SUMMARY OF CURRICULUM

UNDERGRADUATE PROGRAM OF SCIENCE EDUCATION
FACULTY OF MATHEMATICS AND NATURAL SCIENCES
UNIVERSITAS NEGERI SURABAYA
2025

OBJECTIVE OF THE DEGREE PROGRAM

The Undergraduate Program of Science Education (UPSE) belongs to Faculty of Mathematics and Natural Sciences (FMNS) at Universitas Negeri Surabaya (UNESA). This study program was established on 21 December 2006 based on the Decree of General Director of Higher Education of the National Education Department of Indonesia No. 4905/D/T/2006. Objectives of this study program were derived from the visions and missions of institution and faculty as detailed in the following paragraphs.

1. The Vision and Mission of Institution

In 2022, UNESA officially changed its institutional status from a Public Service Agency (BLU) to a State University with Legal Entity (PTNBH) status. Following this transition, UNESA established new institutional vision and missions as a State University with Legal Entity status.

Vision of Universitas Negeri Surabaya:

"Becoming a strong, adaptive, and innovative educational university based on entrepreneurship"

Mission of Universitas Negeri Surabaya:

a. to prove education in both educational and non-educational fields that is strong, adaptive, and innovative, based on entrepreneurship;
b. to conduct research and enhance the quality of innovation in educational and non-educational fields with an entrepreneurial foundation;
c. to carry out community service and disseminate innovations in educational and non-educational fields with an entrepreneurial basis for the welfare of society;
d. to implement the *Tridharma* of higher education through a multi-campus system in a synergistic, integrated, harmonious, and sustainable manner, while upholding UNESA's strengths;
e. to organize governance that is effective, efficient, transparent, and accountable, ensuring continuous quality improvement;
f. to establish productive national and international collaborations to create, develop, and disseminate innovations in educational and non-educational fields with an entrepreneurial foundation.

2. The Vision and Mission of Faculty

In alignment with UNESA's new vision, the Faculty of Mathematics and Natural Sciences has developed its own revised vision and missions to support the achievement of the university's goals.

Vision of the Faculty of Mathematics and Natural Sciences (FMNS):

"Becoming a resilient, adaptive, innovative, and collaborative Faculty of Mathematics and Natural Sciences based on edu-ecopreneurship and gaining international recognition"

Edu-ecopreneurship is defined as entrepreneurial behavior in the educational process that takes environmental sustainability into account. It involves creativity, innovation, and the courage to take risks in driving educational transformation. Edu-ecopreneurship encompasses eco-

innovation (innovations in educational processes that contribute to reducing environmental burdens), eco-opportunities (the ability to utilize educational opportunities available in the surrounding environment), and eco-commitment (the willingness to work hard and engage in environmentally friendly educational practices).

Mission of FMNS

a. to organize research-based education in the field of education and non-education of Mathematics and Natural Sciences that is adaptive, innovative, collaborative, and characterized by eduecopreneurship;
b. to conduct research and improving the quality of innovation in the field of MIPA education and non-education through global collaboration;
c. to organize community service and disseminating innovations in the field of MIPA education and non-education for community empowerment;
d. to organize effective, efficient, transparent and accountable governance in FMIPA;
e. to establish productive national and international cooperation to create, develop, and disseminate innovations in the fields of MIPA education and non-education.

3. Program Educational Objectives (PEO)

As a consequence of the vision and missions of UNESA and FMNS, as well as the scientific vision of the UPSE — "To promote innovation in integrated science education and learning based on eduecopreneurship" — the Program Educational Objectives (PEOs) of the UPSE focus on producing graduates who are capable of becoming science educators, science education research assistants, science education institution managers, science education laboratory managers, and science education entrepreneurs. Specifically, the PEOs of the UPSE are to produce graduates with the following characteristics:

a. mastering knowledge and skills in the field of integrated pedagogical science (physics, chemistry, and biology) to carry out their professional or entrepreneurial responsibilities (PEO-1);
b. having responsibility in performing professional duties based on professional ethics (PEO-2);
c. having a strong and resilient personality, with the ability to compete globally in carrying out their professional or entrepreneurial roles (PEO-3);
d. having the ability to communicate effectively and collaborate in the fulfillment of professional responsibilities (PEO-4);
e. having the ability to engage in continuous self-development and innovation in response to situations and challenges in their professional duties (PEO-5).

The PEOs were formulated by considering the inputs from alumni and science education experts, current curriculum for middle school students, evaluation results of tracer studies, and contents of National Science Education Standards (NSES) 1996 and Next Generation Science Standards (NGSS) 2013. These PEOs also show alignment with the Indonesian Qualification Framework (IQF). Table 1 illustrates the linkage between the PEOs of UPSE and Level 6 of the INQF, the designated level for bachelor education. Guided by these PEOs, UPSE graduates are expected to develop the competencies necessary to compete at both local and global levels.

Table 1. The Relationship between the PEOs of UPSE and the IQF

	Capable of apply science, technology, and art within his/her expertise and adaptable to various situations faced during solving a problem (IQF-1)	Mastering in-depth general and specific theoretical concepts of certain knowledge and capable of formulating problem-solving procedure (IQF-2)	Capable of taking strategic decision based on information and data analysis as well as providing direction in choosing several alternative solutions (IQF-3)	Responsible for his/her own jobs and can be assigned to take responsibility of the attainment of organization's performances (IQF-4)
PEO-1	S	S	S	M
PEO-2	S	S	S	S
PEO-3	S	S	S	S
PEO-4	M	S	M	S
PEO-5	S	S	S	S

S-Strong, M-Moderate

4. Program Learning Outcomes (PLO)

As part of its commitment to continuous improvement, the UPSE has revitalized its curriculum and introduced the 2024–2028 transformative curriculum. The resulting Program Learning Outcomes (PLOs) are outlined in Table 2.

Table 2. The PLOs of UPSE for the 2024–2028 Transformative Curriculum

Competency SSC-ASIIN	Aspect	PLO	Description
General and Social Competences	**Attitude (AT)**	PLO-1/AT-1	Demonstrates adherence to religious, national, and cultural values, along with academic ethics in the performance of duties.
		PLO-2/ AT-2	Shows resilience, collaboration, adaptability, innovation, inclusiveness, lifelong learning, and entrepreneurship.
		PLO-3/AT-3	Applies logical, critical, systematic, and creative thinking in professional tasks aligned with field competency standards.
	General Skills (GS)	PLO-4/GS-1	Engages in continuous self-development and collaboration.
		PLO-11/GS-2	Communicate ideas and research results effectively both in oral and written forms.
Subject-Specific Competences	**Knowledge (KN)**	PLO-5/KN-1	Demonstrate fundamental knowledge of physics, chemistry, and biology, as well as mathematics relevant to science.
		PLO-6/KN-2	Demonstrate knowledge of integrated science.
		PLO-7/KN-3	Demonstrate pedagogical knowledge of designing, implementing, and evaluating science learning.
		PLO-8/KN-4	Demonstrate knowledge related to science education research.
	Special Skills	PLO-9/SS-1	Demonstrate the ability to design, implement, and evaluate science learning through the effective use of ICT.

Competency SSC-ASIIN	Aspect	PLO	Description
	(SS)	PLO-10/SS-2	Demonstrates the ability to design and implement experiments or investigations in integrated science learning to analyze scientific cases and issues, solve problems, and interpret data.

The connection between PLOs, PEO, and IQF is shown in Table 3.

Table 3. Correlation between the PLOs, PEOs and IQF

PLO	PEO					IQF			
	PEO-1	PEO-2	PEO-3	PEO-4	PEO-5	IQF-1	IQF-2	IQF-3	IQF-4
PLO-1		√	√						√
PLO-2			√	√	√	√		√	
PLO-3					√	√	√	√	
PLO-4				√	√			√	√
PLO-5	√					√	√		
PLO-6	√					√	√		
PLO-7	√					√	√		
PLO-8	√					√	√		
PLO-9	√					√	√		
PLO-10	√				√	√	√	√	
PLO-11				√			√	√	

PROGRAM STRUCTURE

The UPSE 2024-2028 transformation curriculum was developed through a comprehensive process involving inputs from stakeholders, alumni, and science education experts. In its design, both national and international references were considered to ensure the relevance of graduate competencies. In response to the current developments in science education, the revitalized curriculum incorporates updated references, including the Kurikulum Merdeka and the Next Generation Science Standards (NGSS) 2013. This update strengthens the program's alignment with contemporary national and international standards while maintaining continuity in the essential competencies expected of graduates. The curriculum structure development process is illustrated in Figure 1.

