CURRICULUM EVALUATION
ASSESSMENT AND CONSOLIDATION OF GRADUATE LEARNING ACHIEVEMENTS, *TRACER STUDIES*, AND CONTINUOUS IMPROVEMENT EFFORTS

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2024

Introduction

We praise God Almighty for the completion of the report "Curriculum Evaluation: Assessment and Consolidation of CPL Achievements, *Tracer Studies*, and Sustainable Improvement Efforts" in 2024. This report was compiled as part of the ongoing efforts of the Science Education Study Program, Faculty of Mathematics and Natural Sciences (FMNS), State University of Surabaya (Unesa) to reflect and improve the curriculum as a whole.

In compiling this report, we refer to a variety of comprehensive data, including the results of alumni *tracer studies*, evaluation of graduate learning outcomes (CPL), alumni and industry input, assessment of curriculum suitability with job market needs, and challenges faced both internally and externally. This evaluation is a crucial strategic step to ensure that the curriculum implemented is not only relevant to the times, but also able to prepare graduates who are competitive and globally competitive.

In this era of dynamic change, the demands on science education graduates are increasingly complex, especially with the emergence of the industrial revolution 4.0 that prioritizes STEM skills, as well as the mainstreaming of sustainability in accordance with the *Sustainable Development Goals* (SDGs). Therefore, the consolidation carried out through this assessment is expected to provide a clear direction for sustainable improvement of curriculum quality.

We would like to thank all parties who have contributed to the preparation of this report, including lecturers, students, alumni, industry partners, and other stakeholders. Hopefully this report can be a useful guideline for improving the quality of education in the Science Education Study Program of FMNS Unesa and can have a positive impact on the development of science education in Indonesia.

Surabaya, August 2024
Drafting Team

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A. Background

The curriculum is an important component in the education system that serves as a guideline in the learning process to achieve the expected competencies. In the era of globalization and rapid technological development, the demands for university graduates continue to change along with the dynamics of the job market and industrial needs. Regular curriculum evaluations are essential to ensure that educational programs remain relevant. In addition, curriculum evaluation is also able to provide feedback for a program, so that it can support the learning process of graduates that are competitive and in accordance with the needs of society, the world of work, and scientific development. Each Study Program has an *Educational Objectives* Program (PEO) and *a Learning Outcomes Program* (PLO). Both are key elements in setting education quality standards that are oriented towards achieving the long-term goals of graduates and learning achievement in the short term.

Curriculum evaluation aims to identify the strengths and weaknesses of the curriculum structure and content, as well as its relevance to academic and professional demands. This evaluation involves a variety of stakeholders, including educators, students, alumni, and industry, to provide a holistic view of the extent to which the curriculum has achieved its expected *learning outcomes*. The Rector Regulation of the State University of Surabaya Number 15 of 2023 concerning the Curriculum of the State University of Surabaya also emphasizes curriculum evaluation to measure the results and impact of the current curriculum to be used as a basis for future policymaking. In particular, the Academic Senate Regulation of the State University of Surabaya Number 10 of 2023 concerning the Development of the Curriculum of the Study Program of the State University of Surabaya states that each Study Program is required to evaluate the curriculum every one cycle of the study period by involving stakeholders. In this context, curriculum evaluation is carried out with reference to three main perspectives: Internal (*PLO Assessment*), Alumni, and *Industry*. Evaluation from an internal perspective includes an assessment of the extent to which the study program is able to achieve the learning objectives that have been set. On the other hand, evaluations from alumni and industry reflect the relevance of the curriculum to the needs of the world of work and the real contribution of graduates in the field. These three perspectives are important for building a curriculum that is not only academically strong, but also able to adapt to external changes.

