UNNES
UNIVERSITAS NEGERI SEMARANG

FACULTY OF MATHEMATICS AND NATURAL SCIENCES

PROGRAMME HANDBOOK

NATURAL SCIENCE EDUCATION

CURRICULUM

BACHELOR OF NATURAL SCIENCE EDUCATION (BSE)

FACULTY OF MATHEMATICS AND NATURAL SCIENCES
UNIVERSITAS NEGERI SEMARANG
2025

PROGRAM TITLE	:	Bachelor of Natural Science Education (BSE)
Location of the study program HEI site(s) where the program is provided	:	https://unnes.ac.id/mipa/s1-bachelor-of-natural-science-education/
Faculty/Department	:	Faculty of Mathematics and Natural Sciences
Academic Degree	:	Bachelor's degree
Date or planned date of introduction	:	6 April 2009 (Decree No. 498/D/T/2009)
First time of national and international accreditation	:	18 October 2012 (Decree No. 032/BAN-PT/Ak-XV/S1/X/2012) – National Accreditation (B)
Current accreditation	:	Excellent No. 1013/SK/LAMDIK/Ak/S/X/2023
Subject field	:	Science Education, Natural Sciences, Biology Education, Chemistry Education, Physics Education, Environmental Science Education, Curriculum Development, Ethnoscience and Local Wisdom, Educational Technology
Regular study duration	:	8 Semesters (Bachelor of Education)
Number of (ECTS) credits	:	144 SKS (216 ECTS)
Enrollment period(s)	:	Odd Semester
Frequency of the offered programme	:	Annually
Capacity per year	:	100
Number of students currently enrolled	:	421
Average number of graduates per year	:	90
Target group(s)	:	High school students
Admission requirements	:	The international students need to hold a high school degree and have TOEFL-*like* minimal 450/TOEFL IBT 60/IELTS 4/ TOEIC 500/Duolingo English Test 80. Applicants who come from English-speaking countries or graduated from a program/class conducted in English may attach the official letter from school as a replacement for TOEFL/IELTS scores.

Tuition fees (avg)	**:**	Rp. 4.167.450 (€255,84)
Type of studies	**:**	Full-time
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FOREWORD

The curriculum development at Universitas Negeri Semarang (UNNES) is designed to address educational needs that are relevant to global developments by emphasizing learning outcomes, sustainability, and meaningful impact on students and society. The concepts are further elaborated as follows:

1. *Outcome-Based Curriculum*:

This approach emphasizes the attainment of clearly defined competencies and learning outcomes for students. Each study program is systematically designed to achieve specific educational objectives, while assessment is conducted to determine whether students have attained the expected outcomes in knowledge, skills, and attitudes. This curriculum ensures that students acquire not only theoretical knowledge but also practical skills relevant to professional contexts and global challenges. Consequently, it supports the development of competent, work-ready human resources in their respective fields.

2. *Sustainable Curriculum*:

A sustainable curriculum focuses on developing academic capacities that remain adaptable to evolving societal demands and contribute to achieving the Sustainable Development Goals (SDGs). It also integrates social, economic, and environmental issues into the learning process. The sustainable curriculum aims to prepare students to address global challenges, including environmental crises and social inequalities. It encourages students to apply their knowledge to generate solutions that benefit not only themselves but also society as a whole.

3. *Impactful Curriculum*:

An impactful curriculum is designed to generate tangible effects on student development, society, and the surrounding environment. This includes applying knowledge in real-world contexts through experiential learning activities such as internships, research projects, and community engagement programs. Through this approach, UNNES seeks to produce graduates who are not only academically competent but also capable of making meaningful contributions to societal development. Graduates are expected to provide solutions to social and economic issues at both local and global levels.

Overall, the aforementioned branding reflects a holistic curriculum that integrates knowledge, skills, and social values within the learning process, in order to graduate students who are not only academically accomplished but also demonstrate strong commitments to sustainability and positive societal impact. Characteristics of the Impactful Curriculum are a) Outcome-oriented, emphasizing what graduates are genuinely capable of performing after completing their studies, b) Relevant to societal and workforce needs, addressing contemporary challenges such as digital transformation, climate change, social equity, and related issues, c) Transformational, not merely transmitting knowledge, but also shaping students' ways of thinking, values, and actions, d) Measurable impact, incorporating assessment mechanisms to evaluate whether the curriculum achieves its intended outcomes, for example, through tracer

studies, social impact assessments, or graduate contributions, e) Inclusive and sustainable, targeting all segments of society while promoting long-term transformation.

Semarang, January 2025
Rector

Prof. Dr. S. Martono, M.Si.

PREFACE

This curriculum has been developed as part of the revision and refinement of the 2020 Bachelor of Natural Science Education (BSE). The revision was also intended to anticipate the rapid transformation of educational directions in Indonesia. The development of the BSE curriculum, in line with its historical trajectory, began in 2015 by adopting the generic descriptors of the Indonesian National Qualifications Framework (**KKNI**) adjusted to the corresponding qualification levels and aligned with the **Regulation of the Minister of Research, Technology, and Higher Education No. 44/2015**. By the 2017/2018 academic year, the implementation had progressed to its third year. Curriculum development has been conducted through systematic, structured, and realistic procedures. With the enactment of **the Regulation of the Minister of Research, Technology, and Higher Education No. 44/2015,** replacing **Regulation No. 49/2014**, as well as **Regulation No. 55/2017** concerning Teacher Education Standards, it became necessary to review and revise the 2015 Curriculum. The BSE curriculum review evaluation led to the reconstruction of courses, while the curriculum refinement evaluation resulted in the reconstruction of Semester Learning Plans (RPS) in 2018. Subsequently, further evaluations and refinements transformed the 2018 Curriculum into the 2020 Curriculum.

The evolving dynamics of education in Indonesia, particularly following the issuance of **the Regulation of the Minister of Education, Culture, Research, and Technology No. 53 of 2023**, emphasize that learning materials in academic education should primarily prepare graduates to master, develop, and/or apply branches of science and technology. This policy was promptly adopted and addressed by UNNES through **Rector Regulation No. 89 of 2024** concerning Higher Education Standards at Universitas Negeri Semarang (UNNES). This regulation was enacted as a follow-up to the national higher education standards issued by the Ministry of Education, Culture, Research, and Technology. **As a Legal Entity State University (*Perguruan Tinggi Negeri Badan Hukum/PTNBH*), UNNES** envisions becoming a world-class university and a pioneer of excellence in conservation-oriented education. In 2025, these regulations were accommodated within the formulation of **the *UNNES 2025 Curriculum: Outcome-Based, Sustainable, Impactful*.**

Operationally, the development of the 2015 BSE Curriculum was carried out through the following procedures: (1) alignment with prevailing regulations; (2) review of scientific disciplines and expertise; (3) analysis of societal and stakeholder needs; (4) formulation of graduate profiles; (5) formulation of learning outcomes; (6) selection and weighting of subject matters; (7) establishment of courses, credit units, and course descriptions; (8) development of the curriculum structure for each study level; and (9) preparation of Semester Learning Plans (RPS). The current Curriculum for the BSE program was developed through the participation of lecturers, students, alumni, stakeholders, curriculum experts, and the Indonesian Science Educators Association (*Perkumpulan*

Pendidik IPA Indonesia/PPII). We sincerely hope that this curriculum will provide meaningful benefits to all stakeholders.

Semarang, December 2025
Programme Coordinator

Fidia Fibriana, S.Si., M.Sc., Ph.D.

1. Curriculum Foundations

1.1 Foundations of Philosophy

The development and implementation of the higher education curriculum are grounded in a philosophical foundation that offers an in-depth view of the essence of education, people, and society. The philosophies of perennialism, essentialism, progressivism, and reconstruction serve as the main references for formulating the transformative direction and goals of higher education. **Perenialism** emphasizes the importance of universal values and enduring knowledge that shape the character and wisdom of students. Education is seen as a process of forming human beings who are intellectually intelligent and have strong moral principles. **Essentialism** focuses on mastering basic competencies and disciplines essential to life. The curriculum is designed to equip students with intellectual and professional skills that are relevant to the demands of the times. Meanwhile, **progressivism** encourages experiential learning, problem-solving, and student involvement in the learning process. Education is a means of developing individual potential and adapting to social change. Furthermore, **reconstructionism** views education as a tool to build a more just and sustainable society. The curriculum is geared toward forming agents of change who can respond critically to global and local challenges. This philosophical foundation provides guidelines for designing, implementing, and evaluating the curriculum to develop students who understand the essence of life and contribute to improving the quality of life, both personally and socially.

1.2 Sociological Basis

The sociological foundation of the development of the higher education curriculum emphasizes that education does not take place in a vacuum but is firmly rooted in the dynamics of relationships among individuals, society, and culture. The curriculum serves as a reflection and, at the same time, a guide for social transformation by integrating the community's knowledge, skills, and values. The curriculum is designed to form socially conscious individuals, able to understand their roles and responsibilities in a pluralistic society; bridging the interaction between individuals and society, through learning that is relevant to social realities and contemporary challenges; and inheriting and reflecting culture, both local and global, as part of the process of forming student identity and character. In this context, the curriculum must accommodate cultural diversity and values, so that students are able to appreciate differences and contribute to building an inclusive society; providing space for the development of social skills, such as communication, collaboration, and empathy, which are essential in community life; and encourage a critical understanding of social structures, including issues such as inequality, sustainability, and social justice. The curriculum reflects applicable social norms, structures, and values, and must respond to social changes such as family dynamics, cultural pluralism, and technological developments. Higher education, through an adaptive and

transformative curriculum, plays a role as a vehicle for the formation of active, critical, and responsible citizens.

