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Students' theses as tool for prospecting major courses in biology study program

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ABSTRACT

Students in the Department of Biology at Andalas University are required to write a thesis based on one of ten core subjects: animal systematics, plant systematics, animal ecology, plant ecology, microbiology, genetics, animal physiology, plant physiology, animal structure and development, and plant structure and development. This study analyzed the dynamics of student interest in these subjects as thesis topics from 2000 to 2019. A total of 1,201 thesis titles were analyzed descriptively based on the average and frequency per year, and visualized in tables and graphs. The results showed that microbiology was the most popular (14.7 theses/year), followed by plant physiology (9.8) and animal systematics (9.4). The two least popular fields were animal and plant structure and development (fewer than two theses/year). Unstructured interviews with final-year students revealed that the availability of supervisors, research funding, and laboratory access were the primary factors influencing topic selection. Theses with a single topic were more numerous than those with mixed topics. Integrating two or more courses into one thesis can be a solution to increase interest in less popular courses. If this approach is not effective, it may be worth considering removing the course from the elective list for the final project. The implications of these findings suggest that enhancing interdisciplinary research opportunities might also encourage broader topic selection. Continuous evaluation of the curriculum is necessary to ensure that elective subjects remain relevant and aligned with students' interests and departmental capabilities, potentially leading to curriculum refinement or restructuring.

INTRODUCTION

The development of science and knowledge cannot be separated from ongoing research in various scientific fields (UNESCO, 2010). Research is defined as a series of activities involving observation in the field or laboratory, analysis, and summarizing the facts gathered from observation to understand and provide solutions to research problems (Hadi & Haryono, 2005). Universities and colleges, as part of the higher education system in Indonesia, also apply research to develop the capacity of their faculty staff, as well as other scholars employed in the respective disciplines. For university or college students, the results from their research will be embodied in the form of a thesis. For students, a thesis is not only a means to train them in conducting research, but also to develop their capabilities in thinking, analyzing, outlining findings, and writing them

concisely (Chandra, 2015). Completing a thesis will also help enhance students' communication skills, as they will need to actively seek advice from advisers and other faculty staff to develop their thesis. Additionally, in most universities and colleges, students are required to present their thesis in seminars, where they respond to questions from the audience.

The students in the Biology Department, Faculty of Mathematics and Natural Sciences, Universitas Andalas (hereinafter referred to as the Biology Department), are not exempt from this thesis obligation before being considered eligible for a bachelor's degree. According to the latest academic book used in the department, students can start their thesis proposal as early as their fifth semester with a cumulative 120 credit hours (Tim Akademik Jurusan Biologi, 2015). Upon presenting and approving a seminar proposal, students can proceed with research to collect data that they will analyze and document as their thesis. There have been ten major clusters of biology courses appointed in the Biology Department from which students can opt for their theses. These major courses consist of animal systematics, plant systematics, animal ecology, plant ecology, microbiology, genetics, plant physiology, animal physiology, animal structure and development, and plant structure and development (Tim Akademik Jurusan Biologi, 2015).

The Biology Department has implemented a competence-based curriculum since the early 2000s, which influences not only the learning process but also affects thesis completion. Until recently, there have been some revisions to the curriculum system without altering the major courses that serve as the backbone of education in the department. Hence, this paper aims to provide an analysis of students' interest in selecting a specific major course as their thesis topic. It is an important consideration in directing the future development of the department's academics.

METHOD

This study primarily employed a quantitative approach by reviewing the metadata from students' theses that were graduated between 2000 and 2019. These theses are stored in the reading room of the Biology Department. The query excluded theses from graduate students, focusing only on the undergraduate ones. The theses are then grouped on the basis of publication year, regardless of the differences in students' register numbers or their year of graduation. A qualitative approach was also employed through an unstructured interview conducted with students who visited the reading room, primarily asking them about the factors that influenced their choice of research topic for their final thesis and which laboratory they would work in to conduct their research.

