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Students' perception of agricultural microbiology education: Insights into teaching, learning, engagement, and curriculum development

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ABSTRACT

The study highlights the perception of undergraduate agricultural university students on agricultural microbiology education. The questionnaire survey containing 22 items targets 43 students enrolled in the Department of Agricultural Microbiology (AMB) and responses are collected via google form. The study aims at evaluating students' perception on teaching methods, their opinion on microbiology in agriculture, and their self-assurance in using laboratory equipment and conducting the practical work. Key aspects for improving teaching quality, teaching aids, theocratical content and practical guidebook are discussed. The present investigation supported the AMB to formulate qualified education program towards the students-centered approach.

Keywords: agricultural microbiology, students' perception, teaching methods, laboratory equipment, practical works

INTRODUCTION

Since 2015, Yezin Agricultural University (YAU) has prioritized comprehensive education and research reforms in collaboration with international agencies. As part of this effort, a credit transfer system for the undergraduate program was introduced in the 2017-2018 academic year. To expand specialized fields of study and produce highly qualified professionals in agricultural science, YAU established the Department of Agricultural Microbiology (AMB) in 2017 to advance knowledge and technology in applied agricultural microbiology. Recognizing the critical role of microbiology in sustainable agriculture and ecosystem function, the application and management of microbial resources are essential for improving crop quality and food safety. Globally, the use of microbes continues to expand across various aspects of human life and industrial development. To further strengthen its academic framework, AMB has set its mission to achieve excellence in education, training, technology dissemination, and innovative research, contributing to the advancement of Myanmar's agricultural sector. Its objectives are to equip students with a comprehensive understanding of microbial science, its applications in crop production and environmental management, and to develop proficiency in microbial technology.

In the undergraduate program, AMB introduced introductory microbiology in the second semester of the second year. From the third year onward, students begin specialized education, selecting one of 13 specialization fields. Within this framework, agricultural microbiology is offered as part of the core subject group "environmental science," alongside subjects from pathology, entomology, and soil and water science. To support this specialization, AMB initially developed nine subjects, including introductory microbiology, general microbiology, microbial techniques, applied microbiology, microbial genetics, and microbial ecology. This curriculum was established with support from the YAU-Japan International Cooperation Agency (JICA) technical cooperation project from 2015 to 2019. In response to credit requirements, two additional subjects: biofertilizer production and fundamentals of bioremediation and phytoremediation were introduced in 2021. As a result, AMB now offers a total of 11 major subjects, most of which incorporate practical components. A total of five teaching staff including professor and head were taking responsibilities in both teaching and research in AMB at YAU. The present strength of the teaching staff seems to be similar to the number of staff in international universities irrespective of their degree level and position. However, the number of subjects annually offered for the first semester (November-March) was five-six subjects in second semester (May-October). From 2019-2025, AMB offers agricultural microbiology courses to five student cohorts.

To establish a well-structured, multidisciplinary course emphasizing microbial knowledge and technology, and effective learning outcomes, it is essential to gather baseline data. This includes students' perceptions of microbiology courses, teaching

Table 1. List of the questions to clarify students' perception of applied microbiology