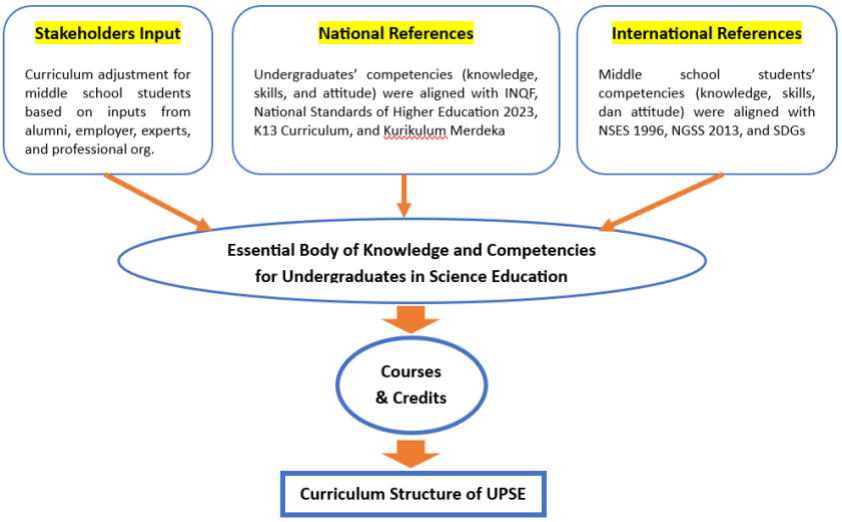


Figure 1. The curriculum structure development process of the UPSE

The development of the UPSE curriculum was guided by five principles of UNESA's curriculum framework: relevance, flexibility, continuity, efficiency, and effectiveness. Relevance is ensured through alignment with national and international standards and user needs; flexibility by adapting to emerging educational issues such as the shift from K13 to Kurikulum Merdeka; and continuity by demonstrating structured relationships among courses, as shown in Figure 2 and the PLO roadmap. Efficiency and effectiveness are achieved by integrating all relevant aspects to support the attainment of the PEOs.

The curriculum of UPSE is delivered in 4 phases/years through 3 main structures: basic knowledge, interdisciplinary knowledge and pedagogical knowledge, as shown in Figure 2. In this structure, the learning process to gain the main competencies is modelled as a house. Basic and interdisciplinary knowledge are the foundation or the main requirement for students to learn pedagogical knowledge which is represented as the pillars of the house. Both basic and interdisciplinary knowledge function as pedagogical content knowledge. Without the content knowledge, pedagogical knowledge is meaningless. As a student mastery both content and pedagogical knowledge, they are expected to have competencies of science educators or teachers as the roof which cover all science education knowledge.

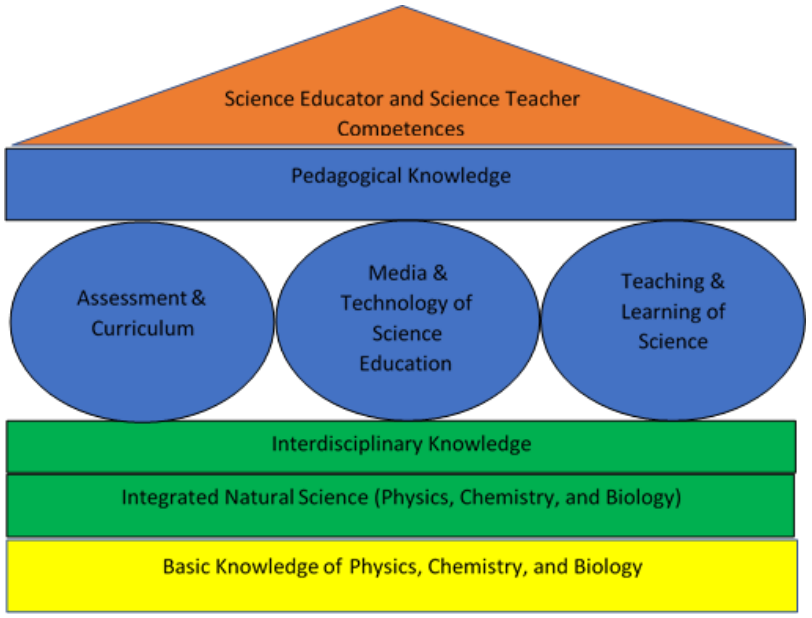


Figure 2. Model of curriculum structure of UPSE

The minimum workload of UPSE is 144 Credit Units (CU) which correspond to 6,523.2 hours[1] or 229 ECTS[2], and are generally distributed in 8 regular semesters. On average, the total hour per semester is 906 hours (20 CU). The workload for each regular semester is limited to 1,042 hours, corresponds to 23 CU (36.57 ECTS). The detailed curriculum structure of the UPSE in relation to PLOs is shown in Table 4.

[1] Referring to The Decree of Rector Unesa No. 736/HK/KM/2023 dated March 2nd, 2023, 1 CU for bachelor degree or 1 *sks* equals to 170 minutes per week. For one semester, each course is conducted in 16 weeks (including midterm and final exams). Thus, 1 CU equals to 16 weeks × 170 minutes = 2,720 minutes or 45.3 hours.

[2] 1 CU equals to 1.59 ECTS, assuming that 1 ECTS equals to 28.48 work hours per semester (45.3/28.48 = 1.59) (according to The Decree of Rector Unesa No. 736/HK/KM/2023 dated March 2nd, 2023).

Table 4. Curriculum structure 2024 - 2028 of the UPSE

No	Code	Course Title	CU	PLO 1	PLO 2	PLO 3	PLO 4	PLO 5	PLO 6	PLO 7	PLO 8	PLO 9	PLO 10	PLO 11
				AT-1	AT-2	AT-3	GS-1	KN-1	KN-2	KN-3	KN-4	SS-1	SS-2	GS-1
Semester I														
1	1000002177	English	2											√
2	8420103023	General Biology*)	3					√						
3	8420802028	Fundamentals of Science	2						√					
4	8420103045	General Physics*)	3					√						
5	8420103074	General Chemistry*)	3					√						
6	1000002047	Physical Education and Fitness	2	√	√									
7	8420802186	Basic Mathematics	2					√						
8	1000002018	Pancasila	2	√	√									
Total			**19 CU (30.21 ECTS)**											
Semester II														
9	100000202x	Religion	2	√										
10	1000002048	Foundations of Education	2			√				√				
11	8420802042	Philosophy of Science Education	2			√				√				
12	8420803067	Cellular Life	3					√						
13	1000002033	Citizenship	2	√										
14	8420803155	Learning Theories	3			√				√				
15	1000002046	Digital Literacy	2									√		
16	8420803199	Integrated Science*)	3	√					√					
Total			**19 CU (30.21 ECTS)**											
Semester III														
17	1000002003	Indonesian	2											√
18	8420803209	Fluids, Waves and Optics*) (elective)	3						√				√	
19	8420803161	Laboratory Management and Safety*)	3										√	
20	8420803153	Science Curriculum Review	3							√		√		
21	8420802203	Artificial Intelligence for Science Learning (elective)	2									√		
22	8420803090	Learning Media	3							√		√		
23	8420804200	Interdisciplinary Science	4	√					√				√	
24	8420803201	Environmental Science*)	3	√					√				√	
Total			**23 CU (36.57 ECTS)**											
Semester IV														
25	8420803038	Ethnoscience	3	√					√				√	
26	8420803195	Innovative Learning	3							√		√		
27	8420802181	Micro Learning	2							√		√		
28	8420803205	Local Wisdom–Based Science Learning (elective)	3	√					√	√				
29	8420803010	Assessment of Learning Processes and Outcomes	3							√		√		
30	1000002176	Entrepreneurship	2		√									
31	8420802077	Conservation of Natural Resources and Environment*)	2						√				√	
32	8420802214	Statistical Methods	2			√				√				
33	8420803123	Earth and Space Science	3						√					
Total			**23 CU (36.57 ECTS)**											
Semester V														