This research used a literature review as the method. This method has been recognized as reliable to analyse and synthesize the data needed to answer the research problem mentioned above (Ramdhani et al., 2014; Snyder, 2019). The metadata from the theses are sorted and tabulated using the criteria such as publication year, major course of the thesis, and the nature of the discipline used in research. The latter criterion is divided into (1) pure, if it only uses one major course as a research topic, and (2) mixed, if it uses more than one major course as a research topic. After curating and confirming the metadata, the analysis focuses on the tendency of certain major courses to be opted for as thesis topics by students. This analysis was also assisted by the information gained from students' interviews, which served as qualitative data. The findings are then presented descriptively using frequency tables and figures. The information gained from

interviewing students will also be used to address tendencies and other phenomena observed from the metadata.

RESULTS AND DISCUSSION

Total Theses and Total Theses Per Year

In total, there are 1.201 undergraduate theses published in the Biology Department between 2000 and 2019, with an average of 60.1 theses published per year. Only 26 theses were recorded in 2000 (Figure 1), making this year the lowest number of theses published. This number gradually increased toward the next two decades, especially after the Biology Department accepted more students into the undergraduate program using regular and non-regular university entrance pathways (Tim Akademik Jurusan Biologi, 2015). Even in 2018, the department published 101 theses, which is the highest number of theses published this year. The adjustment in the curriculum system also played a role in accelerating the study period for students, allowing them to complete the thesis proposal, research, and thesis defense as early as possible. The efforts from the Biology Department are in line with the general indicators for a successful undergraduate program in one of faculties in a particlar university, which include a higher index of graduation, shortening students' study period, and higher opportunity to get a job upon graduation (Siswanto & Sampurno, 2015).