No	Students perception on
1	Theory subject teaching methodology (a) excellent (b) good (c) fair (d) poor
2	Practical subject teaching methodology (a) excellent (b) good (c) fair (d) poor
3	Applied microbiology guidebook contents (a) excellent (b) good (c) fair (d) need supplement (e) poor
4	Teaching aids (a) good (b) fair (c) poor
5	Are you familiar with laboratory equipment and able to handle? (a) awareness and utilizing (b) awareness (c) utilizing (d) need practices
6	Do you feel familiar with laboratory equipment skills compared to last year? (a) familiar (b) anxious (c) not anxious (d) more fear
7	Do you like applied microbiology subjects? (a) favorite (b) normal (c) least favorite (d) no idea for continuous study
8	What are the most understanding and interest topics in applied microbiology contents?
9	What are the most understandable practical topics in applied microbiology contents?
10	Do you have a willingness to make questions and discussion if you have difficulties in learning? (a) ever asked (b) occasionally asked (c) never asked
11	How often do you have group discussions with your classmates? (a) always (b) sometimes (c) only once (d) never
12	Type of media you use to make discussion with your classmates (a) smartphone (b) facebook messenger (c) viber group (d) in person (e) both media and in person
13	Type of digital platforms you use for study (a) youtube (b) google pages (c) instagram (d) facebook (e) media and all channels (f) youtube and google pages
14	Do you prefer the practical examination question format for this year? (a) more preference (b) preference (c) no preference
15	Weightage of theory and practical content (a) fair (b) too much practical and less theory (c) too much theory and less practical
16	Conducting recapitulation on whole lecture (a) most preference (b) preference (c) no preference
17	Theory and practical linkage (a) extremely (b) normal (c) slightly (d) none
18	Understanding in agricultural microbiology subject (a) clearly understand (b) understand (c) complex (d) boring
19	Interest in applied microbiology subject (a) more interest (b) interest (c) a little interest (d) no interest
20	Presence of happiness on the course taken (a) always (b) sometimes (c) never
21	Choice of microbiology subject in next semester (a) selected (b) no selection
22	Satisfaction with teacher's explanation (a) yes (b) normal (c) no

methods, research facilities, and the overall impact on students' academic performance. Additionally, continuous monitoring and evaluation of curriculum and research facilities are necessary to ensure ongoing improvement. To support this effort, a questionnaire survey was conducted to assess students' perspectives on applied microbiology subject, their understanding of the subject matter, their capacity in using laboratory equipment, and their practical skills.

METHODOLOGY

A total of 43 students who took the applied microbiology course at YAU were surveyed using a questionnaire distributed via a Google Form, prepared by AMB staff. A structured interview questionnaire was designed and sent to third-year students from the 2022-2023 and 2024-2025 academic years who had taken applied microbiology as an elective course. The questionnaire included 22 items covering students' subject choices, understanding of microbial knowledge, practical work experience, challenges faced, and suggestions for future improvements (**Table 1**). After collecting data, the responses were entered into a database and categorized according to the respective questions. Quantitative data analysis was conducted using Microsoft Excel, with descriptive statistical values, including frequency counts and percentages, calculated to interpret respondents' perceptions.

To assess levels of satisfaction, quality, importance, agreement, disagreement, or frequency, a Likert scale survey was employed, allowing for the collection of rank-ordered responses (https://www.jmu.edu/assessment/sass/_files/likert_ scale_ guide.pdf).

RESULTS AND DISCUSSION

Perception of Students on Teaching Methods

30.2% of students rated the theory teaching methods of the applied microbiology course at YAU as excellent, while 67.4% rated it as good and 4.7% as fair. Regarding practical classes per week and teaching style, 53.5% of students rated them as excellent, 39.5% as good, 4.7% as fair, and 2.3% as poor (**Figure 1**).

Teaching methods refer to the strategies used by instructors to organize and implement various educational activities to achieve specific learning goals (Al-Rawi, 2013). In our approach, we integrated a blend of lectures, discussions, dialogues, practical demonstrations, group learning assignments, and student presentations to enhance engagement and understanding. Overall, most students rated both theory and practical teaching methods in AMB as good. These results reflect AMB's efforts to provide well-structured and timely practical and lecture sessions.

Perception of Students on Teaching Aids

Only 11.6% of students rated the preparation of the applied microbiology guidebook and its content as excellent, while 79.1% rated it as good, 4.7% as fair, 2.3% felt additional guidebooks were needed, and 2.3% rated it as poor. Regarding the balance between theory and practical content, 65.1% of students found it fair, 27.9% thought there was too much practical and too little