1.3 Historical Foundation

The historical foundation in the development of the higher education curriculum emphasizes that the curriculum must be able to facilitate students to learn according to the context of their time. The curriculum is not only tasked with transferring knowledge, but also inheriting the cultural values and golden history of past nations that are relevant to the present, as well as transforming them into the learning era that is being lived. In facing the challenges of the 21st century, students need to be equipped not only with scientific insights, but also with historical awareness to be able to live better in the midst of social and technological changes. The curriculum is designed to support students' active participation in the Industry 4.0 era as well as develop the ability to read the signs of the Industrial Revolution 5.0. The history of the development of the Curriculum of the BSE programme shows a systematic and continuous process. Starting in 2015, the curriculum was compiled based on the generic descriptors of KKNI and Permenristekdikti 44/2015, then underwent evaluation and reconstruction in the 2017/2018 academic year until the birth of the 2020 Curriculum. The change in the direction of higher education policy in Indonesia, which is marked by the issuance of Permendikbudristek 53 of 2023, emphasizes that learning in higher education must prepare graduates who are able to master, develop, and/or apply branches of science and technology. This change was immediately adapted by UNNES through the issuance of Rector's Regulation Number 89 of 2024 concerning Higher Education Standards which became the basis for the preparation of the UNNES 2025 Curriculum: Learning Outcome-Based Sustainability, Impactful.

The juridical basis is the legal basis that ensures that all stages of curriculum development are carried out in accordance with national and institutional regulations. This curriculum was prepared in order to improve the Curriculum of the 2020 Bachelor of Natural Science Education (BSE) programme and in response to the dynamics of national education that continues to develop. Some of the main regulations that are referenced include Permenristekdikti 44 of 2015 concerning National Standards for Higher Education as a replacement for Permenristekdikti 049/2014, and Permenristekdikti 55 of 2017 concerning Teacher Education Standards. Furthermore, Permendikbudristek 53 of 2023 is the main guide in adjusting the learning substance to suit the profile of academic education graduates. UNNES Rector Regulation Number 89 of 2024 is a follow-up that represents UNNES' commitment as a Legal Entity State University (PTNBH) to provide higher education with international standards and a conservation perspective. The curriculum preparation procedure is carried out systematically and realistically through nine stages: adjustment of regulations, study of scientific fields and expertise, study of the needs of the community and stakeholders, formulation of graduate profiles and learning outcomes, determination of study materials and credits, formation of courses, preparation

of curriculum structure, and preparation of Semester Learning Plan. This curriculum was born from a collaboration between lecturers, students, alumni, curriculum experts, the Indonesian Science Educators Association (PPII), and various stakeholders who have concerns about improving the quality of science education in Indonesia.

1.4 Legal Basis

1. Law of the Republic of Indonesia No. 14 of 2005 concerning Teachers and Lecturers (Statute Book of the Republic of Indonesia No. 157 of 2005, Supplement to Statute Book of the Republic of Indonesia No. 4586);
2. Law of the Republic of Indonesia No. 12 of 2012 concerning Higher Education (Statute Book of the Republic of Indonesia No. 158 of 2012, Supplement to Statute Book of the Republic of Indonesia No. 5336);
3. Presidential Regulation of the Republic of Indonesia Number 8 of 2012, concerning the Indonesian National Qualifications Framework (KKNI);
4. Regulation of the Minister of Education and Culture of the Republic of Indonesia Number 73 of 2013, concerning the Implementation of KKNI in the Higher Education Sector;
5. Government Regulation of the Republic of Indonesia Number 57 of 2021, concerning National Education Standards;
6. Regulation of the Minister of Education and Culture, Research and Technology of the Republic of Indonesia Number 53 of 2023, concerning Quality Assurance of Higher Education;
7. Guidelines for the Preparation of KPT to Support Independent Learning Independent Campus Towards a Golden Indonesia, 2024, Directorate General of Belmawa, Higher Education-Ministry of Education and Culture.
8. Independent Learning Guide – Independent Campus, 2024, Dit Belmawa, Directorate General of Higher Education Research & Technology. Ministry of Education and Culture.
9. Guidelines for the Implementation of the Internal Quality Assurance System for Universities Providing Academic Education, 2024, Directorate of Belmawa, Directorate of Directorate of Education, Directorate of Education, Culture, and Culture.
10. UNNES Rector Regulation No. 89 Th 2024 concerning UNNES Higher Education Standards

2. Vision, Mission, Objectives, and Strategy of the Study Program

2.1 Academic Vision

Scientific vision: Developing science education that **excels** in **mastering technology** and **learning innovations** with a **conservation perspective**.

2.2 Mission

1. Organizing and developing Natural Sciences education in an educational program that is superior, conservation-oriented and internationally reputable
2. Developing and creating science and technology in the field of Natural Sciences education, as well as a civilization that is conservation-oriented and internationally reputable
3. Disseminating science and technology in the field of Natural Sciences education with a conservation perspective and international reputation
4. Building and developing cooperation in supporting the strengthening of internationally reputable institutions

2.3 Program Educational Objectives

The Bachelor of Natural Science Education (BSE) programme aims to produce educators and education personnel with a Bachelor of Education degree in the field of Science Education (S.Pd.) expertise, which has:

PEO 1-Conservation Attitudes/Characters and Visionaries to Face the Future

Graduates demonstrate a scientific, professional, ethical, reflective, conservation-minded attitude, and are committed to instilling environmental, cultural, and social conservation values, as well as being able to appreciate and understand the trends of science education in the future as well as being a driver of positive change in society through sustainable and inclusive science education.

Element: *Attitude, Sustainability Awareness, Ethical Behavior*

Linkage: UNNES Vision, the Character of Conservation Minded Graduates

PEO 2-Mastery of Science Science, Science Education, and TPACK-Readiness *of Technology*

Graduates master the basic competencies of science educators, namely conceptual and procedural knowledge in the field of basic science and integrated science, science education, and have the ability to integrate information and communication technology pedagogically and contextually in accordance with the principles of TPACK for 21st century learning and adequate for their opportunities for further study at a higher level.

Element: *Knowledge of Science, Pedagogical Content Knowledge, TPACK-Readiness of Technology*

Linkage*:* Innovative Educators, Research and Digital Learning

PEO 3-Competent in Education in the field of Science and *Professional Soft Skills*
Graduates have strong 21st century skills, including *Critical thinking, Creativity, Collaboration, Communication, Citizenship,* and *Character-building*, demonstrate personal, professional, pedagogical, and social competencies, as well as demonstrate leadership skills and social responsibility in the practice of Science Education, research in order to develop Science Education, and competence in the dissemination of the field of Science Education through education and training.
Element: *6C, Teacher Professional Competencies, Social Leadership*
Linkage: Professional competence of educators, role of society
PEO 4-Innovative and Adaptive in Science and Science Education Technology with a Conservation Perspective
Graduates are able to design and implement innovations in science-based learning and research in science and science education, as well as develop contextual, collaborative, and data-based science learning resources and tools that are conservation-oriented (ethnoscience and local wisdom).
Element: *Science Learning Specific Skills, Research and Innovation Capacity, Learning Resource Management*
Linkage: Researcher and Educational Resource Manager

3. UNNES Value

As part of UNNES, the BSE programme upholds the core values of UNNES which are the philosophical, sociological, and historical foundations in the implementation of higher education. These values include:

World Reputable

a) The study program is committed to producing graduates who are able to compete globally through mastery of technology, learning innovation, and scientific communication skills.
b) Curriculum development is carried out with reference to international standards and supports cross-border academic mobility.

Educational Excellence

a) The study program supports the implementation of Independent Learning Independent Campus (MBKM), differentiated education, and inclusion for students with disabilities.
b) Learning is designed to accommodate the diversity of students' potential through a personalized approach and career path flexibility.

Conservation Insights

a) The entire process of education, research, and community service is based on the spirit of environmental, cultural, and social conservation.
b) The curriculum integrates ethnoscience, local wisdom, and continuing education as part of the scientific identity of the study program.

These UNNES values are the foundation for forming graduates who are not only academically competent but also have character and ethics, and who actively contribute to sustainable community development.

4. Graduate Profile (GP) & Summary of Graduate Learning Outcomes (PLO)

Table 1. Graduate *Profile* and description

No	Graduate Profile	Graduate Profile Description
GP1	Science Educator	Graduates proficient in pedagogical and natural science foundations can serve as science instructors and learning facilitators. Moreover, graduates exhibit the professional competencies required for twenty-first-century science educators. They can develop and execute student-centered, innovative, contextual, and technology-driven science teaching that aligns with scientific progress and integrates environmental, social, and local knowledge into their learning in the digital era.
GP2	Research Assistant in Science Education	Graduates possess proficiency as the early-career researchers with skills in science education and scientific inquiry who engage in investigations in the field of science education and contribute to the advancement of scientific knowledge, educational policies, or science-based solutions to address community issues, subsequently disseminating their findings in scientific forums or publications.
GP3	Science Education Resource Manager	Graduates possess managerial competencies as designers, managers, entrepreneurs, and evaluators of science education resources, including classrooms, laboratories, schools, and both educational and non-educational institutions. They are competent at managing natural, human, material, technological, educational, and environmental resources in an efficient, inclusive, and sustainable data-driven manner, aligned with modern needs.