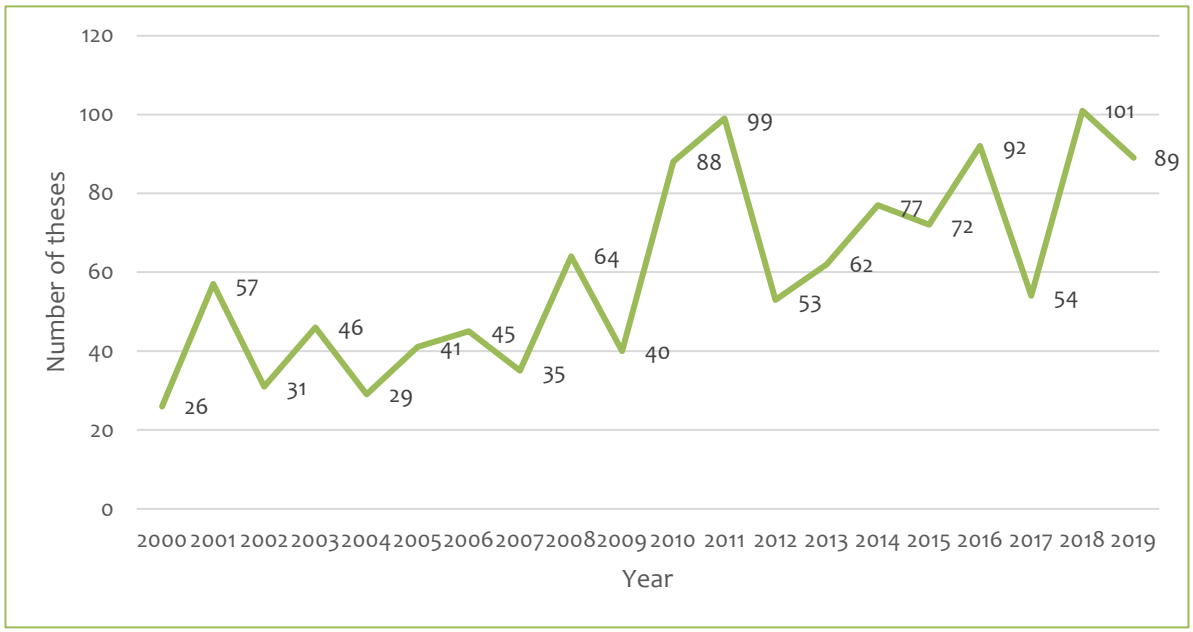

Figure 1. Theses published per year in Biology Department from 2000 to 2019

The advance of information and communication technology (ICT) post 2000, followed by the integration of ICT into the education system, has significantly contributed to assisting the learning process, including the completion of students' final theses (Ghavifekr et al., 2012). Students have more access to ICT facilities and infrastructure provided by the university or third parties involved in education, hence they are more supported by a dynamic and proactive teaching-learning environment (Arnseth & Hatlevik, 2010). Unlike the pre-2000 era, when students had to physically search for learning and research materials in the library, the presence of ICT in the education

system provides them with unimpeded access to online educational content, anytime and almost anywhere they have an internet connection. In this way, students can familiarize themselves with sufficient literature that helps them complete the thesis.

Supervisors are essential in guiding the students through every phase of their thesis completion. A good supervisor can greatly motivate students under their supervision, sometimes providing literature regarding students' theses, as well as overseeing students' work, despite each student having a different academic performance (Darling-Hammond et al., 2017; Wu et al., 2024; Zackariasson & Magnusson, 2024). In connection with this, the Biology Department has progressively added new faculty members to its academic staff roster, ensuring the availability of lecturers in all the department's major courses, as well as acting as thesis supervisors for students. This could also mean shortening the waiting time for students to have a thesis supervisor assigned to them.

Theses Per Major Courses

Through the curating and sorting of thesis metadata, it has been revealed that the population of theses published per year in each major course taught in the Biology Department (Table 1). Microbiology, with a total of 293 theses and an average of 14.7 theses per year, becomes the major course that publishes the most theses. Shortly followed by Plant Physiology (total 196 theses and average per year = 9.8) and animal systematics (total 188 theses and average per year = 9.4). Two major courses, namely Animal Structure and Development and Plant Structure and Development, fall behind, with a total of 31 and 21 theses, respectively, and significantly fewer than two theses published per year. These two major courses may still appear to have the fewest publications during the period from 2000 to 2019; however, a thorough examination of the yearly details reveals that these major courses went some years without any publications at all (Figure 2). It differs from courses such as Plant Systematics and Genetics, which, although they have only published theses, have consistently published at least one thesis per year. Animal Physiology, on the other hand, has shown a significant increase in thesis publications since 2014, following a period of stagnancy of around eight years.

Table 1. Total theses during the period 2000-2019 and average theses per year for each major course in the Biology Department

Biology Major Course	Total publication	Average theses per year	Min	Max
Animal Systematics	188	9.4	3	21
Plant Systematics	96	4.8	0	11
Animal Ecology	128	6.4	0	19
Plant Ecology	126	6.3	0	20
Microbiology	293	14.7	6	31
Genetics	55	2.75	0	9
Plant Physiology	196	9.8	3	29
Animal Physiology	70	3.5	0	18
Animal Structure & Development	31	1.55	0	4
Plant Structure & Development	21	1.05	0	4

During the interview with students, they expressed what helps them decide which major course to pick for their research and thesis topic. The reputation of the laboratory, in which the major course houses its research and the respective staff, becomes the main consideration.

Students typically seek advice from senior students who are already established in a specific laboratory. The advice typically concerns the availability of assigned supervisors in the laboratory, the financial funding secured by laboratory staff and lecturers, any ongoing projects where they can be involved, and the academic atmosphere established within the laboratory. Students usually consider their seniors' advice more, given that they come from a party that has experienced firsthand situations in the laboratory they target.