No	Code	Course Title	CU	PLO 1	PLO 2	PLO 3	PLO 4	PLO 5	PLO 6	PLO 7	PLO 8	PLO 9	PLO 10	PLO 11
				AT-1	AT-2	AT-3	GS-1	KN-1	KN-2	KN-3	KN-4	SS-1	SS-2	GS-1
34	100000xxxx	MBKM Recognition (Teaching Assistant/Entrepreneurship)	20		√		√			√				
35	8420803094	Research Methodology	3			√					√			√
Total			**23 CU (36.57 ECTS)**											
Semester VI														
	Recognition of School Field Experience Program													
36	MBKM0032	Design of School Field Experience Program	2				√			√				
37	1000002051	Curriculum Analysis	2							√				
38	1000002055	Learning Assessment	2							√				
39	1000002049	School Management	2				√			√				
40	1000003053	Instructional Material Development	2							√		√		
41	1000002054	Instructional Media Development	2							√		√		
42	1000002050	School Program Development	2				√			√				
43	1000003052	Lesson Plan Development	2							√		√		
44	1000004056	Teaching Practice	2							√		√		√
45	MBKM0031	Evaluation of School Field Experience Program	2				√			√				
Total			**20 CU (31.8 ECTS)**											
Semester VII														
46	8420803163	Fundamentals of Biochemistry*) (elective)	3						√					
47	8420803068	Electricity and Magnetism*) (elective)	3						√					
48	1000002104	Final Project Proposal	2								√			√
49	8420803197	Anatomy and Physiology of Living Organisms*) (elective)	3						√					
50	8420802069	Entrepreneurship in Science Education (elective)	2		√									
51	1000020156	Social and Emotional Learning (elective)	2		√		√			√				
52	8420803208	Science Education for Sustainable Development (elective)	3						√	√			√	
53	0000000000	STEAM Education (elective)	4		√				√				√	
Total			**18 CU (28.62 ECTS)**											
Semester VIII														
54	1000020163	Communication Skills (elective)	2							√				√
55	8420802029	Fundamentals of Biotechnology*) (elective)	2						√				√	
56	1000004105	Final Project	4			√					√		√	√
57	8420802005	Analysis of School Science (elective)	2					√		√				
58	8420102073	Current Socio-scientific issues (CSSI) (elective)	2	√					√					
Total			**10 CU (15.90 ECTS)**											
Total			**144 CU (228.96 ECTS)**											

Note: *) Integrated with practicum

Table 5. Compulsory and Elective Courses in the UPSE Curriculum

Courses	CU	ECTS	Note
Compulsory courses	125	198.75	The 130 CU are distributed into 49 compulsory courses including university compulsory courses.
Elective courses	19	30.21	To complete their study, students should take at least 19 CU from the 36 CU of elective courses available.
Total	**144**	**228.96**	

Table 6. UNESA Compulsory Courses

No.	Code	Course Name	CU
1	100000202x	Religion	2
2	1000002018	Pancasila	2
3	1000002033	Citizenship	2
4	1000002003	Indonesian	2
5	1000002046	Digital Literacy	2
6	1000002047	Physical Education and Fitness	2
7	1000002177	English	2
8	1000002176	Entrepreneurship	2
Total			16

Table 7. Elective Courses in UPSE Curriculum

No.	Code	Course Name	CU
1	8420803209	Fluids, Waves and Optics*)	3
2	8420802203	Artificial Intelligence for Science Learning	2
3	8420803205	Local Wisdom–Based Science Learning	3
4	8420803163	Fundamentals of Biochemistry	3
5	8420803068	Electricity and Magnetism	3
6	8420803197	Anatomy and Physiology of Living Organisms	3
7	8420802069	Entrepreneurship in Science Education	2
8	1000020156	Social and Emotional Learning	2
9	8420803208	Science Education for Sustainable Development	3
10	0000000000	STEAM Education	4
11	1000020163	Communication Skills	2
12	8420802029	Fundamentals of Biotechnology	2
13	8420802005	Analysis of School Science	2
14	8420102073	Current Socio-scientific issues (CSSI)	2
	Recognition of Teaching Assistant Program		
15	1000003065	Design of Teaching Assistant Program	2
16	1000004066	Instructional Material Development	4
17	1000004067	Implementation of Teaching Assistant Program	4
18	1000003069	Dissemination of Teaching Assistant Program	4
19	1000003070	Report Development of Teaching Assistant	4

No.	Code	Course Name	CU
		Program	
20	1000003068	Evaluation of Teaching Assistant Program	2
	Recognition of Entrepreneurship Program		
21	1000003089	Design of Entrepreneurship Program	2
22	1000004091	Implementation of Entrepreneurship Program	4
23	1000004090	Product Development of Entrepreneurship Program	4
24	1000003093	Dissemination of Entrepreneurship Program	4
25	1000003094	Report Development of Entrepreneurship Program	4
26	1000003092	Evaluation of Entrepreneurship Program	2
Total			14

Note: *) Integrated with practicum

The undergraduate curriculum is designed to be completed within eight semesters (four years), with a total of 144 CU (228.96 ECTS). The program roadmap is structured progressively to equip students with fundamental scientific knowledge, pedagogical competence, research skills, ICT literacy, and field experience. The learning outcomes (PLOs) are achieved through the following stages:

1. **Foundation Stage (Semesters I–II)**
   Students acquire general knowledge and fundamental sciences including Biology, Physics, Chemistry, and Mathematics, alongside Integrated Science. National and institutional compulsory courses (e.g., English, Pancasila, Religion, Citizenship, and Physical Education) instill values, ethics, and communication skills. Introductory courses in education and learning theories provide the basis for pedagogical knowledge. Digital literacy enhances competence in ICT for learning.
2. **Integration Stage (Semesters III–IV)**
   This stage emphasizes integration of sciences and pedagogy through courses such as Environmental Science, Interdisciplinary Science, Ethnoscience, and Earth and Space Science. Students learn Curriculum Review, Learning Media, Innovative Learning, Assessment of Learning Processes, and Micro Learning, as well as laboratory safety and management. Research skills are strengthened through Statistical Methods and critical thinking courses.
3. **Application and Field Experience Stage (Semesters V–VI)**
   Students gain real-world exposure through MBKM programs (Teaching Assistance or Entrepreneurship) and School Field Experience Programs. They engage in Research Methodology, Curriculum Analysis, Instructional Material and Media Development, Lesson Planning, and Teaching Practice, which enable them to design, implement, and evaluate science learning effectively using ICT.
4. **Specialization and Research Stage (Semesters VII–VIII)**
   In the final stage, students deepen their expertise through electives such as Biochemistry, Biotechnology, Anatomy and Physiology, Electricity and Magnetism, STEAM Education, Science Education for Sustainable Development, and Current Socio-scientific Issues. Soft-skill and entrepreneurship-related courses (e.g., Social and Emotional Learning, Entrepreneurship in Science Education, Communication Skills) further prepare them for

professional practice. The curriculum culminates with the Final Project (Thesis), where students demonstrate research competence, problem-solving ability, and effective communication of scientific ideas.

Overall, the curriculum roadmap guides students from mastering fundamental sciences and pedagogy → integrating science and educational approaches → applying knowledge through field experience → to developing research and specialization, as shown in Figure 3. Detail roadmap to achieve each PLO in this study program is shown in following figures.