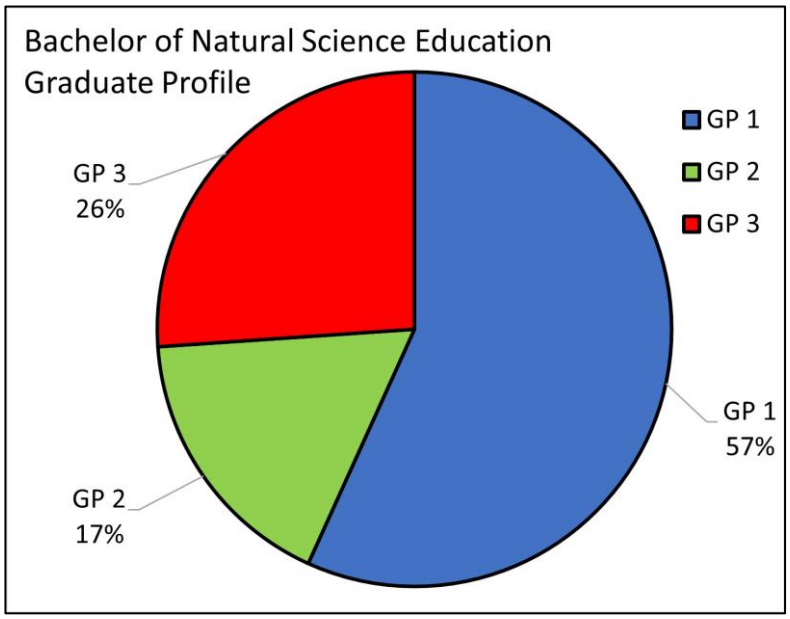

Figure 1. Graduate Profiles (GPs) of BSE UNNES from 2020-2025

5. Program Learning Outcome (PLO)

The Program Learning Outcomes (PLO) of BSE programme at UNNES are formulated through a systematic mechanism grounded in national regulations. The framework is structured with clear components: Observable Action (behaviours measurable according to Bloom's taxonomy), Expected Level or Standard (aligned with IQF Level 6), Discipline Specific (tailored to the field of Natural Science Education), and Description of How to Achieve the Action (through learning, practice, and assessment). These outcomes are designed to underpin the development of courses. Table 2 presents the alignment between the PLO and GP. The mapping illustrates how each PLO supports the competencies, attitudes, and professional characteristics expected in the graduate profile, ensuring coherence between curriculum design, learning outcomes, and the envisioned roles of graduates in science education.

Table 2. Relationship between Programme Learning Outcome and Graduate Profile

No	Programme Learning Outcome	Domain (Cognitive, Affective, Psychomotoric)	Graduate Profile		
			GP1	GP2	GP3
PLO 1	Graduates understand how to apply knowledge acquired from various general and professional foundational courses to design knowledge-based solutions that are relevant to social, cultural, and environmental sustainability.	C: Mastery of educational concepts and knowledge	√√√	√√√	√√√
PLO 2	Graduates are able to apply practical skills in their field of expertise, including collaboration, communication, critical thinking, and the design and evaluation of science-based activities in the context of work, research, and community service.	P: Ability to design and implement innovative, contextual learning; science learning processes and laboratory experiments	√√√	√√√	√√√

No	Programme Learning Outcome	Domain (Cognitive, Affective, Psychomotoric)	Graduate Profile		
			GP1	GP2	GP3
PLO 3	Graduates demonstrate a commitment to conservation and inclusivity by considering the relationship between resource utilization and professional conduct that upholds human values, ethics, and sustainability in education.	A: Social responsibility, ethics, and integrity	√√√	√√√	√√√
PLO 4	Graduates integrate basic and interdisciplinary science knowledge with pedagogical skills and collaborative attitudes to design contextual science learning based on environmental, social, and local cultural issues in an innovative, reflective, and student-centered manner.	A: Collaborative, innovative, and reflective attitude; C: Integration of basic and interdisciplinary science knowledge; P: Pedagogical skills for contextual science learning	√√√	√√	√
PLO 5	Graduates apply the TPACK-Readiness of Technology framework to select and utilize information technology and integrate it effectively and ethically into the design of science learning and teaching materials, with an adaptive attitude toward technological	A: Ethical, adaptive; C: TPACK framework, technological knowledge; P: Use of ICT, instructional design, mastery of educational technology	√√√	√√	√

No	Programme Learning Outcome	Domain (Cognitive, Affective, Psychomotoric)	Graduate Profile		
			GP1	GP2	GP3
	developments in education.				
PLO 6	Graduates analyze problems in science learning and communicate ideas, findings, and solutions systematically, both orally and in writing, with openness and responsibility.	A: Systematic, open, and responsible attitude; C: Science education, pedagogical knowledge; P: Problem analysis and communication in science education	√√	√√√	√
PLO 7	Graduates make decisions based on data analysis (qualitative/quantitative) and evaluation, and demonstrate a proactive attitude in solving science education problems and making pedagogical decisions.	A: Decision-making, proactive; C: Science education, pedagogical knowledge, evaluation; P: Data analysis and learning outcome evaluation	√√	√√√	√√
PLO 8	Graduates design and conduct research in science education and/or integrated science independently or collaboratively, upholding scientific integrity and contributing to the advancement of knowledge through scholarly outputs.	A: Independent, collaborative, scientific integrity; C: Science education and/or integrated science; P: Research design and implementation	√√	√√√	√
PLO 9	Graduates operate science laboratory instruments for teaching, practicum, and research activities, and manage laboratory resources efficiently and safely using digital	A: Conservation-oriented, efficient; C: Laboratory management, safety, sustainability; P: Laboratory operation, safety skills, environmental management	√√	√	√√√

No	Programme Learning Outcome	Domain (Cognitive, Affective, Psychomotoric)	Graduate Profile		
			GP1	GP2	GP3
	tools, with conservation awareness and attention to occupational safety and environmental sustainability.				
PLO 10	Graduates develop science learning resources creatively and innovatively using digital tools and research-based approaches, showing concern for inclusivity and diversity.	A: Creative, innovative, inclusive, caring; C: Science education, instructional media, technological pedagogical knowledge; P: Development of learning resources (media, modules, assessments), learner needs research	√√√	√√	√
PLO 11	Graduates establish and maintain professional networks across institutions and disciplines in the context of academic collaboration and quality improvement in science education, through responsible and ethical engagement in scholarly forums, learning communities, and collaborative activities.	A: Disciplined, collaborative, ethically engaged; C: Science education; P: Communication skills for networking and academic collaboration	√	√√	√√√
PLO 12	Graduates demonstrate independence, leadership, and entrepreneurial spirit in science education and scientific endeavors, with	A: Independent, leadership, environmentally conscious; C: Science education and scientific knowledge; P: Entrepreneurial skills in science education and	√	√√	√√√

No	Programme Learning Outcome	Domain (Cognitive, Affective, Psychomotoric)	Graduate Profile		
			GP1	GP2	GP3
	concern for environmental preservation and sustainable development.	integrated science activities			

Note: The relationship between Graduate Learning Outcomes (PLO) and Graduate Profiles (PL) is indicated by the symbol √. The number of √ marks reflects the degree of relevance and support: √ indicates relevant, √√ indicates more relevant, and √√√ indicates highly relevant.

6. Body of Knowledge (BoK)

The Body of Knowledge (BoK) of the BSE programme represents the scientific foundation that underpins curriculum development (Figure 2). The fields of study are structured with reference to the Technological Pedagogical and Content Knowledge (TPACK) framework which serves as a guiding model for the integration of technology into teaching and learning. The programme is designed to highlight distinctive features that align with its vision, mission, and objectives, while remaining consistent with the broader vision, mission, and objectives of the university.

Figure 2. *Body of knowledge*

The Body of Knowledge (BoK) integrates the TPACK framework with the concept of technology readiness skills to equip students with 21st-century competencies. Beyond mastery of TPACK components: Technological Knowledge (TK), Technological Content Knowledge (TCK), Technological Pedagogical Knowledge (TPK), and Pedagogical Content Knowledge (PCK). Students are guided to develop comprehensive teacher competencies, including personal, professional, pedagogical, and social dimensions. The programme also embeds UNNES's conservation pillars, namely strengthening values and character, preserving arts, culture, and local wisdom, sustaining natural resources, and fostering environmental awareness.

The BoK serves as the foundation for curriculum design, systematically translated into course structures that progressively build the expected competencies. In line with Permendikbudristek No. 53/2023, the BoK incorporates scientific and technological foundations, current knowledge relevant to the discipline, new concepts from recent research, and professional practices. Consistent with Permendiktisaintek No. 39/2025, it extends beyond national standards by adopting global higher education quality benchmarks, promoting curriculum flexibility, recognition of prior learning (RPL), cross-programme and cross-border mobility, and responsiveness to industry and global demands through innovative, applied approaches.