Some laboratories, along with major courses involved within, are considered as 'tough' subjects for being research and thesis subjects. This assumption was based on qualification that required from the students who want to join that laboratory, including high grade point average (GPA), earning minimum grade point on prerequisite courses and having clear vision on research they want to do in that laboratory. To some extent, this 'toughness' is also perceived by students emanating from the lecturers that teach in the respective courses. Lecturers, in general, are required to have good work ethic in learning process they bring to students. However, some of them bring this work ethic into another level that most students may find themselves overwhelming to go with. These 'tough' courses are actually passable, by recalling that the role of lecturer as supervisor is pivotal to guide students through their researches and theses process (Purwanto, 2007). It is indeed that some students convincingly proved that only their hard work and self-motivated-ness that can bring them to success.

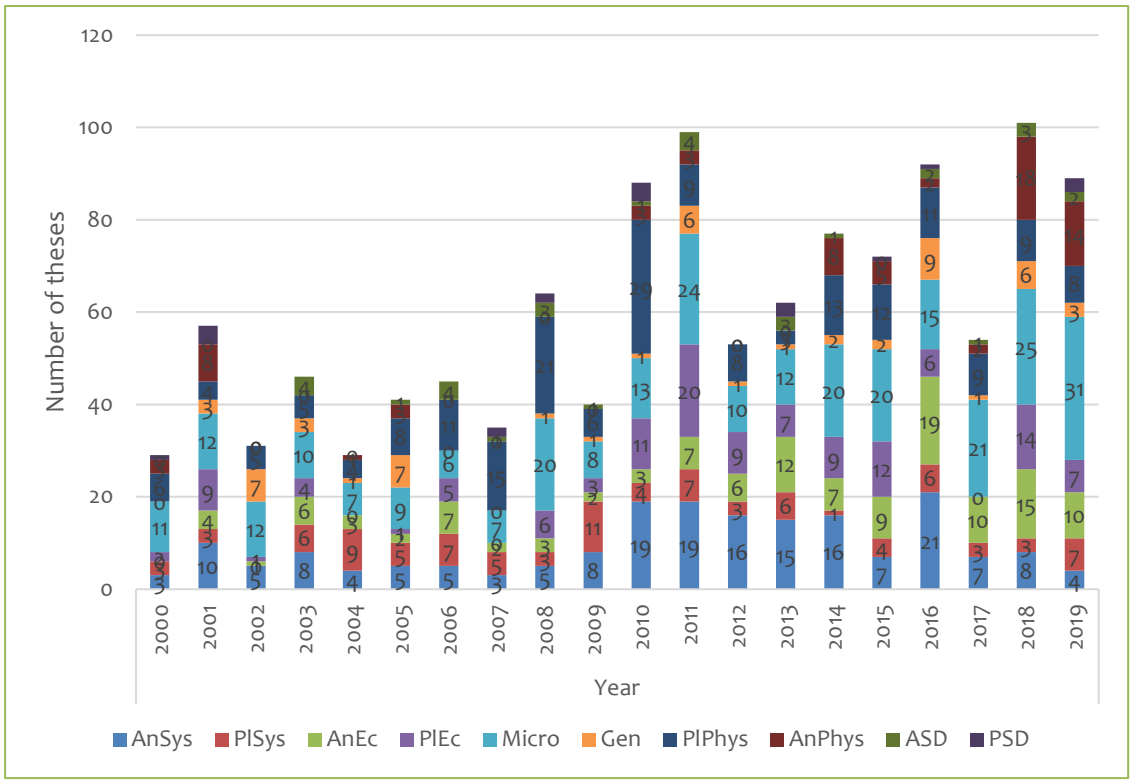

Figure 2. Undergraduate theses per major course as research topic between 2000-2019

Pure versus Mixed Topic Theses

Some research questions are sufficiently defined through the use of a single major course as the guiding discipline. Some, however, require more than one standpoint to analyze the answers to the questions. This second initiative is the emergence of interdisciplinary research in biology, which not only integrates between major courses in biology, but also with other fields of

knowledge (Burke & Costa, 2019). Using interdisciplinary and mixed methods between disciplines as ways to view and analyse the data and findings in research will give more insight for students and scholars to investigate their research questions and formulate solutions (Klein et al., 2005).