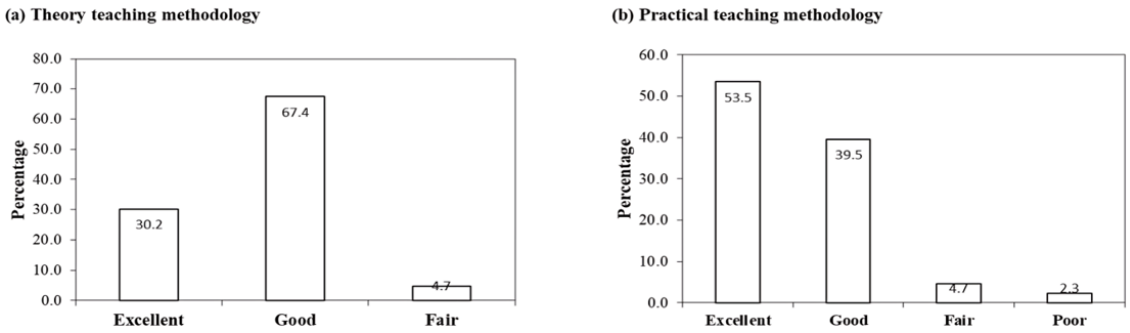

Figure 1. Perception of students on theory and practical subject teaching methodology (N = 43) (Source: Authors' own elaboration)

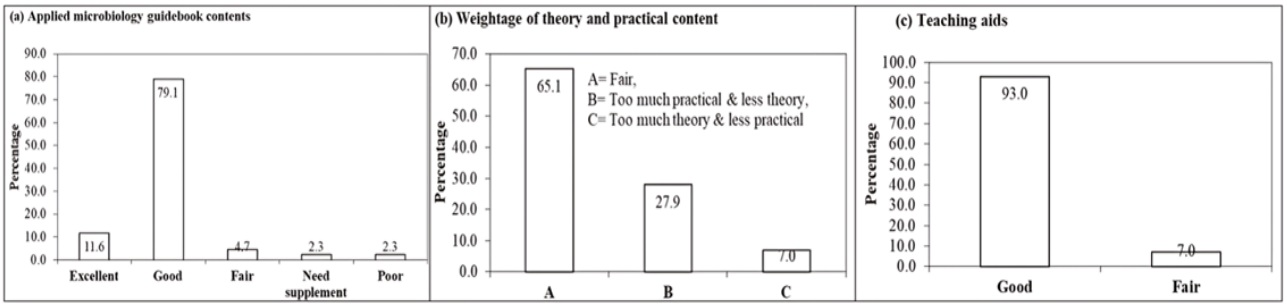

Figure 2. Perception of students on teaching aids (N = 43) (Source: Authors' own elaboration)

theory, and 7.0% felt the opposite. More than 90% of students rated the teaching aids in AMB as good, with 7.0% rating them as fair (**Figure 2**).

The applied microbiology theory guidebook and practical content covers seven topics, which were developed based on works by Brooks (2016), Cappuccino and Sherma (2013), Khakural and Sherma (1984), Bandyopadhyay et al. (2012), Chen and Liu (2019), and Campbell and Postgate (1965). Each topic is designed to help students gain fundamental knowledge in soil microbiology, microbial techniques, and the effective use of laboratory facilities.

Over 90% of students found the guidebook content to be good, while a few students rated it as fair, and a small number considered it poor. Some students also suggested that additional content was needed, as they felt the current material was unclear. Therefore, the guidebook content should be improved and made more concise. In relation to the survey results on the balance between theory and practical content, less than half of the students felt that the balance was inadequate. Thus, lecturers should adjust the proportion of practical and theoretical content.

According to Poljak (1985), "technical or teaching aids are tools for work," which include various tools that support the achievement of educational goals. The success of education depends not only on the content knowledge and the lecturer's ability to explain it, but also on adopting effective teaching methods and using varied educational tools (Čirić, 2014). The current teaching aids and laboratory facilities in AMB were provided by the Japanese government under the YAU-JICA technical cooperation project. Survey results indicated that many students felt the teaching aids were sufficient and supportive in enhancing their learning and understanding.

Perception of Students on Handling Laboratory Equipment and Their Skills

A total of 42 students responded to this question. 42.9% of students reported that they understood how to use laboratory equipment and were capable of handling it well, while 9.5% understood its use but were unable to handle it properly, 7.1% could handle the equipment but did not fully understand its usage, and 40.5% felt they needed more practice to both understand and use the laboratory equipment. A total of 43 students responded to the question regarding familiarity and comfort with laboratory equipment, 86.0% of students indicated they had become more familiar with the equipment and improved their skills, 7.0% experienced anxieties when handling the equipment, and 7.0% reported feeling less anxious (**Figure 3**).