Strategically, the BoK supports national and international priorities such as the SDGs, differentiated and deep learning, inclusive education for students with disabilities, environmentally friendly curriculum development, international joint degree collaborations, fast-track pathways with UNNES postgraduate programmes, and alignment with policies of the Ministry of Higher Education, Science, and Technology. With this approach, the BoK functions not only as an academic foundation but also as a strategic instrument for shaping graduates who are excellent, relevant, and adaptive to future challenges.

7. Subject Matters

Within the framework of Outcome-Based Education (OBE), subject matters are strategically designed elements that support the achievement of programme and course learning outcomes (PLO and CLO). Subject matters encompass disciplinary knowledge studied by students and must be demonstrable in the learning process (Anderson & Krathwohl, 2001:12–13 in KPT 2024). According to BSNP (2010), subject matters are the core materials taught to support competency achievement. Their determination is based on the formulated PLO, the relevant Body of Knowledge of the study program, evaluation of existing courses, and the design of new courses. Subject matters are systematically structured to foster the development of knowledge, skills, and attitudes targeted in the curriculum. Each subject matter must be measurable and demonstrable by students through appropriate learning activities and assessments. Once subject matters are identified, the next step is to develop a matrix linking subject matters to PLO. This matrix explains the relationship between subject matters and the intended PLO, the required learning time (in hours), the student-centered learning experiences provided, and the types of assessment used to measure achievement.

Table 3. Subject matters and PLO period in one semester

PLO	Subject Matters	Code	Period (h)	PLO Period (h/semester)
1	Philosophical foundations , character, and conservation in the context of education	SM1.1	10.9375	330
	The foundation of the education profession is based on a sustainable culture and environment	SM1.2	9.6875	
2	Fundamentals of pedagogical competence	SM2.1	10.9375	330
	Soft skills, personal competence, social competence, and their application to society	SM2.2	9.6875	
3	Cornerstone of conservation and resource management values (nature, human, and educational)	SM3.1	10.9375	330
	Humanitarian values, scientific ethics, and professional ethics	SM3.2	9.6875	
4	Concepts of Basic Mathematics and Natural Sciences, Applied Sciences, Interdisciplinary and Multidisciplinary Science	SM4.1	37.5	600

PLO	Subject Matters	Code	Period (h)	PLO Period (h/semester)
5	Concepts of Basic Mathematics and Natural Sciences, Applied Sciences, Interdisciplinary and Multidisciplinary Science	SM4.1	12.1875	600
	Learning technology and innovation	SM5.1	7.5	
	Fundamentals of education and learning, innovative and contextual science learning strategies (learning planning, implementation, and assessment)	SM6.1	14.0625	
	Educational research methodology and scientific research (literature review, innovative research methods, and scientific publications)	SM8.1	1.875	
	Science Laboratory, SOP/Occupational Health and Safety, management, and sustainability	SM9.1	1.875	
6	Philosophical foundations , character, and conservation in the context of education	SM1.1	0.9375	600
	The foundation of the education profession is based on a sustainable culture and environment	SM1.2	4.6875	
	Concepts of Basic Mathematics and Natural Sciences, Applied Sciences, Interdisciplinary and Multidisciplinary Science	SM4.1	13.125	
	Fundamentals of education and learning, innovative and contextual science learning strategies (learning planning, implementation, and assessment)	SM6.1	9.375	
	Study of the learning curriculum	SM6.2	3.75	
	Educational research methodology and scientific	SM8.1	5.625	

PLO	Subject Matters	Code	Period (h)	PLO Period (h/semester)
	research (literature review, innovative research methods, and scientific publications)			
7	Concepts of Basic Mathematics and Natural Sciences, Applied Sciences, Interdisciplinary and Multidisciplinary Science	SM4.1	16.875	600
	Learning technology and innovation	SM5.1	1.875	
	Fundamentals of education and learning, innovative and contextual science learning strategies (learning planning, implementation, and assessment)	SM6.1	9.375	
	Qualitative and quantitative data analysis	SM7.1	3.75	
	Educational research methodology and scientific research (literature review, innovative research methods, and scientific publications)	SM8.1	3.75	
	Science Laboratory, SOP/Occupational Health and Safety, management, and sustainability	SM9.1	1.875	
8	Concepts of Basic Mathematics and Natural Sciences, Applied Sciences, Interdisciplinary and Multidisciplinary Science	SM4.1	37.5	750
	Qualitative and quantitative data analysis	SM7.1	3.75	
	Educational research methodology and scientific research (literature review, innovative research methods, and scientific publications)	SM8.1	3.75	
	Science Laboratory, SOP/Occupational Health and	SM9.1	1.875	

PLO	Subject Matters	Code	Period (h)	PLO Period (h/semester)
	Safety, management, and sustainability			
9	Concepts of Basic Mathematics and Natural Sciences, Applied Sciences, Interdisciplinary and Multidisciplinary Science	SM4.1	29.0625	600
	Science Laboratory, SOP/Occupational Health and Safety, management, and sustainability	SM9.1	1.40625	
	Instrumentation and practicum	SM9.2	1.40625	
10	Concepts of Basic Mathematics and Natural Sciences, Applied Sciences, Interdisciplinary and Multidisciplinary Science	SM4.1	1.875	600
	Learning technology and innovation	SM5.1	13.125	
	Fundamentals of education and learning, innovative and contextual science learning strategies (learning planning, implementation, and assessment)	SM6.1	11.25	
	Study of the learning curriculum	SM6.2	3.75	
	Educational research methodology and scientific research (literature review, innovative research methods, and scientific publications)	SM8.1	1.875	
	Inclusivity in learning	SM10.1	5.625	
11	Concepts of Basic Mathematics and Natural Sciences, Applied Sciences, Interdisciplinary and Multidisciplinary Science	SM4.1	35.625	750
	Fundamentals of education and learning, innovative and contextual science learning strategies (learning planning, implementation, and assessment)	SM6.1	3.75	

PLO	Subject Matters	Code	Period (h)	PLO Period (h/semester)
	Educational research methodology and scientific research (literature review, innovative research methods, and scientific publications)	SM8.1	5.625	
	Resource management (education, humans, nature)	SM11.1	1.875	
12	Concepts of Basic Mathematics and Natural Sciences, Applied Sciences, Interdisciplinary and Multidisciplinary Science	SM4.1	39.375	750
	Educational research methodology and scientific research (literature review, innovative research methods, and scientific publications)	SM8.1	3.75	
	Resource management (education, humans, nature)	SM11.1	1.875	
	Scope and basic concepts of entrepreneurship, business idea development, and sustainable application of science	SM12.1	1.875	

Table 4. Subject matters

Code	Subject Matters
SM1.1	Philosophical foundations, character, and conservation in the context of education
SM1.2	The foundation of the education profession is based on a sustainable culture and environment
SM2.1	Fundamentals of pedagogical competence
SM2.2	Soft skills, personal competence, social competence, and their application to society
SM3.1	Cornerstone of conservation and resource management values (nature, human, and educational)
SM3.2	Humanitarian values, scientific ethics, and professional ethics
SM4.1	Concepts of Basic Mathematics and Natural Sciences, Applied Sciences, Interdisciplinary and Multidisciplinary Science
SM5.1	Learning technology and innovation
SM6.1	Fundamentals of education and learning, innovative and contextual science learning strategies (learning planning, implementation, and assessment)
SM6.2	Study of the learning curriculum

Code	Subject Matters
SM7.1	Qualitative and quantitative data analysis
SM8.1	Educational research methodology and scientific research (literature review, innovative research methods, and scientific publications)
SM9.1	Science Laboratory, SOP/Occupational Health and Safety, management, and sustainability
SM9.2	Instrumentation and practicum
SM10.1	Inclusivity in learning
SM11.1	Resource management (education, humans, nature)
SM12.1	Scope and basic concepts of entrepreneurship, business idea development, and sustainable application of science

8. Learning Module

Learning materials consist of knowledge (facts, concepts, principles, theories, and definitions), skills and processes (such as reading, writing, numeracy, critical thinking, communication, and creative expression), and values (Hyman, 1973:4 in KPT 2024). The depth and breadth of these materials are determined by PLO of each study program. In the BSE programme, learning materials are prioritised to prepare graduates to master, develop, and apply branches of science and technology, delivered through courses as formal credit units.

Beyond meeting academic standards, the subject matters developed also reflect UNNES's vision as a world-class, conservation-oriented university and a pioneer of educational excellence. Courses such as Conservation Education, Inclusive Science Education, Science Learning Media and Technology, and Sustainable Science Entrepreneurship are designed to equip students with 21st-century competencies relevant to both global and local challenges. The curriculum further supports the achievement of the Sustainable Development Goals (SDGs) by integrating environmental, social, and economic issues into teaching and learning.

The programme actively promotes cross-regional and international collaboration through elective courses and programme development accessible to students from outside UNNES and abroad. This supports academic mobility, fast-track pathways, and credit transfer. With this approach, learning materials serve not only as an academic foundation but also as a strategic instrument for shaping graduates who are excellent, adaptive, and committed to sustainable development.