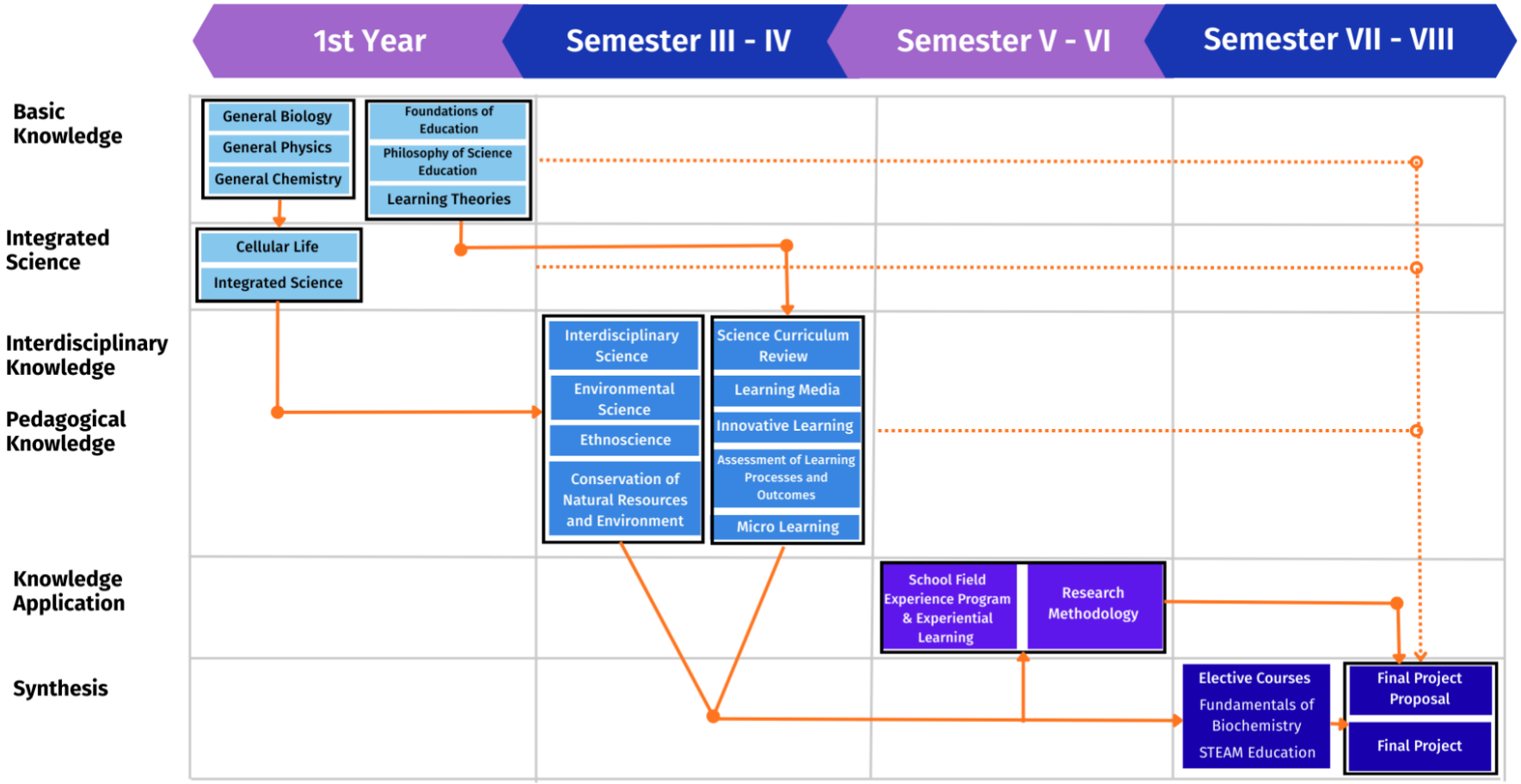
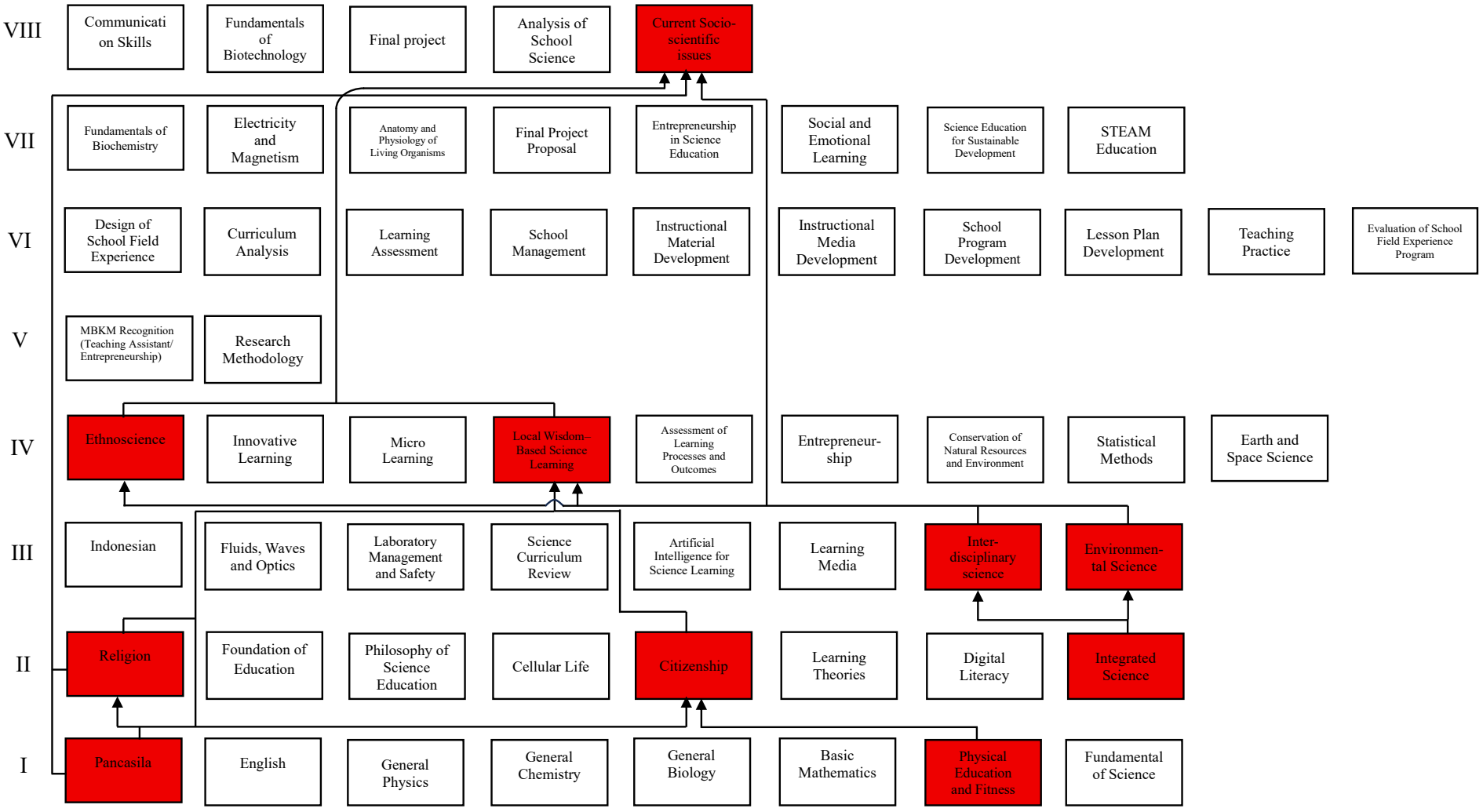


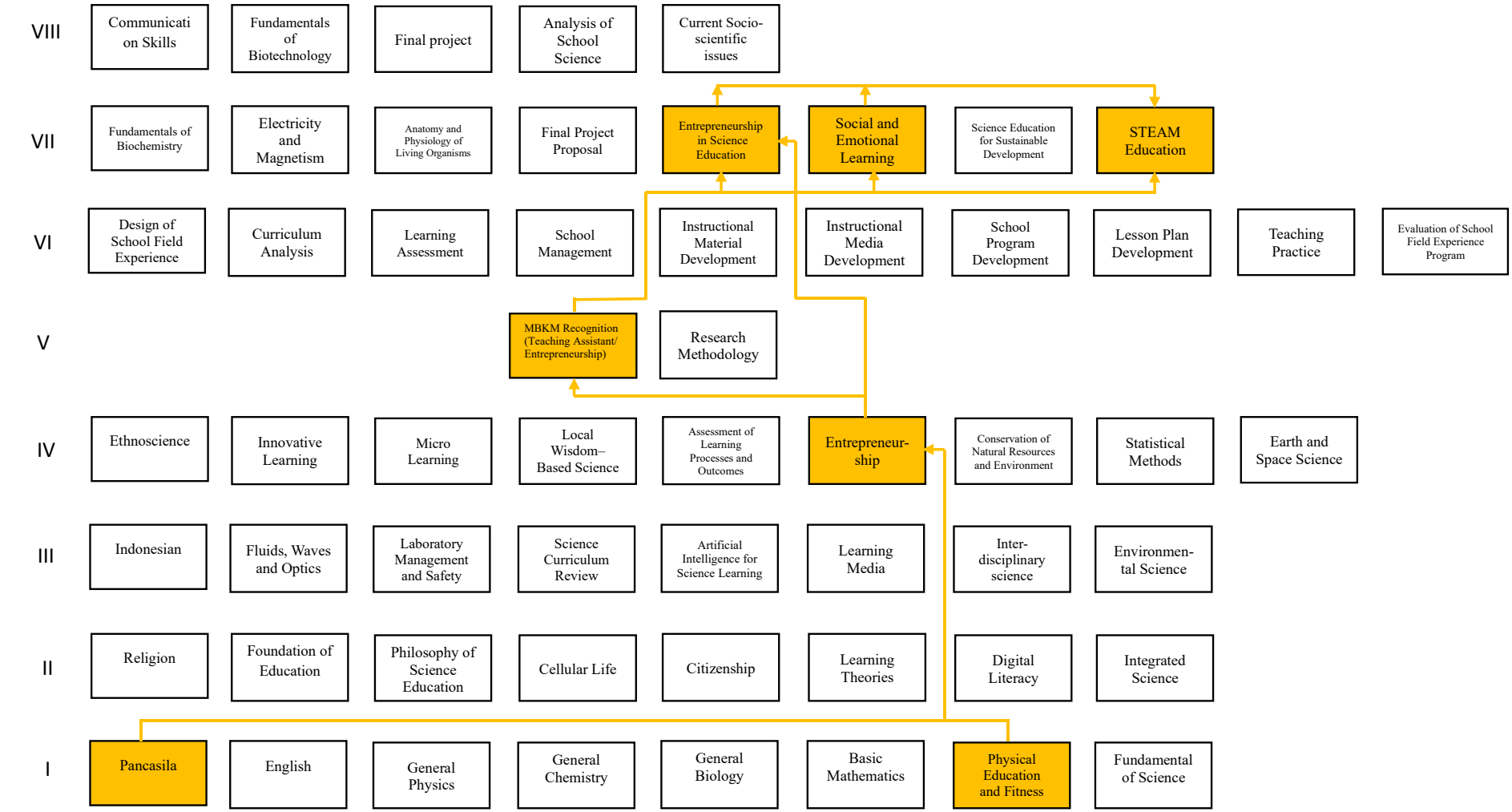
Figure 3. Roadmap of the UPSE's Curriculum Structure