The theses published in the Biology Department between 2000 and 2019 also used these two types of research (Figure 3). Despite having been used since 2000, interdisciplinary research in biology was still lower than pure disciplines in terms of publication volume, with 949 theses in total (an average of 47.5 theses per year) versus 252 theses in total (an average of 12.6 theses per year) respectively. Some students expressed their concern to not use interdisciplinary research for their theses as it has degree of complexity and require more time and techniques in doing the analysis. Using this type of research also requires supervisors from different disciplines, which may be thought by students to imply them as another administrative complexity. Hence, staying with pure discipline thesis research becomes more preferable in this sense.

Implication for Future Academic in Biology Department

Through the curating and sorting on thesis metadata, it has been revealed the population of published theses per year in each major course taught in Biology Department (Table 1). Microbiology, along with Animal Systematics and Plant Physiology, become the most stable course in term of annual thesis publication. While other courses ever experienced null-thesis publication at certain years of their running, these three courses could stay with a handful of theses published. The reasons are probably from the availability of lecturers from these courses to supervise students' theses within the range of course disciplines, as well as some other factors revealed from the interview.

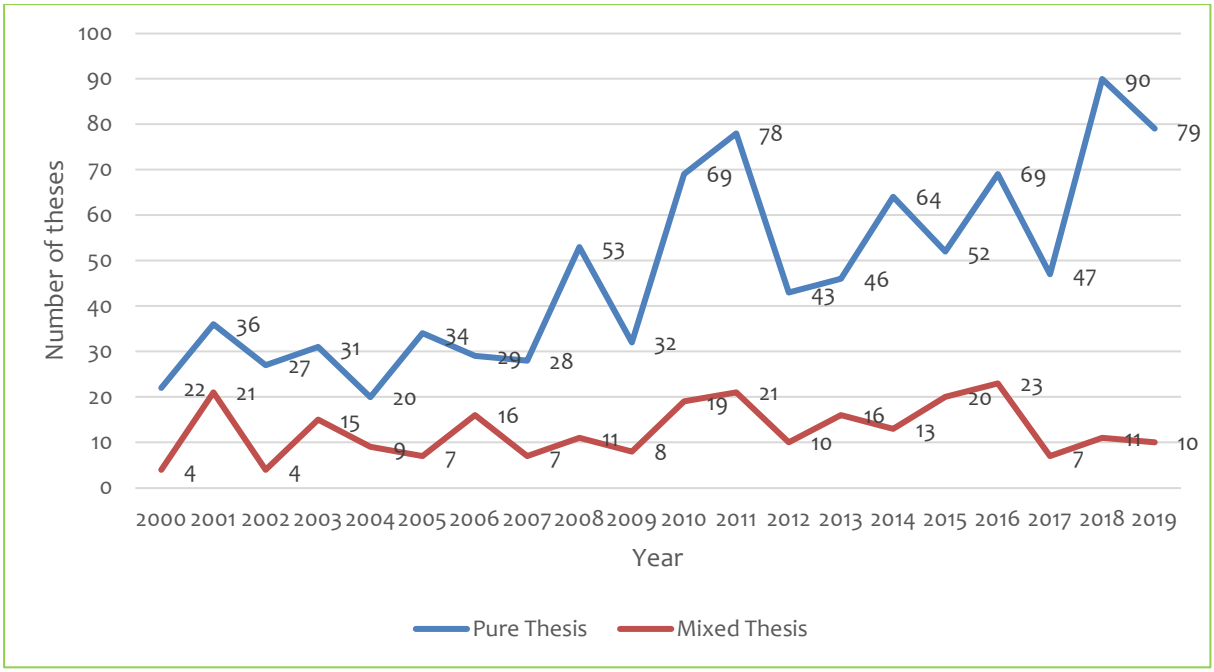

Figure 3. Pure and mixed topics theses in the Biology Department between 2000 to 2019