Table 5. Learning module

Code	Subject Matters	Learning Module
SM1.1	Philosophical foundations, character, and conservation in the context of education	Religious Education Pancasila Education Civic Education Conservation Education Indonesian Language Introduction to Education Educational Psychology Guidance and Counseling School Management Digital Literacy and Humanity School Field Introduction (PLP) Community Service Program (KKN) Final Project
SM1.2	The foundation of the education profession is based on a sustainable culture and environment	
SM2.1	Fundamentals of pedagogical competence	
SM2.2	Soft skills, personal competence, social competence, and their application to society	

Code	Subject Matters	Learning Module
SM3.1	Cornerstone of conservation and resource management values (nature, human, and educational)	
SM3.2	Humanitarian values, scientific ethics, and professional ethics	
SM4.1	Concepts of Basic Mathematics and Natural Sciences, Applied Sciences, Interdisciplinary and Multidisciplinary Science	Mathematics for Science Basic Biology I Basic Biology II Basic Physics I Basic Physics II Basic Chemistry I Basic Chemistry II Basic Science Earth Science and Astronomy Biophysics Biochemistry Integrated Sciences Systematics of Living Things Science Learning Media and Technology Mechanics Nutrition and Health Science Microbiology Statistics Analytical Chemistry Biotechnology Electronics Wave and Optics Genetics Environmental Science Theory of Science Learning Science at School Analysis Strategy and Design of Science Learning Evaluation of Science Learning Science Microteaching Science Instruction in English Anatomy and Physiology of Living Things Science E-Learning Management and Laboratory Techniques Entrepreneurship Science Computation Electricity and Magnet* Thermal Properties of Matters* Introduction to Solid State Physics*

Code	Subject Matters	Learning Module
		Bioenergy* Chemistry in Life * Horticultural Cultivation* Applied Sciences*
SM5.1	Learning technology and innovation	Statistics Science Computation Strategy and Design of Science Learning Evaluation of Science Learning Science Microteaching Science Instruction in English Science Learning Media and Technology Science E-learning Management and Laboratory Techniques Ethnoscience and Local Wisdom STEM (Science, Technology, Engineering, Mathematics)* R&D in Science* Science Education Research Instrument Development* Inclusive Science Education* Informal Science Education* Science in Media* Environmental Education* Disaster Management*
SM6.1	Fundamentals of education and learning, innovative and contextual science learning strategies (learning planning, implementation, and assessment)	School Field Introduction (PLP) Community Service Program (KKN) Final Project English Language English for Science Study and Development of Science Curriculum Research Methodology in Science Education Science Education Seminar Basic Biology I Basic Biology II Basic Physics I Basic Physics II Basic Chemistry I Basic Chemistry II Electronics Science at School Analysis Strategy and Design of Science Learning Evaluation of Science Learning Science Microteaching Science Instruction in English Science Competition Coaching Strategies*
SM6.2	Study of the learning curriculum	Study and Development of Science Curriculum

Code	Subject Matters	Learning Module
SM7.1	Qualitative and quantitative data analysis	Ethnoscience and Local Wisdom Research Methodology in Science Education Science Education Seminar Mathematics for Science Biophysics Biochemistry Statistics Analytical Chemistry Biotechnology Electronics Wave and Optics Science Computation Environmental Science Theory of Science Learning Science at School Analysis Strategy and Design of Science Learning Evaluation of Science Learning Science Learning Media and Technology Management and Laboratory Techniques R&D in Science* Science Education Research Instrument Development* Scientific Article*
SM8.1	Educational research methodology and scientific research (literature review, innovative research methods, and scientific publications)	
SM9.1	Science Laboratory, SOP/Occupational Health and Safety, management, and sustainability	Basic Biology I Basic Biology II Basic Physics I Basic Physics II Basic Chemistry I Basic Chemistry II Basic Science Biophysics Biochemistry Microbiology Analytical Chemistry Biotechnology Electronics Management and Laboratory Techniques
SM9.2	Instrumentation and practicum	
SM10.1	Inclusivity in learning	English Language English for Science Ethnoscience and Local Wisdom Study and Development of Science Curriculum Science Education Seminar Basic Chemistry II Basic Science Earth Science and Astronomy Biophysics Biochemistry
SM11.1	Resource management (education, humans, nature)	
SM12.1	Scope and basic concepts of entrepreneurship, business idea development, and	

Code	Subject Matters	Learning Module
	sustainable application of science	Integrated Sciences Anatomy and Physiology of Living Things Nutrition and Health Science Microbiology Analytical Chemistry Biotechnology Electronics Wave and Optics Genetics Science Computation Environmental Science Theory of Science Learning Science at School Analysis Strategy and Design of Science Learning Evaluation of Science Learning Science Microteaching Science Instruction in English Science Learning Media and Technology Science E-Learning Management and Laboratory Techniques Entrepreneurship STEM (Science, Technology, Engineering, Mathematics)* R&D in Science* Science Education Research Instrument Development* Inclusive Science Education* Informal Science Education* Science Competition Coaching Strategies* Science in Media* Environmental Education* Disaster Management* Scientific Article* Design Thinking*

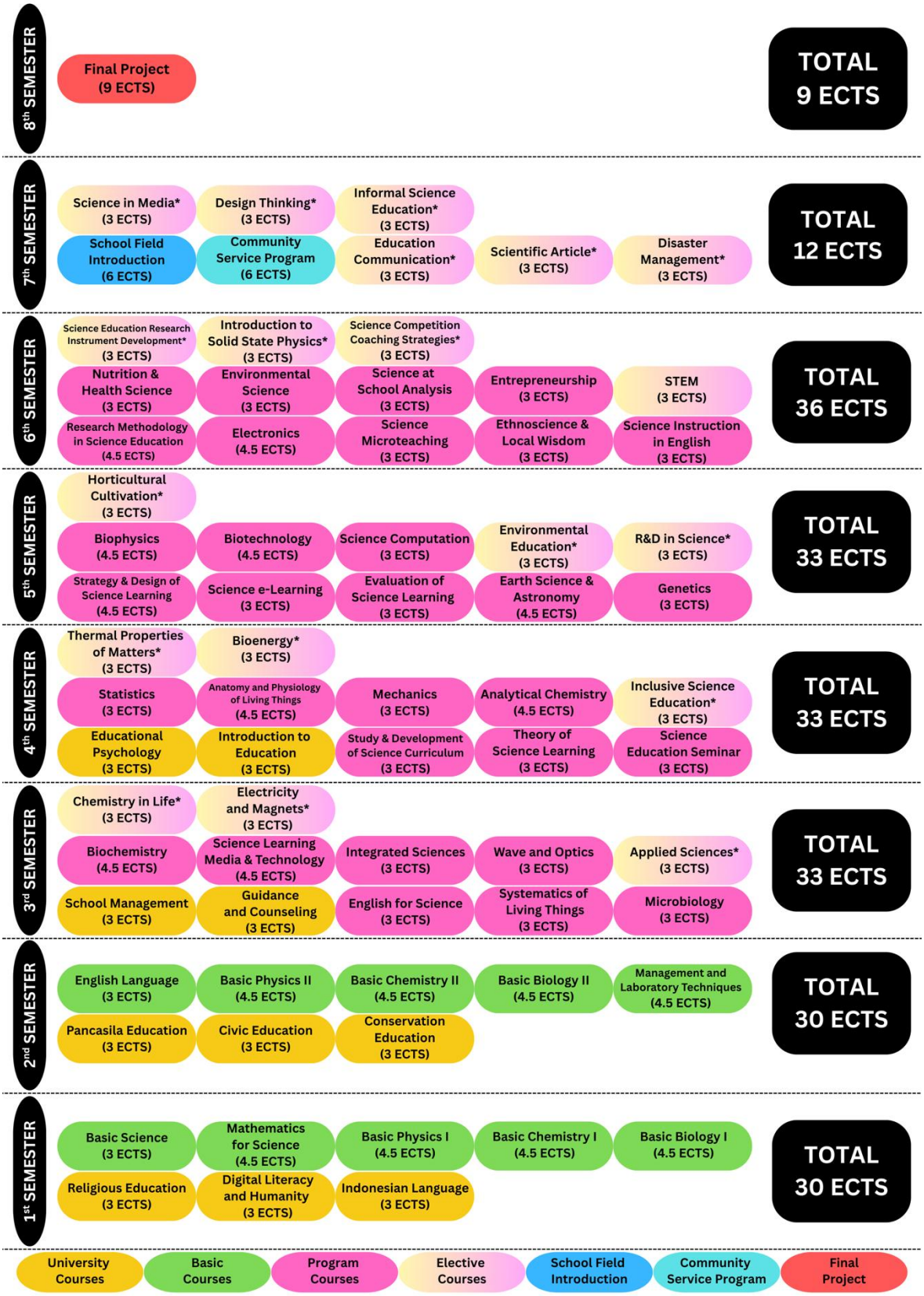

Figure 3. Curriculum overview for 8 semesters in BSE programme

Table 6. Curriculum overview in credit system

No.	Course Group	Semester								Total Credits	Proportion (%)
		1	2	3	4	5	6	7	8		
1.	University Core Module	6	6							12	8.33
2.	Basic/Faculty Module		4	13	7	7				31	21.53
3.	Program Specific Module	14	14	16	7	13	13			77	53.47
4.	Elective Module			2	2	2	4			10	6.94
5.	School Field Practice							4		4	2.78
6.	Community Service Program							4		4	2.78
7.	Final Project								6	6	4.17
	Total	**20**	**20**	**22**	**22**	**22**	**24**	**8**	**6**	**144**	**100**