Laboratory equipment and materials are critical for conducting practical work (Rakhmonkulov & Usarov, 2019). In microbiology studies, essential tools include autoclaves, laminar flow hoods, digital balances, pH meters, microscopes, auto-pipettes, petri dishes, and others (Varghese & Joy, 2014). Students must develop both an understanding and the skill to use these tools.

However, according to the survey results, while students seemed somewhat familiar with laboratory equipment, they felt they still needed more practice to become proficient, especially compared to their first semester of third year. In Myanmar, students lack opportunities to work with fundamental laboratory equipment at the senior high school level due to a shortage of teaching aids provided by the local government. In contrast, students in countries like India are introduced to laboratory tools and equipment much earlier, even during senior high school (Restiana & Djukri, 2021). The introduction of agricultural microbiology as a subject at the undergraduate level in YAU could explain why students feel they need more practice and experience to become skilled in using laboratory equipment, such as microscopes, auto-pipettes, digital balances, and glassware.

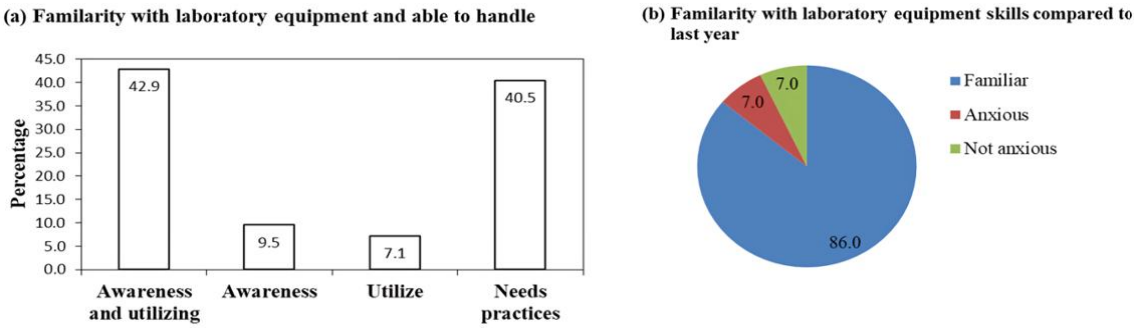

Figure 3. Perception of students on handling laboratory equipment skills (N = 43) (Source: Authors' own elaboration)

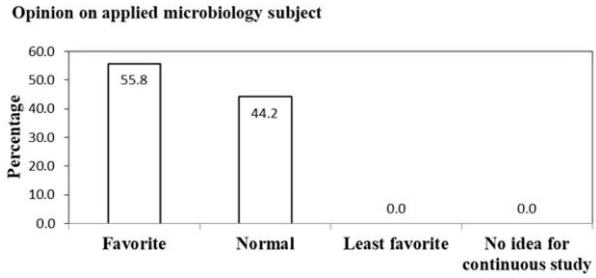

Figure 4. Perception of students on applied microbiology subjects (N = 43) (Source: Authors' own elaboration)