B. Juridicial Basis

1. Law Number 20 of 2003 concerning the National Education System.
2. Law Number 12 of 2012 concerning Higher Education.
3. Government Regulation Number 57 of 2021 concerning National Education Standards c.q. Government Regulation Number 66 of 2010 concerning Amendments to Government Regulation Number 17 of 2010 concerning the Management and Implementation of Education.
4. Government Regulation Number 4 of 2014 concerning the Implementation of Higher Education and Higher Education Management.
5. Government Regulation Number 37 of 2022 concerning State Universities Legal Entities of the State University of Surabaya.
6. Presidential Regulation Number 8 of 2012 concerning the Indonesian National Qualifications Framework (KKNI).
7. Regulation of the Minister of Education, Culture, Research, and Technology Number

53 of 2023 concerning Quality Assurance of Higher Education.
8. Regulation of the Rector of the State University of Surabaya Number 15 of 2023 concerning the Curriculum of the State University of Surabaya.
9. Regulation of the Academic Senate of the State University of Surabaya Number 10 of 2023 concerning the Development of the Curriculum of the Study Program of the State University of Surabaya.

C. Summary of The Current Curriculum

The Program Education Objectives (PEO) set by the Science Education Study Program, Faculty of Mathematics and Natural Sciences (FMNS) State University of Surabaya (Unesa), focuses on producing graduates who are able to become science (science) educators, especially at the high school level, science education researchers, and entrepreneurs in the field of applied science or science education. In detail, the educational objectives of the UPSE Science Education Study Program FMNS Unesa are described in Table 1.

Table 1 PEO of the Science Education Study Program of FMNS Unesa

PEO	Description
PEO1	Mastering knowledge/skills in the field of integrated science pedagogy (physics, chemistry, and biology) to carry out professional or entrepreneurial tasks
PEO2	Have responsibility in carrying out their professional duties based on ethics profession
PEO3	Have a strong and resilient personality and be able to compete globally in carrying out their professional duties or entrepreneurship
PEO4	Have the ability to communicate and cooperate in carrying out Professional Duties
PEO5	Have the ability to do self-development and innovation sustainable according to the situation and challenges in the tasks of his profession

All PEOs are intended to form the profile of graduates of the Science Education Study Program FMNS Unesa as **science educators (teachers), science education researchers, science laboratory managers, education managers, and/or entrepreneurs** who have the ability:

1. Applying his field of expertise in the field *of pedagogical integrated science* and utilizing science and technology to design, implement, and evaluate *integrated science* learning and solve learning problems professionally according to the situation and challenges faced.
2. Mastering natural sciences, pedagogy, and problem-solving methodologies as well as applications in the field of work to support their professional duties and to solve *integrated science* (professional) learning problems.
3. Able to make the right decisions based on information and data analysis to solve *integrated science learning problems and* integrated science *learning innovation products*, both independently and in groups.
4. Responsible in carrying out their professional duties and can be given responsibility in their professional organization to solve *integrated science learning problems*.

In addition to the main profile, there is also an additional profile of graduates of the Science Education Study Program of FMNS Unesa presented in Table 2.

Table 2 Additional profiles of graduates of the Science Education Study Program FMNS Unesa

No.	Profession	Competency Description
1	Science Educator	Science Education graduates have the ability to be science educators for junior high schools. characterized by having character: loyal, intelligent, independent, honest, caring, and resilient (ideal dream), environmentally friendly, globally minded by utilizing local potential in the field of science education, having desire to innovate by utilizing ICT, and have an entrepreneurial spirit that is ready to be trained and trained to become a professional science teacher, and able to learn for a lifetime
2	Educational Researcher	As an instrument developer, surveyor, observer, data analyst and educational research report, both individually and as a member of the research team education
3	Educational Institution Manager	As the chairman or member of the institution's management team education, both formal and informal
4	School Laboratory Manager	Junior high school science lab manager or equivalent
5	Entrepreneur	Entrepreneurship in the field of science education and other fields

In order for the profile of the graduate to be realized, the Science Education Study Program FMNS Unesa determines the Graduate Learning Outcomes or PLO presented in Table 3.

Table 3 PLO Science Education Study Program FMNS Unesa.