PLO 1 Roadmap

Semester

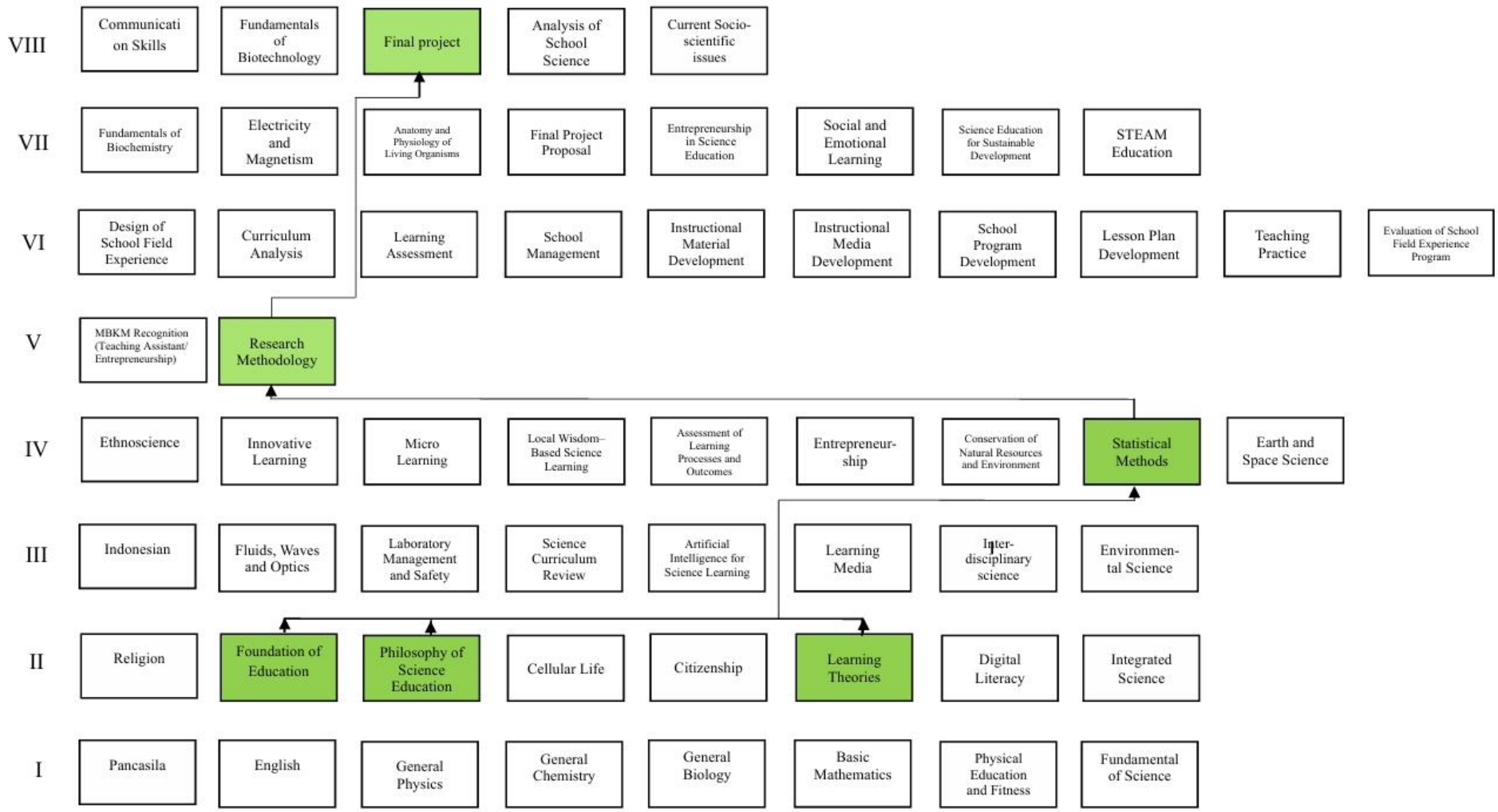


PLO 2 Roadmap

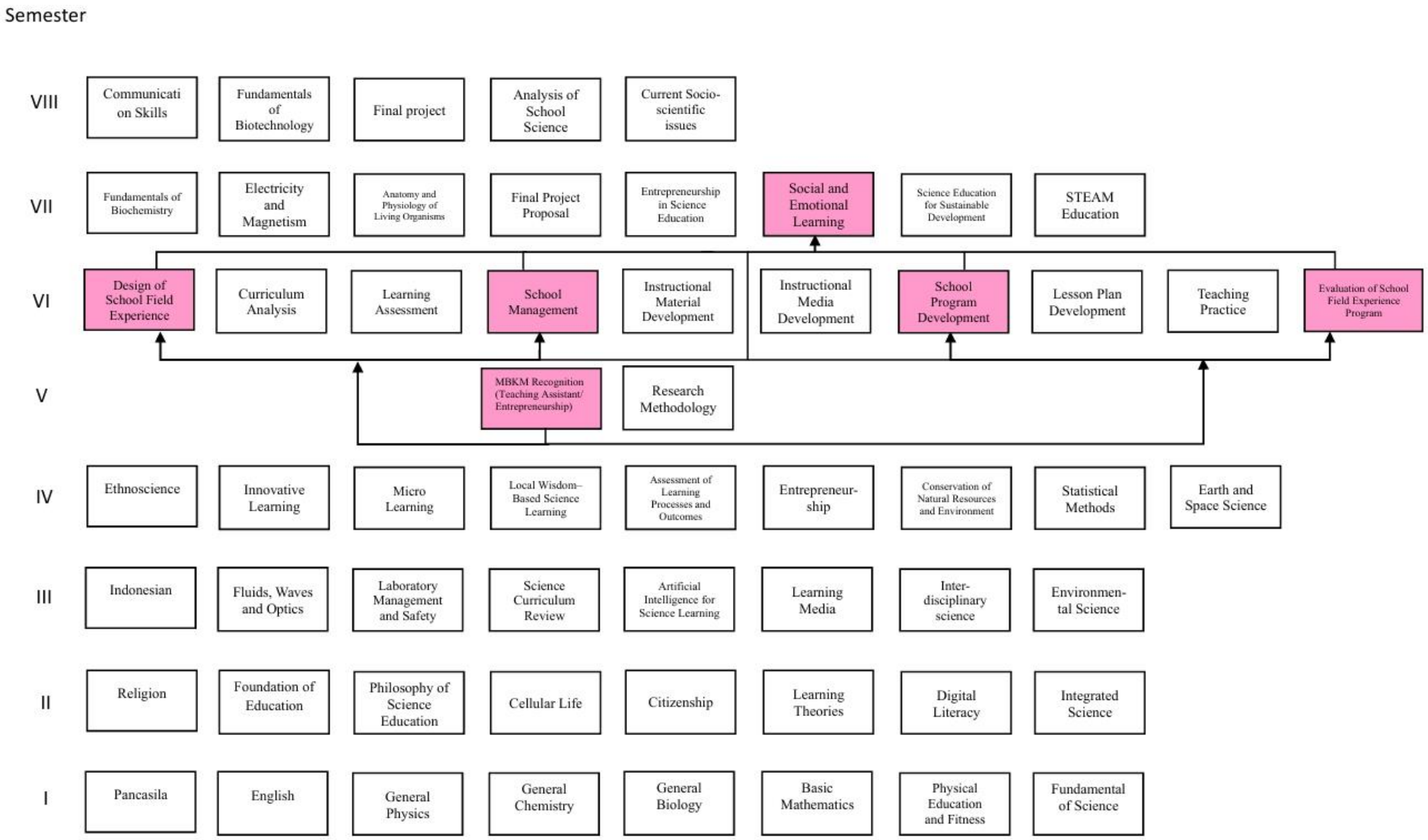


PLO 3 Roadmap