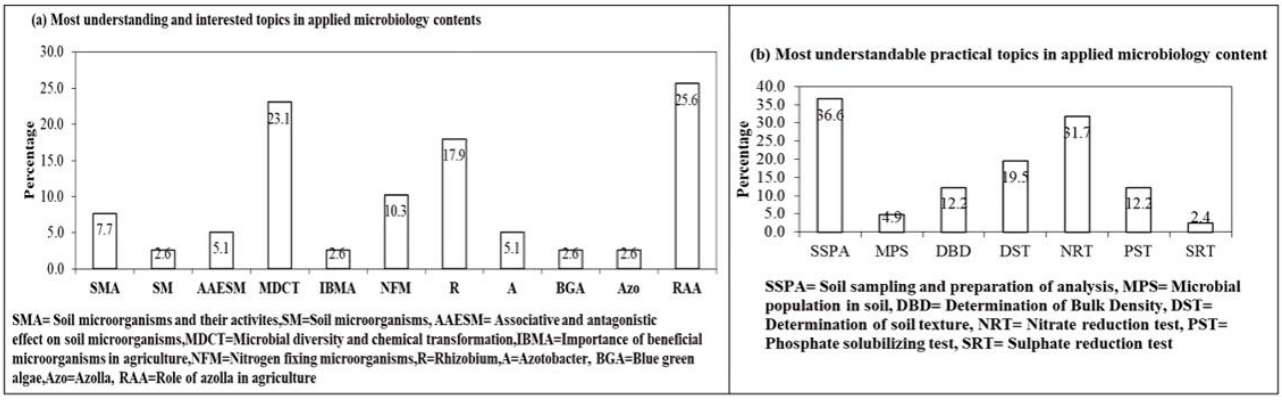

Figure 5. Perception of students on their interested topics in applied microbiology subject (N = 41) (Source: Authors' own elaboration)

Perception of Students on Applied Microbiology Subject

55.8% of the students answered that microbiology subject was their favorite subject among the subjects offering at YAU and 44.2% answered normal subject (**Figure 4**). The results indicated that the staff still need to put greater effort into teaching and research to disseminate their knowledge and experience of how microorganisms play a key role in agriculture and food industry. By doing so, students' awareness on microbiology subjects will be elevated. At present, only two staff members hold PhD degrees while the remaining hold bachelor's degrees with less research and teaching experience. Therefore, professional development is urgently needed among bachelor's degree holding staffs to support them in pursuing doctoral qualifications.

Perception of Students on Their Understanding in Agricultural Microbiology Teaching

A total of 39 students responded to this question. 25.6% of the students responded that role of azolla in agriculture (RAA) was their most understanding and interested topic followed by 23.1% in microbial diversity and chemical transformation (MDCT) topic, 17.9% in rhizobium (R), 10.3% in nitrogen fixing microorganisms (NFM), 7.7% in soil microorganisms and their activities (SMA), 5.1% in associated and antagonists effects on soil microorganisms (AAESM) and azotobacter (A), 2.6% in soil microorganisms (SM), importance of microorganisms in agriculture (IBMA), blue-green algae (BGA), and azolla (Azo), respectively. A total of 41 students responded to the question related to practical topics in applied microbiology. 36.6% of the students preferred practical topics with the title of soil sampling and preparation of analysis, 31.7% in nitrate reduction test, 19.5% in determination of soil texture, 12.2% in determination of bulk density and phosphate solubilizing test, 4.9% in microbial population in soil and 2.4% in sulphate reduction test (**Figure 5**).

Students' interest surveys are an important tool for understanding the needs and the preference of the students. There was diversification in each of the students' interest in the topics of both theory and practical subject. Most of the students'

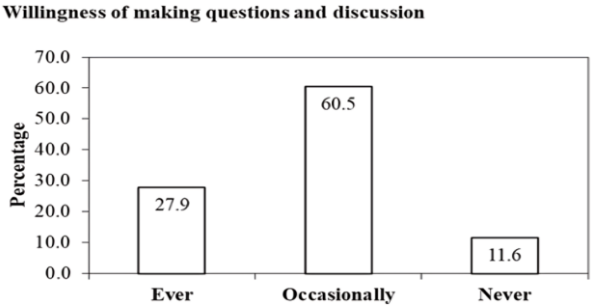

Figure 6. Perception of students on making questions and discussion with lecturers (N = 43) (Source: Authors' own elaboration)