Table 6. Curriculum overview in ECTS system

No.	Course Group	Semester								Total ECTS	Proportion (%)
		1	2	3	4	5	6	7	8		
1.	University Core Module	9	9	6	6					30	13.89
2.	Basic/Faculty Module	21	21		13.5	10.5	10.5			34.5	15.97
3.	Program Specific Module			24	10.5	19.5	19.5			115.5	53.47
4.	Elective Module			3	3	3	6			15	6.94
5.	School Field Practice							6		6	2.78
6.	Community Service Program							6		6	2.78
7.	Final Project								9	9	4.17
	Total	**30**	**30**	**33**	**33**	**33**	**36**	**12**	**9**	**216**	**100**

Table 8. Module distribution

No	Module	Credits/ECTS	T/S/P	Prerequisite Module
Semester 1				
1	Religious Education	2/3	T	
2	Digital Literacy and Humanity	2/3	T	
3	Indonesian Language	2/3	T	
4	Basic Science	2/3	T	
5	Mathematics for Science	3/4.5	T	
6	Basic Physics I	3/4.5	T/P	
7	Basic Chemistry I	3/4.5	T/P	
8	Basic Biology I	3/4.5	T/P	
Total		**20/30**		
Semester 2				
1	Pancasila Education	2/3	T	
2	Civic Education	2/3	T	
3	Conservation Education	2/3	T	
4	Basic Physics II	3/4.5	T/P	
5	Basic Chemistry II	3/4.5	T/P	
6	Basic Biology II	3/4.5	T/P	
7	Management and Laboratory Techniques	3/4.5	T/P	
8	English Language	2/3	T	
Total		**20/30**		
Semester 3				
1	School Management	2/3	T	
2	Guidance and Counseling	2/3	T	
3	English for Science	2/3	T	English Language
4	Systematics of Living Things	2/3	T	Basic Biology I Basic Biology II

5	Microbiology	2/3	T	Basic Biology I Basic Biology II
6	Biochemistry	3/4.5	T/P	Basic Biology I Basic Biology II Basic Chemistry I Basic Chemistry II
7	Science Learning Media and Technology	3/4.5	T/P	
8	Integrated Sciences	2/3	T	
9	Wave and Optics	2/3	T	Basic Physics I Basic Physics II
10	Applied Sciences* Chemistry in Life* Electricity and Magnet*	2/3	T	
Total		**22/33**		
Semester 4				
1	Educational Psychology	2/3	T	
2	Introduction to Education	2/3	T	
3	Study and Development of Science Curriculum	2/3	T	
4	Theory of Science Learning	2/3	T	
5	Science Education Seminar	2/3	T	
6	Statistics	2/3	T	
7	Anatomy and Physiology of Living Things	3/4.5	T	Basic Biology I Basic Biology II
8	Mechanics	2/3	T	Basic Physics I Basic Physics II
9	Analytical Chemistry	3/4.5	T/P	Basic Chemistry I Basic Chemistry II Biochemistry
10	Inclusive Science Education*	2/3	T	

	Thermal Properties of Matters* Bioenergy*			
Total		**22/33**		
Semester 5				
1	Strategy and Design of Science Learning	3/4.5	T/P	Study and Development of Science Curriculum Theory of Science Learning
2	Science E-Learning	2/3	T	
3	Evaluation of Science Learning	2/3	T	Statistics
4	Earth Science and Astronomy	3	T	
5	Genetics	2/3	T	Basic Biology I Basic Biology II
6	Biophysics	3/4.5	T/P	Basic Physics I Basic Physics II Basic Biology I Basic Biology II Mechanics
7	Biotechnology	3/4.5	T/P	Basic Biology I Basic Biology II Biochemistry Genetics Microbiology
8	Science Computation	2/3	T	
9	Environmental Education* R&D in Science* Horticultural Cultivation*	2/3	T	
Total		**22/33**		

Semester 6				
1	Research Methodology in Science Education	3/4.5	T	Statistics Science Education Seminar
2	Electronics	3/4.5	T/P	Basic Physics I Basic Physics II
3	Science Microteaching	2/3	T	Study and Development of Science Curriculum Theory of Science Learning Strategy and Design of Science Learning Evaluation of Science Learning Science Learning Media and Technology
4	Ethnoscience and Local Wisdom	2/3	T	
5	Science Instruction in English	2/3	T	Study and Development of Science Curriculum Theory of Science Learning Strategy and Design of Science Learning Evaluation of Science Learning Science Learning Media and Technology English Language English for Science

6	Nutrition and Health Science	2/3	T	Biochemistry
7	Environmental Science	2/3	T	
8	Science at School Analysis	2/3	T	
9	Entrepreneurship	2/3	T	
10	STEM (Science, Technology, Engineering, Mathematics)* Science Education Research Instrument Development* Introduction to Solid State Physics* Science Competition Coaching Strategies*	4/6	T	
Total		**24/36**		
Semester 7				
1	School Field Introduction (PLP)	4/6	T	
2	Community Service Program (KKN)	4/6	T	
3	Education Communication*	2/3	T	
4	Scientific Article*	2/3	T	
5	Disaster Management*	2/3	T	
6	Science in Media*	2/3	T	
7	Design Thinking*	2/3	T	
8	Informal Science Education*	2/3	T	
Total		**8/12**		
Semester 8				
1	Final Project	6/9	P	
Total		**6/9**		

**Note: ***Elective module

Note:

1. Study programs are required to facilitate learning outside the study program for 3 semesters and provide an alternative of at least one semester in their curriculum documents
2. A student is only given the obligation to take the UNNES internal MBKM for 1 semester or the equivalent of a maximum of 20 credits and the UNNES external MBKM for 2 semesters, both Independent MBKM (flagship: Giat, Lantip, Prigel) and Centralized MBKM or the equivalent of a maximum of 40 credits during their study period
3. A student is required to study in his own study program ≤ 84 credits

Semesters 6 and 7 contain courses/modules/thematic blocks/other forms of choice in the form of study program development learning materials in the form of MKK, MKB and MBB with a total of 28 credits containing new concepts produced from (1) the latest research and (2) the world of work relevant to the profession of study program graduates. Both groups of courses can be taken by students outside the study program at UNNES and students from similar and different study programs from outside UNNES (increasing *inbound* students from other universities). The courses are provided still referring to the needs of PLO according to the profile of the graduates. Courses/modules/thematic blocks/other forms Options are developed so that graduates have additional abilities according to the profile. Study program development courses are elective courses developed according to the agreement of study program associations and learning can be done online or even MOOC. The learning materials in that semester are the Craftsmanship Course/MKB, the Community Life Course/MBB and the Skills and Expertise Course (MKK) and it is very possible to embed various 21st Century Skills.

The study materials developed by the study program refer to the advantages of study program resources so that they have a bargaining value for similar/different study programs both inside and outside UNNES. The management of course taking is regulated using a quota of the number of students by taking into account the resources of the study program. Forms of student learning activities that can be carried out in addition to the process of learning activities, structured assignment activities, and independent activities as well as student exchanges, entrepreneurial activities, independent projects, humanitarian projects, teaching assistance in educational units that can be qualified with PLP, conducting humanitarian projects or building villages/conducting thematic Community Service programs that can be qualified with KKN courses according to the provisions of UNNES. In this 7th semester - when carrying out these activities- it is also possible for students to carry out independent study activities/projects or scientific research/research whose results can be written as Final Projects. Such integrated activities are highly recommended by the study program. Study programs can carry out *Joint Degrees*

efficiently and effectively can distribute courses that can/must be taken at partner universities of at least 20 credits in semesters 5 and 6. The arrangement and management of this program is regulated in its own rules and in accordance with the study program's agreement with partners abroad. In semester 8, students are directed to complete the Final Project which is part of the Craftsmanship Course/MKB. The form of the final project is regulated in the Final Project Guide and determined by the Study Program.

9. Learning Methods

The learning method is a method used to implement plans prepared in real activities to achieve goals optimally. The learning method in higher education is a typical way of learning in higher education that utilizes various basic principles of education as well as other related techniques and resources so that the learning process occurs in the learner. The selection of learning forms and methods is an effort to find the right strategy so that students can meet their learning outcomes by developing active interaction between students, lecturers and learning resources. The learning method used by lecturers to present learning materials to students from the beginning of learning to the end of learning to achieve the goals that have been set. Learning methods are guidelines for lecturers on presenting learning materials so that students can understand them more easily.

The learning method used refers to the National Higher Education Standards (SN-Dikti), namely student-centered learning or *Student Centered Learning* (SCL). SCL is intended to be the learning outcomes of graduates achieved through a learning process that prioritizes the development of creativity, capacity, personality, student needs, and developing independence in seeking and discovering knowledge. SCL develops based on constructivism learning theory which emphasizes that learners are obliged to construct their knowledge in order to learn effectively. Based on the Decree of the Minister of Education and Culture Number 754/P/2020 and the Guidebook for the Main Performance Indicators of Higher Education, the implementation of learning is carried out based on collaborative and participatory learning. Collaborative and participatory learning is student-centered learning. The Collaborative and Participatory Learning Model is case-based learning (*case method*) and problem-based learning (PBL).

10. Learning Modality

In order to present an effective, inclusive, and in accordance with the times, it is necessary to select the right learning modality. Learning modality refers to the way or mode of delivering lecture materials to students, which aims to optimize interaction, concept understanding, and academic and professional competency development. The selection and application of learning modalities in the BSE programme aims to accommodate the diverse needs of learners, expand access to education, and improve the quality of learning that is adaptive to the development of science and technology. Along with technological advances and the dynamics of 21st century educational needs, various forms of learning modalities have been implemented in the higher education environment, including face-to-face lectures, online lectures, *blended learning, hybrid learning*, and asynchronous lectures.