Semester

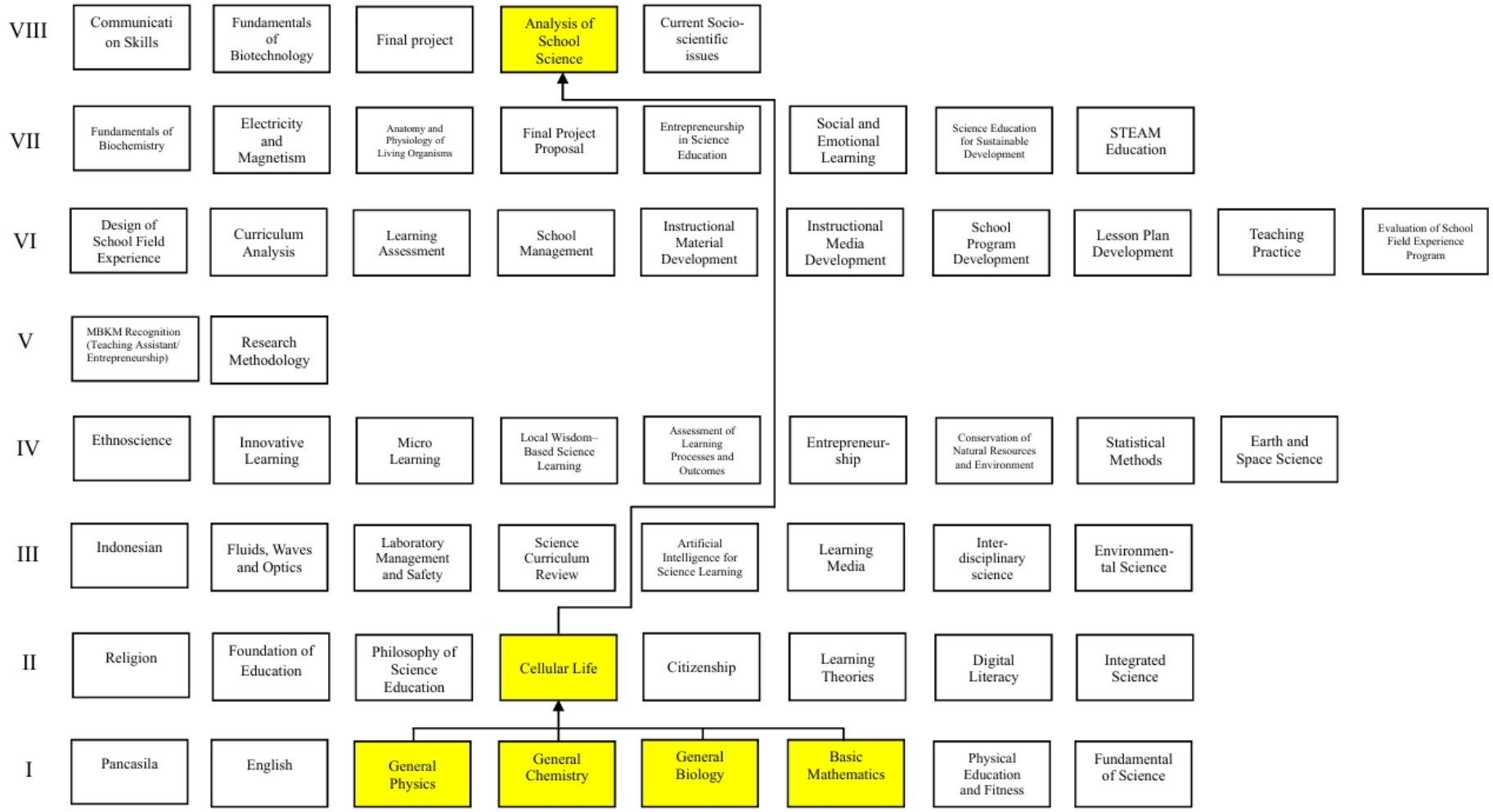


PLO 4 Roadmap

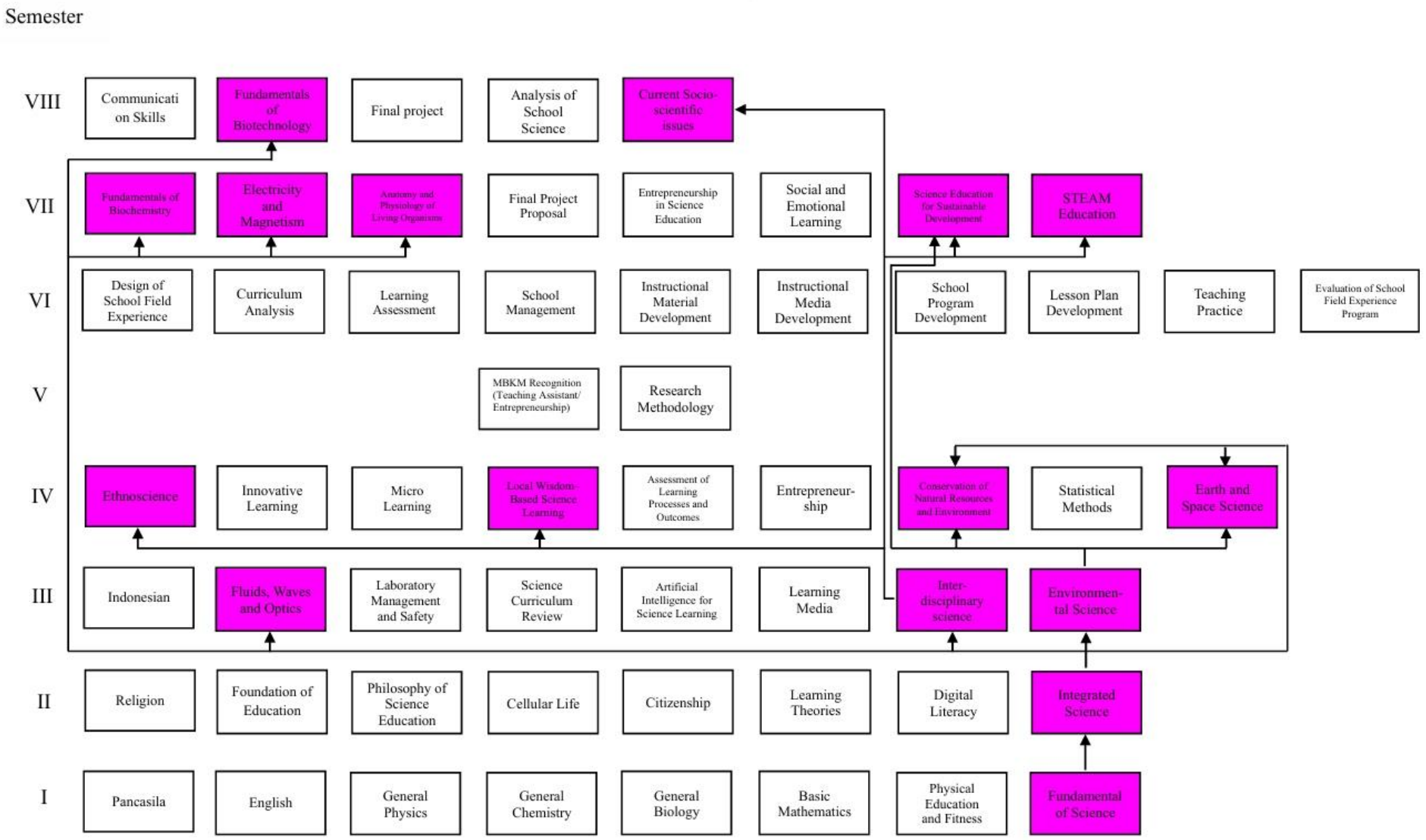


PLO 5 Roadmap

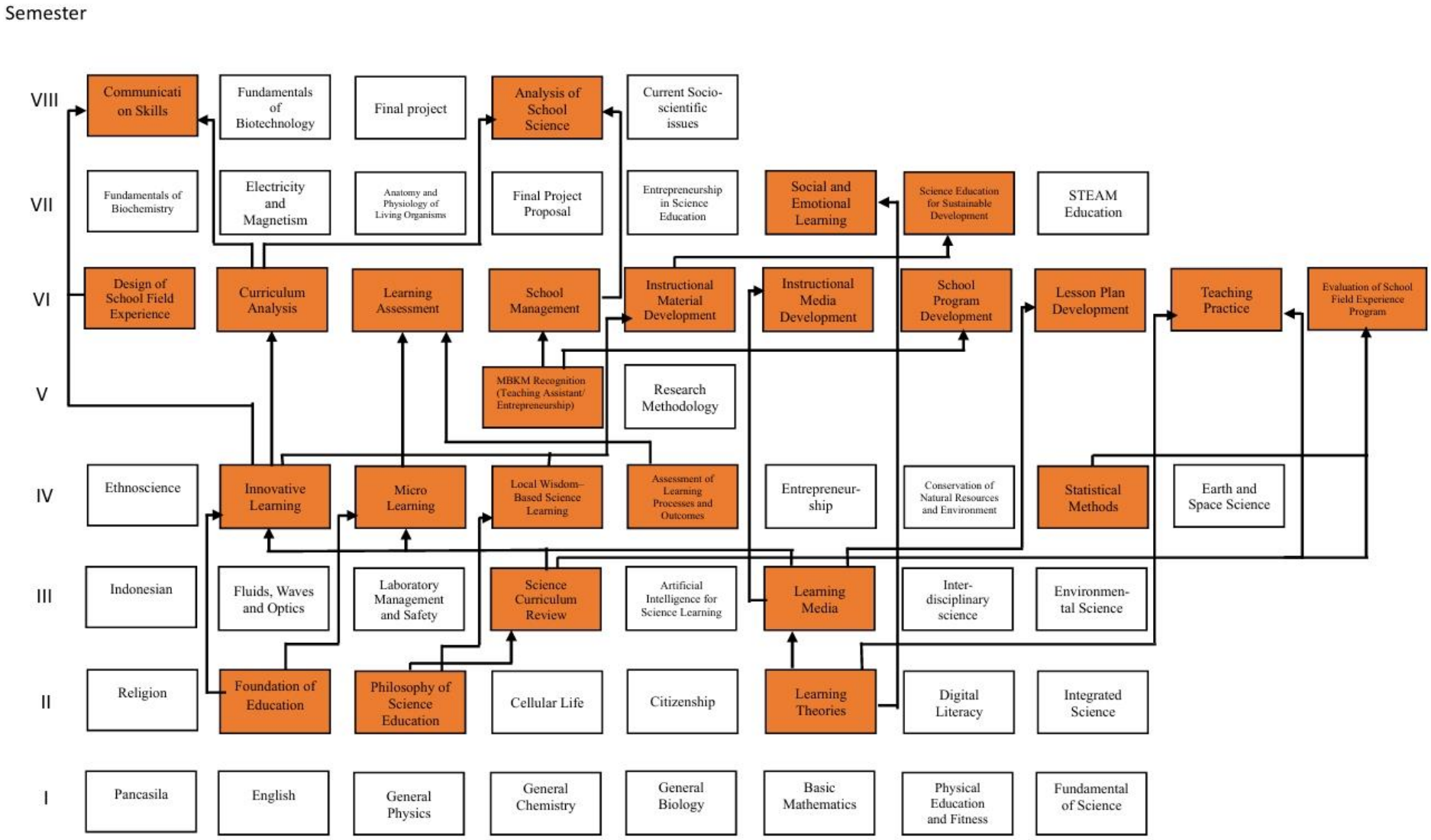