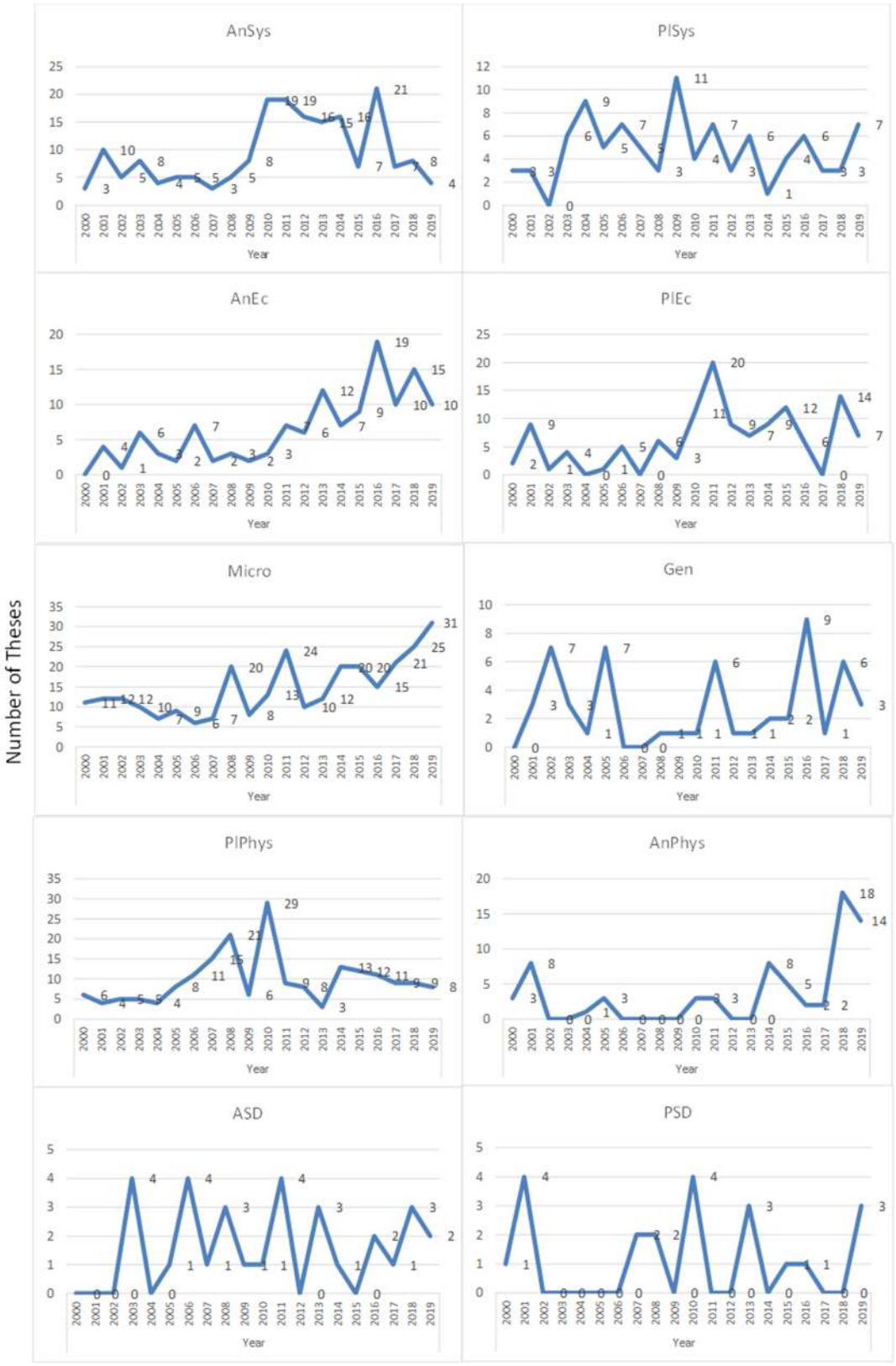

Figure 4. Individual publication statistic with topic related to each major course taught in Biology Department between 2000-2019. AnSys = Animal Systematics, PlSys = Plant Systematics, AnEc = Animal Ecology, PlEc = Plant Ecology, Micro = Microbiology, Gen = Genetics, PlPhys = Plant Physiology, AnPhys = Animal Physiology, ASD = Animal Structure and Development, PSD = Plant Structure and Development