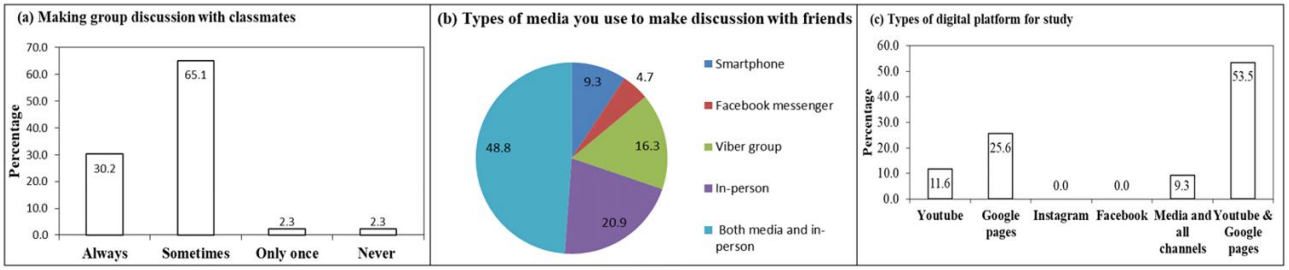

Figure 7. Perception of students on making group discussion (N = 43) (Source: Authors' own elaboration)

understanding and interest was the highest in the topic of RAA which might be due to the reason of practical application of azolla would be simple and students felt the concept of azolla in agriculture was clear. Students prefer theory topics which are connected with practical courses such as the topic like MDCT. Moreover, students' specific interests may depend on their participation in the class actively. If they had an interest, we could see their engagement by asking questions, discussion, and leading the tasks throughout the lecture and practical time. In this survey, we obviously noticed their interest in soil nutrient cycling, and beneficial microorganisms which can be applied to biofertilizer production.

Perception of Students Making Questions and Discussion With Lecturers

60.5% of students reported that they sometimes felt willing to ask lecturers for help when they encountered difficulties in learning applied microbiology, while 27.9% were always eager to ask, and 11.6% had no intention of asking questions (**Figure 6**). In education, a two-way communication approach is essential to achieve effective learning outcomes (Mercer, 2002). The results indicate that most students enrolled in applied microbiology are motivated to ask questions and engage in discussions when they face difficulties. However, a few students showed reluctance to ask questions or participate in discussions, either in class or outside of it.

Perception of Students on Making Group Discussion

65.1% of students reported that they occasionally participated in group discussions with their classmates, 30.2% did so every time, 2.3% once, and 2.3% never participated. 48.8% engaged in both virtual and in-person communication, while 20.9% communicated only in person. Among those who used virtual communication, 16.3% preferred Viber, and 4.7% used Facebook Messenger. Additionally, 9.3% of students used smartphones for discussions.

For study and literature collection, 53.5% of students used YouTube and Google, 25.6% relied solely on Google, and 11.6% utilized YouTube, and 9.3% used all digital platforms (YouTube, Google, Instagram, and Facebook). However, no students used only Instagram or Facebook for this purpose (**Figure 7**).

The survey results indicate that most students occasionally engage in discussions with their classmates. This suggests that students value exchanging knowledge, ideas, and opinions. Such collaborative learning habits should be encouraged, not only within microbiology groups but also across other fields of study. The university should support and facilitate more group discussions by organizing seminars, presentations, and group assignments. In today's digital age, information is easily accessible online, and communication is facilitated through smartphones and laptops. Students seem to prefer using Viber over Facebook Messenger. Nonetheless, the data indicates that students are effectively utilizing ICT tools and digital platforms for discussions and self-study.

Perception of Students on Assessment Methods for Learning

18.6% of students preferred the microbiology practical exam format with multiple-choice questions (MCQs) the most, 76.7% preferred it more, and 4.7% preferred it the least. 72.1% of students favored recapitulation practices at the end of the lecture, while 27.9% preferred it the most (**Figure 8**).

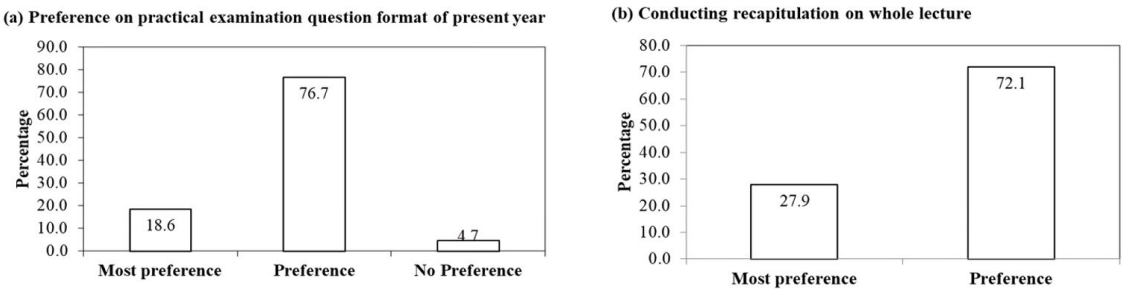

Figure 8. Perception of students on assessment methods for learning (N = 43) (Source: Authors' own elaboration)