Semester



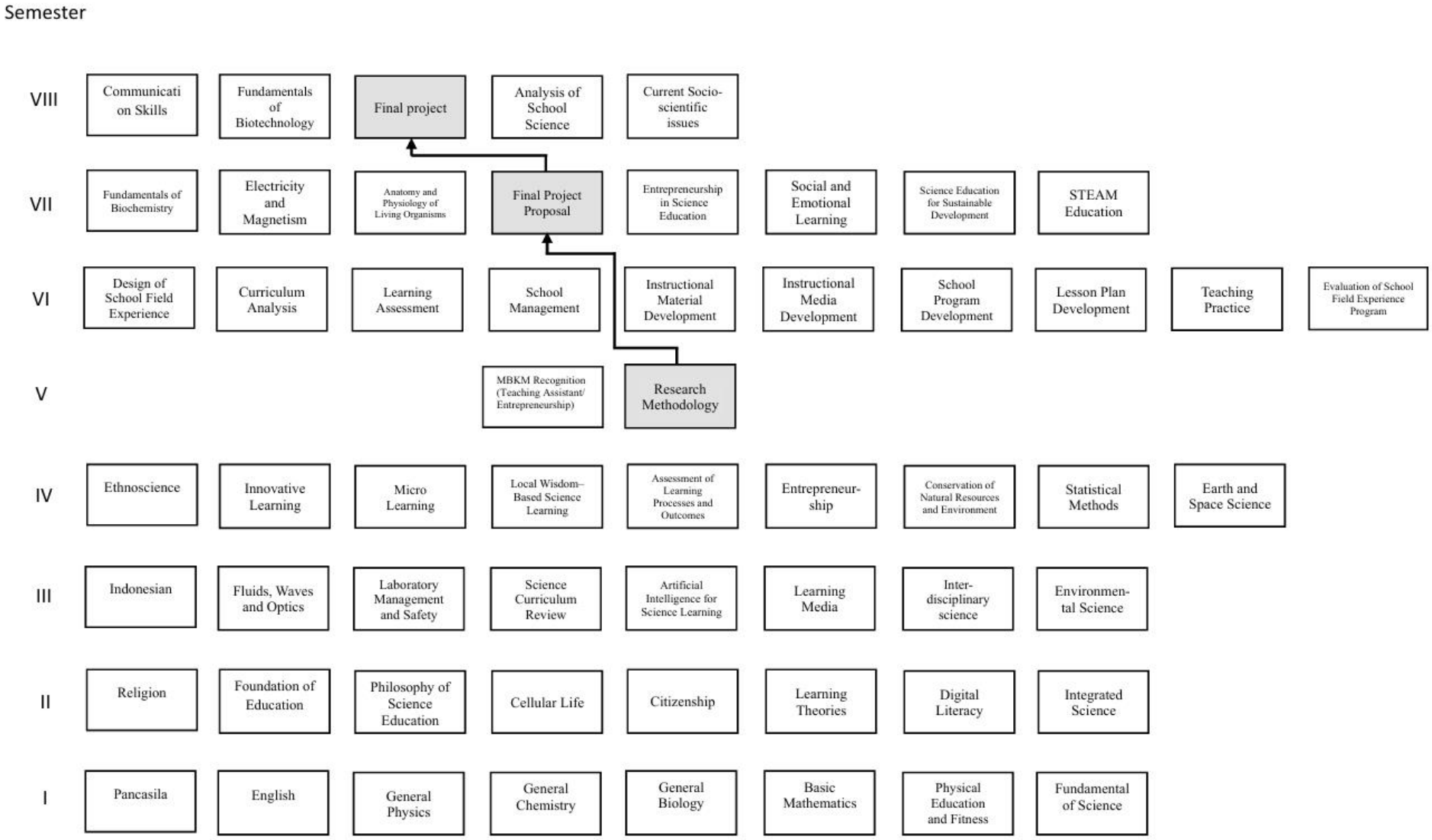
PLO 6 Roadmap



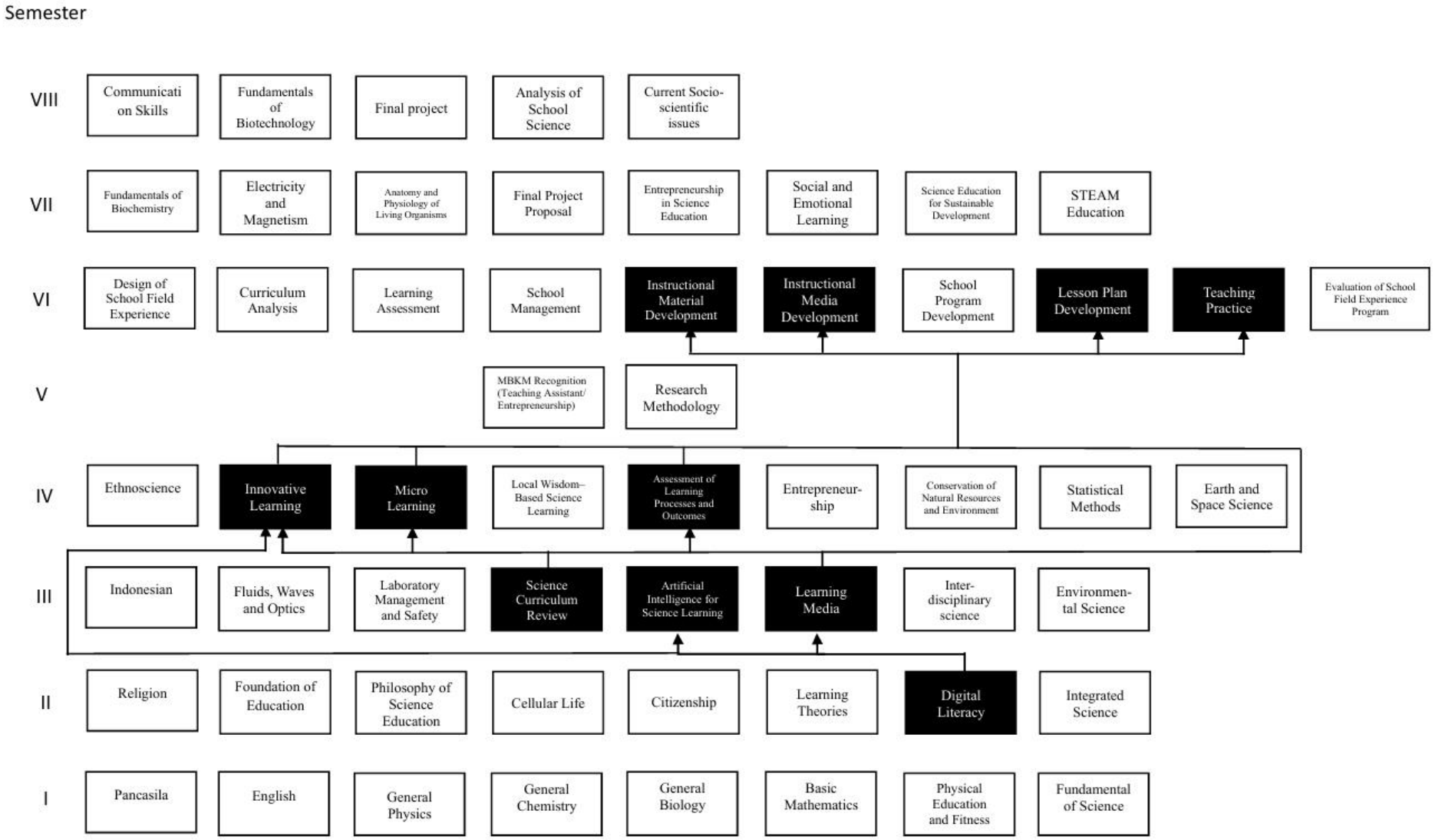
PLO 7 Roadmap