Table 9. Learning modality

No.	Module	Learning modality				
		Face-to-face	Hybrid Learning	Asynchronous Online	Blended Learning	Synchronous Online
1	Religious Education	√		√	√	√
2	Digital Literacy and Humanity	√		√	√	√
3	Indonesian Language	√		√	√	√
4	Pancasila Education	√		√	√	√
5	Civic Education	√		√	√	√
6	Conservation Education	√		√	√	√
7	School Management	√		√	√	√
8	Guidance and Counseling	√		√	√	√
9	Educational Psychology	√		√	√	√
10	Introduction to Education	√		√	√	√
11	Basic Science	√		√	√	√
12	Mathematics for Science	√		√	√	√
13	Basic Physics I	√		√	√	√
14	Basic Chemistry I	√		√	√	√
15	Basic Biology I	√		√	√	√
16	Basic Physics II	√		√	√	√
17	Basic Chemistry II	√		√	√	√

No.	Module	Learning modality				
		Face-to-face	Hybrid Learning	Asynchronous Online	Blended Learning	Synchronous Online
18	Basic Biology II	√		√	√	√
19	Management and Laboratory Techniques	√		√	√	√
20	English Language	√		√	√	√
21	English for Science	√		√	√	√
22	Systematics of Living Things	√		√	√	√
23	Microbiology	√		√	√	√
24	Biochemistry	√		√	√	√
25	Science Learning Media and Technology	√		√	√	√
26	Integrated Sciences	√		√	√	√
27	Wave and Optics	√		√	√	√
28	Study and Development of Science Curriculum	√		√	√	√
29	Theory of Science Learning	√		√	√	√
30	Science Education Seminar	√		√	√	√
31	Statistics	√		√	√	√
32	Anatomy and Physiology of Living Things	√		√	√	√
33	Mechanics	√		√	√	√
34	Analytical Chemistry	√		√	√	√
35	Strategy and Design of Science Learning	√		√	√	√
36	Science E-Learning	√	√	√	√	√
37	Evaluation of Science Learning	√		√	√	√
38	Earth Science and Astronomy	√		√	√	√
39	Genetics	√		√	√	√
40	Biophysics	√		√	√	√

No.	Module	Learning modality				
		Face-to-face	Hybrid Learning	Asynchronous Online	Blended Learning	Synchronous Online
41	Biotechnology	√		√	√	√
42	Science Computation	√		√	√	√
43	Research Methodology in Science Education	√	√	√	√	√
44	Electronics	√		√	√	√
45	Science Microteaching	√		√	√	√
46	Ethnoscience and Local Wisdom	√	√	√	√	√
47	Science Instruction in English	√		√	√	√
48	Nutrition and Health Science	√	√	√	√	√
49	Environmental Science	√		√	√	√
50	Science at School Analysis	√		√	√	√
51	Entrepreneurship	√		√	√	√
52	School Field Introduction (PLP)	√		√	√	√
53	Community Service Program (KKN)	√		√	√	√
54	Tugas Akhir	√		√	√	√
55	Applied Sciences*	√		√	√	√
56	Chemistry in Life*	√		√	√	√
57	Electricity and Magnet*	√		√	√	√
58	Inclusive Science Education*	√		√	√	√
59	Thermal Properties of Matters*	√		√	√	√
60	Bioenergy*	√		√	√	√
61	Environmental Education*	√		√	√	√
62	R&D in Science*	√		√	√	√
63	Horticultural Cultivation*	√		√	√	√

No.	Module	Learning modality				
		Face-to-face	Hybrid Learning	Asynchronous Online	Blended Learning	Synchronous Online
64	STEM (Science, Technology, Engineering, Mathematics)*	√		√	√	√
65	Science Education Research Instrument Development*	√		√	√	√
66	Introduction to Solid State Physics*	√		√	√	√
67	Science Competition Coaching Strategies*	√		√	√	√
68	Education Communication*	√		√	√	√
69	Scientific Article*	√		√	√	√
70	Disaster Management*	√		√	√	√
71	Science in Media*	√		√	√	√
72	Design Thinking*	√		√	√	√
73	Informal Science Education*	√		√	√	√

Note: * Elective module

11. Assesment

Assessment is one or several processes of identifying, collecting and preparing data along with its evidence to evaluate student learning processes and outcomes in order to fulfill Graduate Learning Outcomes. The instruments used for process assessment can be rubrics and for the assessment of results can be used portfolios or design works.

Rubrics

Assessment rubrics are instruments that contain criteria and indicators to assess the extent to which students achieve learning goals. This rubric helps lecturers provide objective, transparent, and consistent assessments. The rubric should be formulated clearly and structured. The rubric consists of dimensions or aspects that are assessed from the criteria of student learning outcome ability or indicators of student learning outcomes. Rubrics can be comprehensive or general and can also be specific or only applicable to a specific topic. The purpose of assessment using rubrics is to clarify the dimensions or aspects and levels of assessment of student learning outcomes. In addition, rubrics are expected to be a driver or motivator for students to achieve their learning achievements. The assessment rubric is very diverse according to the characteristics and learning outcomes in each course. Lecturers who teach courses are given the freedom to develop assessment rubrics. In general, the assessment rubric will include two things, namely:

1. A holistic rubric of assessment guidelines for assessing based on the overall effect or a combination of all criteria. An example of a holistic rubric can be seen in Table 10.
2. An analytical rubric is an assessment guideline that has a level of assessment criteria described and is given an assessment scale or assessment score. An example of an analytical rubric can be seen in Table 11.

Table 10. Holistic rubrics

Levels	Score	Remarks
Very Poor	< 20	The design presented is irregular and does not solve the problem
Poor	21 – 40	The design presented is orderly but does not solve the problem
Fairly Good	41 – 60	The design presented is systematic, solves problems, but is not feasible
Good	61 – 80	The design presented is systematic, problem-solving, implementable, less innovative
Very Good	>80	The design presented is systematic, problem-solving, implementable and innovative

Table 11. Analytical rubrics

Assessed Aspect/ Dimension	Scale				
	Very Poor	**Poor**	**Fairly Good**	**Good**	**Very Good**
	(Score < 20)	**(21-40)**	**(41-60)**	**(61-80)**	**(Score ≥ 81)**
Organization	There is no clear organization. Facts are not used to support the statement.	Enough focus, but insufficient evidence to be used in drawing conclusions.	The presentation was focused and presented some evidence that supported the conclusions.	Well-organized and presents convincing facts to support the conclusion.	Very well-organized by presenting facts supported by examples that have been analyzed according to the concept.
Content	The content is inaccurate or overly general. The listener learns nothing or sometimes misleads.	The content is inaccurate, because there is no factual data, it does not add to the listener's understanding .	The content is generally accurate, but not exhaustive. Listeners can learn some of the implied facts, but they don't add new insights to the topic.	Fill in accurate and complete. The listeners added new insights to the topic.	Content is able to evoke listeners to float their thoughts.
Presentation Style	Speakers are anxious and uncomfortable, and read various notes rather than talking. Listeners are often overlooked. There is no eye contact because the speaker looks more at the whiteboard or screen.	Based on the notes, no ideas are developed outside of the notes, the sound is monotonous.	In general the speaker is calm, but with a flat tone and quite often relies on notes. Sometimes eye contact with the listener is ignored.	The speaker is calm and uses proper intonation, speaks without relying on notes, and interacts intensively with the listener. The speaker is always eye contact with the listener.	Speak with passion, transmit passion and enthusiasm to the listener.

Portfolio

Portfolio assessment is used to assess learning outcomes. The portfolio is an instrument for assessing learning outcomes based on a collection of information that shows the development of student PLO in one semester. Portfolio assessment is obtained based on student work from the

learning process that is considered the best or student work that shows the development of students' ability to achieve learning outcomes. Portfolio valuation can function as a summative as well as formative valuation. Portfolio functions as a summative assessment, meaning that it shows student results or achievements in a certain course or competency. Meanwhile, the portfolio functions as a formative assessment used by lecturers to help students achieve the expected competencies. The portfolio contains evidence of student work results with various assessment methods. The portfolio can consist of written test results, practice assessment results, and case study assignments. Portfolio assessments are very diverse, so the criteria used are developed independently by the lecturers who teach the course. The following is an example of portfolio assessment criteria from the Electronics course with case study tasks in the form of the learning on application of analog Electronics networks in daily life.