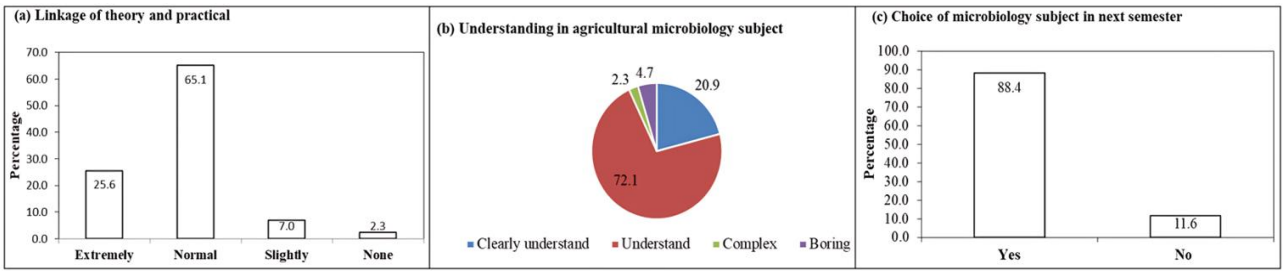

Figure 9. Perception of students on linkage, understanding and satisfaction in the subject (N = 43) (Source: Authors' own elaboration)

Assessment is crucial for promoting effective learning (Sambell et al., 2012). Various assessment methods are available, including exams, open-book exams, MCQs, essays, coursework, learning journals, portfolios, presentations, posters, and peer or self-assessment. In higher education, question formats should aim to assess students' critical thinking and comprehension, rather than focusing on rote memorization and repetitive techniques that emphasize memory recall over deeper understanding (Bhattacharya, 2022).

In the applied microbiology subject, when the MCQ format was used, nearly all students expressed a preference for it, although a few still disliked it. Most students also favored recapitulation practices, where they presented their findings and shared experiences after completing practical sessions. This approach encourages student engagement, allows for the sharing of learning experiences and ideas, and promotes verbal interaction between classmates and instructors. It also helps students identify challenges they faced during the session and encourages more introverted students to open up (Goedhart et al., 2019).

Perception of Students on Linkage, Understanding, and Satisfaction in the Subject

25.6% of the students responded that the contents of applied microbiology theory and practical were very reliable, 65.1% answered reliable, 7.0% less reliable and 2.3% not reliable. 72.1% of the students responded that they understood agricultural microbiology, 20.9% answered clearly understand, 2.3% answered it was difficult to understand and the rest 4.7% answered boring. 88.4% of the students were satisfied with the answers given by the teachers when they had queries while 7.0% satisfied moderately and 4.7% did not satisfy the response given by the teachers (**Figure 9**).

Linking theory and practical aspect of agricultural microbiology is essential for enhancement of understanding, skills development, problem solving ability and innovation and research, etc. Theory provides foundation knowledge and principles of microbiology, explaining how microorganisms interact with plants, soil, and environment. Practical conducting allows students to see these principles in action, reinforcing theoretical concepts through hands-on experiences (Amaral et al., 2020). We prepared a corresponding practical course following theory might be the reason for students' positive responses. Presenting information to children, giving explanations and answering students' questions are three of the main activities in which teachers engage (Eggen & Kauchak, 2004). Poor explanation creates learning problems for the students. In AMB, lecturers explain the subject not only through guidebooks but also with the support of visual aids, using ICT tools such as digital projectors for clear understanding of the students. Results of students' satisfaction on teacher's explanation showed that the lecturer can provide clear and concise answers, it helps students understand complex concepts more easily. However, a negative response by a few students still remained.