Competence	Appropriate competencies KKNI Level 6	PLO	Description
Competence Specific/Specific	Knowledge	PLO1	Able to demonstrate knowledge *basic knowledge of physics*, *chemistry*, *and biology*
		PLO2	Able to demonstrate knowledge *integrated science* (*physics*, *chemistry*, *and biology*)
		PLO3	Able to demonstrate knowledge pedagogic about planning, implementing, and evaluate integrated science learning
		PLO4	Able to demonstrate knowledge related to science education research
	Special Skills	PLO5	Able to design, implement, and evaluate science learning by utilizing ICT

Competence	Appropriate competencies KKNI Level 6	PLO	Description
		PLO6	Able to design and implement Experiments in *Integrated Learning science* and to obtain, analyze, and interpret the data obtained
Social Competence	General Skills	PLO7	Able to communicate ideas, ideas, and research results effectively, both verbally as well as writing
		PLO8	Able to make decisions based on data/ information in order to complete the tasks for which they are responsible and evaluate the performance that has been carried out
		PLO9	Able to work effectively both individually and in groups, having entrepreneurial spirit, and caring for the environment
	Attitude	PLO10	Able to demonstrate scientific, critical, and innovative attitudes in learning *integrated science*, laboratory activities, and his professional duties
		PLO11	Able to demonstrate values religion and culture of the nation, as well as academic ethics in carrying out their duties professional

The suitability and linkage of the curriculum of the Science Education Study Program FMNS Unesa with the competence of graduates according to KKNI level 6 for the undergraduate level and the harmony of the relationship between PEO and PLO are presented in Table 4 and Table 5.

Table 4 KKNI and PEO conformity matrix

Description of KKNI Level 6	PEO1	PEO2	PEO3	PEO4	PEO5
Able to apply their field of expertise and utilize science, technology, and/or art in their field in solving problems and be able to adapt to the situation faced	S	S	S	M	S
Mastering the theoretical concepts of a particular field of knowledge in general and the theoretical concepts of specific sections in that field of knowledge in depth, and being able to formulate the solution of procedural problems	S	S	S	S	S
Able to make the right decision based on information and data analysis, and able to provide guidance in choosing various alternative solutions independently and in groups	S	S	S	M	S

Description of KKNI Level 6	PEO1	PEO2	PEO3	PEO4	PEO5
Be responsible for their own work and can be given responsibility for the achievement of organizational work results	M	S	S	S	S

Note: S = Strong; M = Moderate.

Table 5 Alignment matrix between PEO and PLO

PLO	PEO				
	PEO1	PEO2	PEO3	PEO4	PEO5
PLO1	S	S	S	M	M
PLO2	S	S	S	M	M
PLO3	S	S	S	M	S
PLO4	M	S	S	M	S
PLO5	S	S	S	M	S
PLO6	S	S	S	S	S
PLO7	S	M	S	S	S
PLO8	S	S	S	S	S
PLO9	S	S	S	S	S
PLO10	S	M	S	S	S
PLO11	M	M	M	M	S

Note: S = Strong; M = Moderate.

D. Graduate Learning Achievement Assessment (*PLO Assessment*)

CPL Assessment or PLO *Assessment* is a short-term curriculum evaluation based on the learning process that has been carried out. In accordance with the Academic Senate Regulation of the State University of Surabaya No. 10 of 2023 concerning the Development of the Curriculum of the Study Program of the State University of Surabaya, it states that each Study Program is required to evaluate the curriculum every cycle of the study period by involving stakeholders. The Unesa Science Education Study Program has implemented *an Outcomes-based Curriculum* (OBC) and has reached one cycle for students in the 2019 academic year and has graduated in the 2022/2023 Academic Year. The OBC has been applied in the learning process (*Outcomes based Learning and Teaching* or OBLT) and has been assessed formatively based on the assessment of each Course (*Outcomes based Assessment and Evaluation* or OBAE). The measurement of each Graduate Learning Outcome (CPL or PLO) can be obtained from the average score obtained based on student learning outcomes during one cycle (Academic Year 2019/2020 to Academic Year 2022/2023). The average score for the entire CPL is 78.50. The comparison of the average achievement of each CPL or PLO with the overall average of CPL or PLO is presented in Figure 1.

