of students are satisfied with the modules, but there are technical problems during the laptop-based exam.	Students appreciated the complete and detailed modules, but said the delay in submitting PPTs before the exam hindered their preparation.	Technology support and teaching materials must be improved, including early delivery of materials and the adoption of *Computer-Based Test (CBT)* to reduce technical constraints during exams.
Lecturer Teaching Effectiveness	38.3% of students were not satisfied with the lecturer's ability to deliver material.	Students want lecturers to use simpler language and present relevant examples to make it easier to understand.	Teaching effectiveness can be improved with simpler delivery, strong relevance of the material, and the use of real-life case-based learning approaches.

Clarity of learning objectives is essential in ensuring that students understand the purpose and relevance of the material being studied. From these findings, although goals are often clearly communicated, many students convey difficulties in connecting them to practical applications such as thesis preparation or professional nursing practice. This is in line with a broader educational discussion that highlights the importance of connecting goals with real-world contexts to foster deeper engagement and understanding (Lee-Robbins & Adar, 2023; Rebele & St. Pierre, 2019). For example, students in professional programs, such as nursing and

accounting, often struggle with theoretical content when its practical application is not immediately apparent. Arousing interest or connecting values can be done using attitudinal learning targets, which also help to cognitive goals (Lee-Robbins & Adar, 2023). Educators can use example-based explanation of real-world case studies to help students internalize learning objectives. Making material more relevant to students also motivates them. Above all, improving learning satisfaction and educational outcomes hinges on effectively bridging the gap between theoretical clarity and practical application.

An active and productive learning environment is supported by effective time and classroom management. To resolve the problems of balancing different students' learning speeds with scheduled lessons, optional extra sessions can be held that cater to the individualized needs of students (Uzir et al., 2020). Additionally, small group discussions as an active teaching technique help to minimize disengaged students and enhance the energetic engagement within the classroom (Wolff et al., 2021). Students knowing the basic and fundamental classroom rules, as well as proper behavioral expectations, contribute to a well-controlled and attentive learning setting (Lazarides et al., 2020). Students remain actively engaged and focused and make fewer distracting behaviors when teachers provide clear expectations and effective guidance and feedback. With the combination of time-flexible models of teaching, rules and clear expectations, interactivity, and teaching strategies, and structured classroom policies, teachers can foster positive learning environments that are adaptable and inclusive.

Technological support significantly improves the overall learning experience by aiding in active learner participation and comprehension. Analysis of the data showed issues like poor material distribution and some technical problems during assessments which impeded students' preparation and performance (Bernacki et al., 2019; Lai & Bower, 2019). By using learning platforms and other technologies, self-paced instructional videos and peer collaboration can be incorporated into the lessons. This approach can achieve the set objectives of students' academic performance, illustrating the promise of effective educational technology when combined with appropriate technology (Makinde et al., 2024). The use of technology in the classroom enables students to construct their own understanding with the help of their instructors (Behnagh & Yasrebi, 2020). To reach this goal, educational institutions need to focus on the adequate and effective development of the technology framework to help students learn better.

The impact of a lecturer's teaching effectiveness impacts the outcome of the learning activities as well as the learning engagement of the learners. The data suggest that interactive problem based approaches are more effective than traditional lectures and students are more satisfied and understand concepts better when teaching is implemented using these approaches (Alaagib et al., 2019; Anthony et al., 2019). Employing student centered learning activities, for example, case based discussions and small group discussions enhance critical thinking, collaboration, professional communication, and other competencies needed by professionals (Otache, 2019). Furthermore, important soft skills to teaching, such as effective communication, flexibility, and constructive criticism, are important for teaching as they help the lecturer to effectively manage a diverse class to bring to a diverse class (Tang, 2020; Wieman, 2019). Institutions of higher learning need to ensure that lecturers are trained and are equipped with pedagogical skills, and

teaching technologies appropriate for the students learning because these methods need to be aligned with today's students and their educational environment.

Conclusion

This study focuses on specific aspects that foster concern during the learning process in a Biostatistics course, for example, defining learning outcomes, lectures, time allocation, classroom control, the role of technology, and the effectiveness of the instructor teaching the course. Students generally express satisfaction, despite challenges in connecting theoretical concepts with practical applications, effectively managing class time, overcoming classroom distractions, and optimizing the use of technology. Significant to teaching qualitative and quantitative aspects of a technique during class is concern that centers on student engagement; communication and flexible time allocation emerged as priority areas to boost learning and teaching outcomes. In addressing these issues, universities and colleges can focus on those that impact learning through technology, collaboration within teaching-centered classrooms, and through training programs for classroom practitioners. In this way, instructors will enhance the learners' and society's academic and professional developmental needs through guiding structures and more effective learning experiences.

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