Perception of Students on Interest, Happiness, and Choice of the Subject

60.5% of students reported that they gained more interest, 32.6% expressed interest, and 7.0% showed little interest in the applied microbiology subject. 62.8% enjoyed the applied microbiology classes all the time, 34.9% enjoyed them occasionally, and 2.3% felt the class was normal. 88.4% of students indicated they would be willing to select microbiology as a subject in the next semester, while 11.6% were not (**Figure 10**).

When asked about their interest in the applied microbiology subject, most students expressed positive feedback and enjoyment. It can be assumed that their interest and satisfaction are derived from the opportunity to conduct practical experiments, solve real-world problems, use advanced technology, and explore career prospects. Additionally, students appreciated a comfortable teaching environment that minimized learning pressure. However, some students felt they lacked

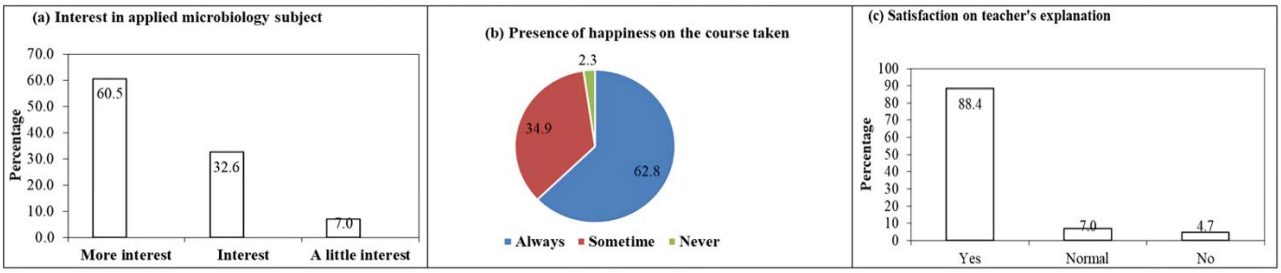

Figure 10. Perception of students on interest, happiness and choice of the subject (N = 43) (Source: Authors' own elaboration)

these benefits. Regardless, the majority expressed a willingness to choose agricultural microbiology-related subjects in the next semester, given the opportunity. Understanding these factors can help lecturers refine their teaching strategies to make applied microbiology more engaging and relevant for all students at YAU.

Comments on the Students

Students provided a range of feedback on teaching methodology, academic performance, their interests, and suggestions for agricultural microbiology. Most students highlighted the importance of more engaging practical activities, group discussions with classmates and lecturers, and the inclusion of relevant diagrams and illustrations in the text to enhance their understanding of the applied microbiology subject.

CONCLUSION

We explored a few surveys related to students' perception on microbiology subjects in the field of agriculture. Present investigation highlighted key aspects of teaching quality, teaching aids, improvement of theory and practical contents. We hope this departmental analysis will empower teaching staff to design a more effective agricultural microbiology program and adopt a student-centered approach. However, the number of subjects loaded on present teaching staff can be encountered to perform effective teaching of theory and practical. Thus, we should consider restructuring the courses and reduce the number of subjects to assure effective learning outcomes through a balance of theoretical understanding and practical application.

Author contributions: YYM: conceptualized and designed study, conducted data analysis, and drafted the initial manuscript and finalized; **TNK:** contributed to the study conceptualization and methodology and data analysis and provided feedback on the original draft; **MM:** assisted with the data entry; **HHH:** provided feedback on the manuscript; & **MTH:** assisted with the reference arrangement. All authors have sufficiently contributed to the study and agreed with the results and conclusions.

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Ethical statement: The authors stated that the study did not involve human or animal subjects. Ethical approval was not required. Informed consents were obtained from students before starting this study. The authors further stated that all participants willingly provided their feedback via google form, and the answers were kept as confidential. Data was analyzed only for this study, and no more intention to use for any other purposes. No personal or sensitive data were collected.

AI statement: The authors stated that no AI technologies were used in any part of this study.

Declaration of interest: No conflict of interest is declared by the authors.

Data sharing statement: Data supporting the findings and conclusions are available upon request from the corresponding author.

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