Microbiology is a course that is taught and guided by at least six lecturers (Tim Akademik Jurusan Biologi, 2015). It provides a minimum of more than 20 slots for these supervisions, which are only offered by lecturers from this course. Animal Systematics employs a different strategy to accommodate more students, despite being taught by around four lecturers. Students who work on their theses in this topic can be supervised by lecturers from other courses without having to do the mixed topic theses. Essentially, each lecturer in the Biology Department has experience in conducting species-based research, which makes them somewhat reliable for supervising theses that are based on the disciplines of systematics and taxonomy. On the other hand, according to some interviewed students, plant physiology (either its lecturers or laboratory) appeals to them because it provides lessons and practice on plant tissue culture. This subject, along with the relatable working atmosphere in the laboratory, is found to be attractive, especially for students who want to conduct research in a sophisticated yet relaxing environment. The lecturers and laboratory of these three courses frequently secure research grants from various sources, ensuring the more capability to financially support student during their research tenure. Both supervisor availability and financial support are essential for accelerating thesis completion (Yendri, 2019).

The other courses, aside from those three above, experienced various scarcities in thesis publishing across the years (Figure 4). Yet, only the Animal Structure and Development course, along with its counterpart, Plant Structure and Development, exhibits some worrisome dynamics. These two courses are currently only taught and guided by one or two lecturers. Some students expressed concern about the lack of other resources in these courses' laboratories that could support student research. Hence, this situation forces them to think twice before taking on a thesis project there. A similar case was previously observed with Animal Ecology and Animal Physiology courses, which experienced zero to very minimal productivity between 2000 and 2010, yet bounced back with a significant number of publications in recent years. Again, the addition of faculty staff and grant procurement within these two courses and laboratories helped boost the number of research projects and, in turn, the students' theses published from those projects. In many global higher education institutions, funding availability becomes essential to sustain the productivity of staff and laboratories under their authority (Bozeman & Gaughan, 2007; Jacob & Lefgren, 2011; Zvobgo, 2022).

Promoting mixed-topic theses among students can be a good solution for helping the low-productivity courses to achieve better performance. Some courses, such as Animal/Plant Structure and Development, can be considered 'stagnant' disciplines; recall that no further significant scientific advancements have been made in the last few decades, even on a global level. Students cannot easily identify any research gaps within these disciplines that they can address through their research and theses. Integrating these less-favorable courses with other major courses to create mixed-research topics can be a promising solution. Mixed-research topics were quite prominent research themes for students in the biology teaching program, in which they do research by combining biology majors with other majors outside biology (Gul & Sozbilir, 2016).

CONCLUSION

This study aims to explore the dynamics and potential future directions of ten major courses taught in the Department of Biology at Universitas Andalas, as reflected in the theses produced by each laboratory that supervises them. The summary of more than 1,200 student theses in the

Biology Department clearly indicates that the major courses, such as Microbiology, Animal Systematics, and Plant Physiology, greatly attract prospective students to conduct research and publish theses under these topics. Some others may have experienced stagnation somewhere in their tenure, yet have shown some improvement recently, such as in Animal Ecology or Animal Physiology. These can provide a thorough picture of the current academic situation in the department and help direct future development. Promoting mixed-topic theses may help solve the thesis publication stagnation problem observed in Animal/Plant Structure and Development courses. In the future, aside from monitoring the scientific output produced by the most favorable major courses along with their staff and laboratories, it is also useful to help nurture those less favorable major courses through various efforts mediated by department authority.

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