Table 12. Portfolio rubrics

Category	**Score**		
	3	**2**	**1**
Topics	The topic raised is very good	The topic raised is quite good	The topic raised is not good
Understanding	Understanding the concepts applied	Simply understand the concepts applied	Not understands the concepts applied
Value	The analyzed product is very useful	The analyzed product is quite useful	The analyzed product is less useful
Presentation	The presentation of the case study is very interesting	The presentation of the case study is quite interesting	Case study presentation is less attractive

Note:
Lecturers can develop according to their needs
A score of 0 is given when students do not make assignments

12. The implementation of learning outside of the study program

Student learning rights of a maximum of 3 semesters are designed by the study program in the form of Independent Learning – Independent Campus (MBKM) and/or degree education cooperation (*join/dual/double degree*) with university partners abroad. The amount of credit weight that must be designed by the study program through MBKM Mandiri and centralized is a minimum of 30 credits and a maximum of 60 credits, the study program designs and implements student exchanges between study programs within UNNES. There are many similarities between study programs and foreign partner study programs for a minimum of 75% joint degree and have similarities in PLO/LO, students are

required to study in partner study programs for at least 2 semesters or regulated in the regulations for educational cooperation. Students study across study programs in UNNES for 1 semester with a minimum number of credits of 10 credits. Students study outside the study program outside UNNES for a maximum of 2 semesters with a minimum number of credits @ 10 credits. The study program must be able to provide (by design) information for students to be able to carry out their independent learning outside the study program according to points c and d plus at least one alternative (The right to study for a maximum of 3 semesters must be designed by the study program in the form of Independent Learning – Independent Campus (MBKM) and or degree education cooperation (*join/dual/double degree*) with university partners abroad.

a) The amount of credit weight that must be designed by the study program through MBKM Mandiri and centralized is a minimum of 30 credits and a maximum of 60 credits, the study program must design and implement student exchanges between study programs within UNNES
b) The many similarities between study programs and foreign partner study programs for a joint degree are at least 75% and have similarities in PLO/LO, students are required to study in partner study programs for at least 2 semesters or regulated in the regulations for educational cooperation with a degree
c) Students study across study programs in UNNES for 1 semester with a minimum number of credits of 10 credits
d) Students study outside the study program outside UNNES for a maximum of 2 semesters with a minimum number of credits @ 10 credits
e) The study program must be able to provide (by design) information for students so that they can independently learn outside the study program according to points c and d plus at least one alternative

Form of MBKM learning activities

1. Internship / Industry Practice
2. Defending the Nation
3. Projects in the Village
4. Student Exchange
5. Research / Research
6. Entrepreneurship
7. Independent Project Studies
8. Humanitarian Project
9. Teaching in School

The implementation of the policy "Independent Learning Independent Campus" of the BSE programme can be followed by students in semesters 3 to 7 (3 semester learning rights). MBKM activities carried out in the programme include Impact Internships, PKM, PPK Ormawa, and Internal MBKM UNNES (Giat,

Lantip, Internal PMM) where course recognition is carried out through learning activities in the Study Program (except for Internal PMM). PMM Internal is an exchange of students outside the study program but still within the scope of the same faculty, so that students are given the opportunity to take courses outside the study program that are relevant to the PLO Study Program.

Ensuring the quality of the implementation of learning outside of the study program

a) In order for the implementation of the Independent Learning - Independent Campus (MBKM) and Join Degree policies, the "right to study for three semesters outside the study program" program can run with guaranteed quality, it is necessary to determine several qualities, including:
b) The quality of the participants' competencies
   Referring to the competency standards of Graduates, the study program sets the competency criteria for participants who are eligible to participate in the independent campus program based on the activity model offered.
c) Quality of implementation
   The study program together with related parties ensures that the implementation of independent campus activities is in accordance with the criteria for the scope of activities and the expected outputs. Quality assurance of this implementation will be regulated through a monitoring and evaluation mechanism for implementation.
d) Quality of internal and external guidance process
   The study program ensures that students receive internal guidance from lecturers and external supervisors (field) during the implementation of the program. This guidance is carried out to ensure that the activities carried out by students are in accordance with the objectives of the activity.
e) Quality of facilities and markets for implementation
   The facilitation of independent learning activities is supported by the use of facilities and infrastructure that ensure that the process can be carried out in accordance with the standards that have been set. For each activity, the study program establishes minimum and standardized infrastructure facilities for the implementation of the program.
f) Quality of reporting and presentation of results
   Students who participate in the independent campus program report the results of independent campus activities in accordance with the activity model followed. The study program ensures that students are able to show performance in accordance with the indicators of activity achievement.
g) Quality assessment
   The criteria for program achievement are determined by the study program by using process and output assessments produced by students by referring to the achievement of competencies that have been formulated.

Student Admissions at Each Stage of the Curriculum

Student admissions at each stage of the curriculum are designed systematically and in stages to form graduates who have competencies as: Science Educators, Beginner Researchers of Science Education and Science, and Managers of Science and Educational Resources.

Early Stages (Semesters 1–2)

In semesters 1 and 2, students are equipped with a scientific foundation and professional character. The courses taught are related to the introduction of the basic science of science and pedagogy, with an introduction to scientific methods and critical thinking, as well as an emphasis on early awareness of environmental issues and educational technology. New students are accepted with a high school background/equivalent and knowledge of science that is not yet uniform. In this early stage, there is a uniformity of basic understanding of science and education, as well as the formation of academic ethos and 21st century character, such as communication, collaboration, and digital literacy. The educational standards applied are as follows. (1) Content Standards, through basic science courses (Basic Physics, General Biology, Basic Chemistry), basic education, and general courses (MKU). (2) Process Standards, through discovery-based learning, group discussions, and reflective assignments. (3) Graduate Competency Standards, through the introduction of Graduate Learning Outcomes (PLO) of study programs as a learning direction.

Strengthening and Deepening Stages (Semesters 3–5)

In semesters 3 to 5, students are equipped with a foundation of conceptual and procedural mastery in science education. The courses studied are related to mastering innovative learning approaches and TPACK, strengthening research methodologies and laboratory skills, and initial understanding of education management and science laboratories. Students at this stage begin to show interest in specific fields and already have the ability to learn independently. Students are ready to receive expertise courses that deepen pedagogical concepts and skills as well as laboratories. The educational standards applied are as follows. (1) Content Standards, through science-based courses. (2) Process Standards, through the application of problem-based learning, case method, and microteaching. (3) Assessment Standards: Authentic assessments (portfolios, case studies, process assessments) and scientific work skills rubrics.

Integrative and Applicative Stages (Semesters 6–7)

In semesters 1 and 2, students are equipped with a curriculum focus on integrating knowledge, research, and field practice. Students learn through courses related to technology-based learning practices and local wisdom, design and implementation of research in the field of education and science science, as well as simulations of laboratory management, classrooms, and educational programs. Students are ready to engage in activities that connect theory with real practice through research, internships, and teaching practices. The educational standards applied are as follows. (1) Content Standards, through Thematic KKN, PLP (School Field Introduction), and various elective courses that suit talents and

interests. (2) Process Standards, through collaborative learning, fieldwork, supervision of teaching practices, and preparation of research proposals. (3) Evaluation Standards, through performance-based evaluation (assessment of teaching practices, research reports, peer assessments).

Stages of Consolidation and Independence (Semester 8)

In this final semester, the curriculum is focused on completing final projects and career readiness. Students are expected to be able and have learning tools based on technology and innovation, be able to compile and present the results of scientific research, and have a resource management plan or case study based on educational needs. Students are in the final stage of education and are focused on completing their final projects and preparing for careers as educators, researchers, or managers of science education.

The educational standards applied are as follows. (1) Content Standards, through thesis, research seminars, and career preparation programs. (2) Assessment Standards, through final project assessment (thesis), scientific presentation assessment, and career readiness evaluation. (3) Graduate Standards, at this stage students must meet all PLO, including professional attitude, scientific work skills, and managerial abilities.

13. Curriculum Management

The determination of the curriculum is carried out by the Higher Education Leadership, which certifies the Study Program's curriculum documents before they are implemented. The implementation of the curriculum is carried out through a learning process, by paying attention to the achievement of PLO, both in graduates (PLO), LO at the MK level (CLO), or LO at each stage of learning in lectures (Sub-CLO). The implementation of the curriculum refers to the RPS prepared by the lecturer or the lecturer team, with attention to the achievement of PLO at the MK, CLO, and Sub-CLO levels. At the course level, this must support the achievement of the PLO imposed on each course. Curriculum evaluation aims to monitor and improve the implementation of the curriculum. Evaluation is carried out in two stages: the formative and the summative. Formative evaluation is carried out in the process of implementing the curriculum by paying attention to the achievement of the PLO imposed on each course. The achievement of PLO is carried out through the evaluation of the achievement of CLO and Sub-CLO which is determined at the beginning of the semester by lecturers/lecturer teams and Study Programs. Evaluation was also carried out on the learning format, learning method, assessment method, RPS, and its supporting learning tools. Summative evaluation is carried out periodically, involving internal and external stakeholders, and is reviewed by experts in the field of study program, industry, and associations, in accordance with the development of science and technology and user needs. Curriculum implementation is controlled every semester using indicators of PLO achievement measurement results. Curriculum control is carried out by the Study Program and monitored and assisted by the quality assurance unit/institution of Higher Education. Continuous improvement of curriculum implementation is based on the results of curriculum evaluation, both formative and summative.

14. Conclusion Remarks

The curriculum of the BSE programme at UNNES is an institutional mandate that must be implemented and is expected to be able to encourage the improvement of the quality of learning that is relevant to global developments, focusing on learning outcomes (outcome-based), sustainable (sustainable), and providing a positive impact (impactful) for students and society. This curriculum document is expected to be a practical academic guide for the implementation of lectures, so that it is directed and achieves the vision, mission, and goals effectively and efficiently. Finally, hopefully, this curriculum document can serve as a strong foundation for achieving the study program's vision and mission. In line with that, the study program is also committed to realizing the vision of UNNES, namely "Becoming a World Reputable University and a Pioneer of Educational Excellence with a Conservation Perspective.