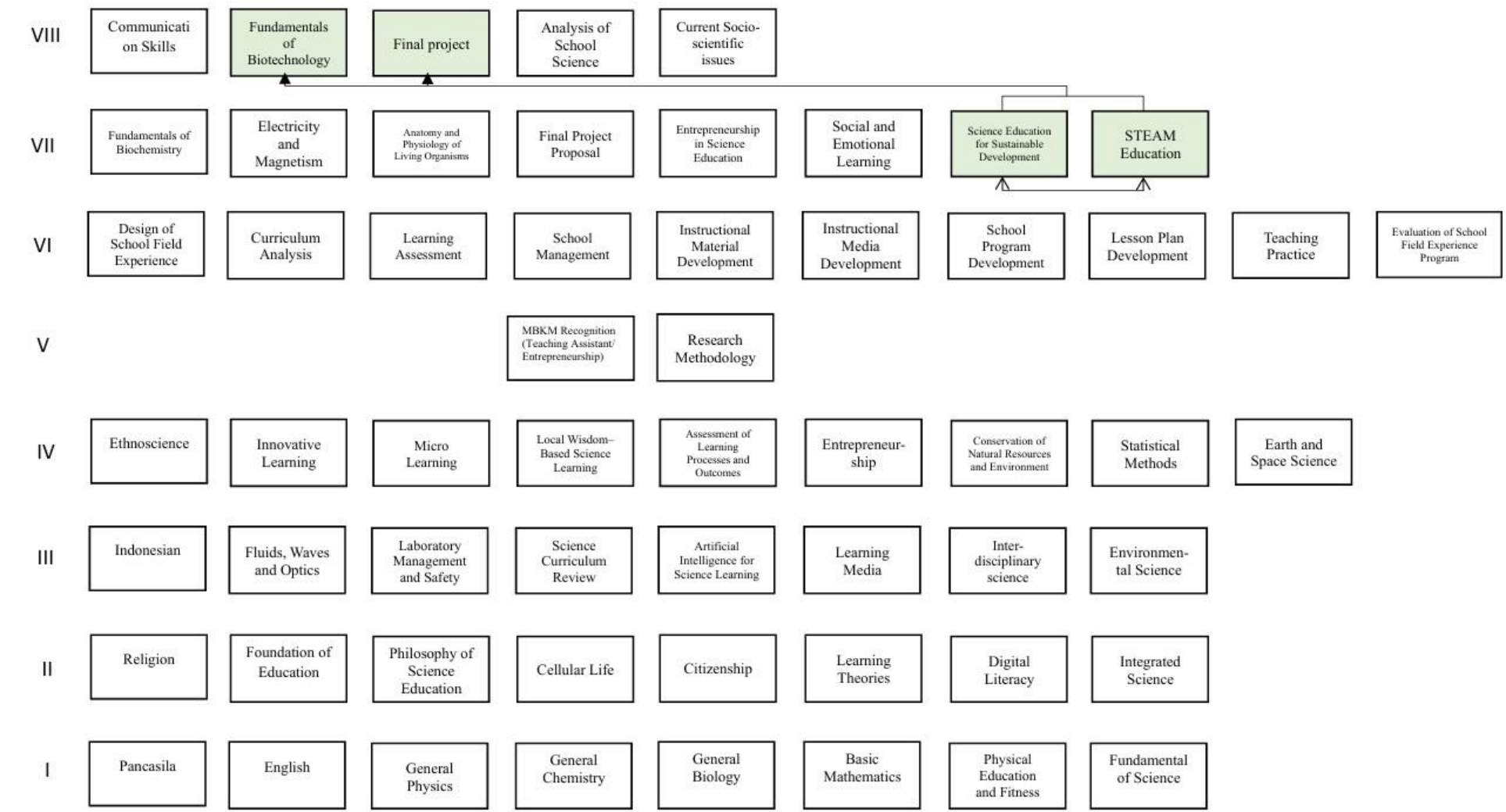
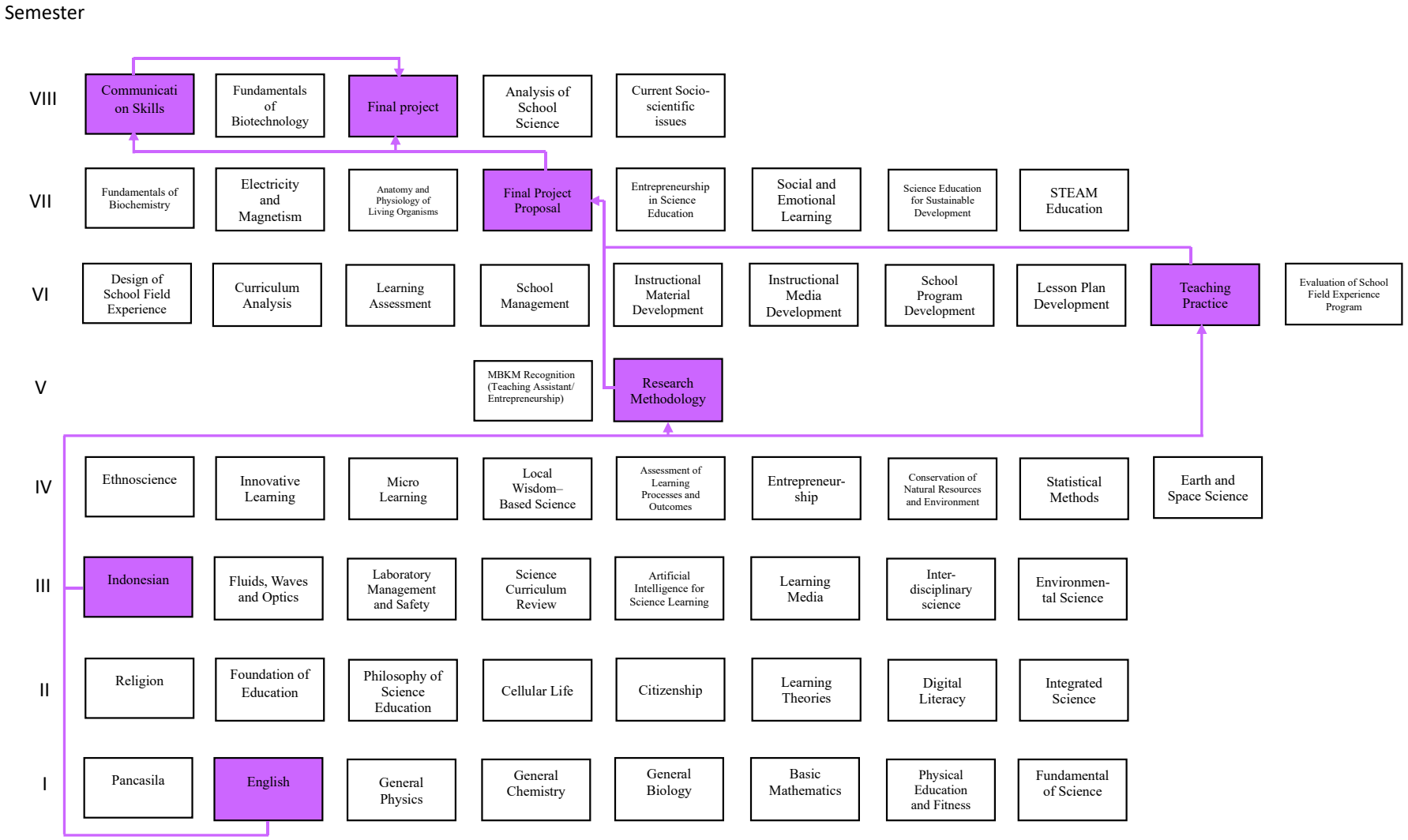
PLO 8 Roadmap



PLO 9 Roadmap



PLO 10 Roadmap



PLO 11 Roadmap