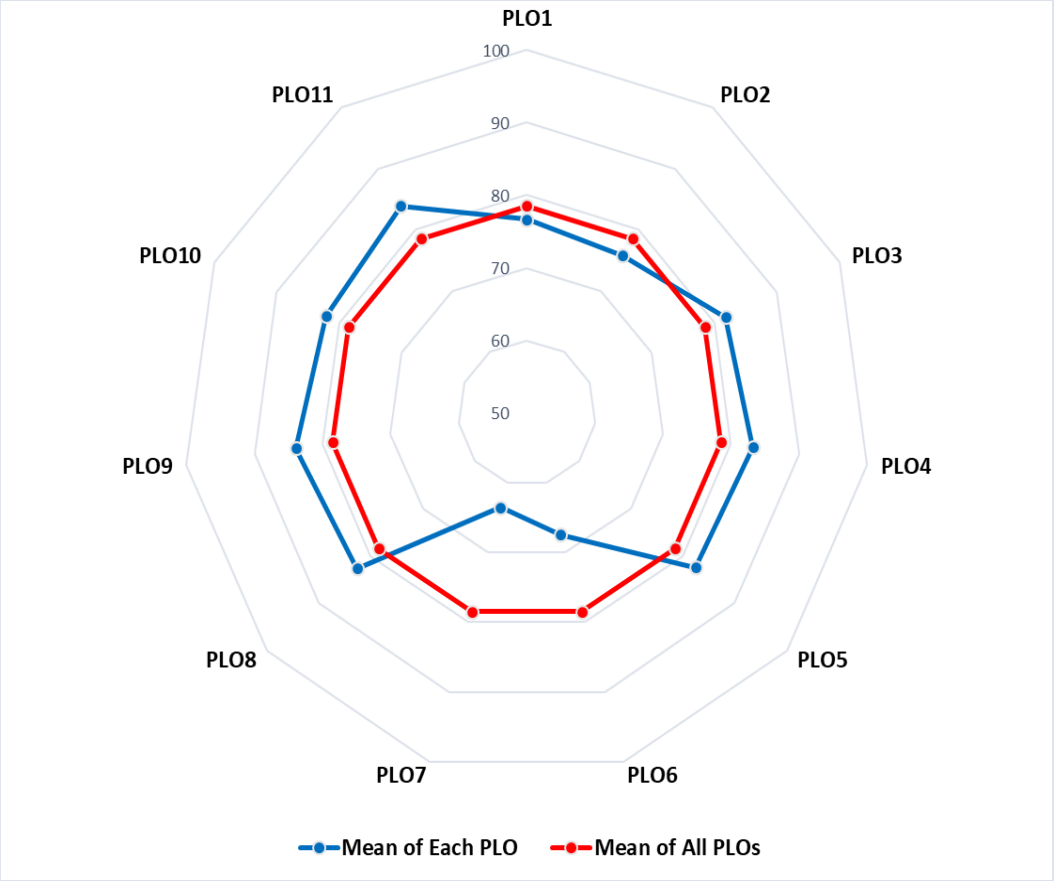

Figure 1 Comparison between PLO average and mean of the entire PLO

Based on Figure 1, in general, the achievement of PLO is still less than 80% (*mean PLOs* = 78.50%). PLO 1, PLO2, PLO 6, and PLO7 are still below the *mean* of the average of all PLO of the FMNS Unesa Science Education Study Program. This indicates that all modules embedded in PLO1, PLO2, PLO6, and PLO7 should be evaluated. PLO1 and PLO2 are closely related to the knowledge competency aspect, while PLO6 and PLO7 are related to the skill competency aspect. These two aspects of competence are very important in ensuring the success of graduates in society. The results of the research show that currently globally the need for *knowledge workers* who have STEM-based knowledge and skills is very high[1]. Science education is closely related to STEM, and the profile of graduates of the FMNS Unesa Science Education Study Program also requires knowledge and skills both related to STEM and its applications related to science and information technology.

If you look at the data in Figure 1, then for PLO3, PLO4, PLO5, PLO8, PLO9, PLO10, and PLO11 it has exceeded 80%. This indicates that students already have knowledge, skills, and attitudes related to pedagogy, *teaching research*, the use of basic ICT, collaborative work, and basic professional skills. This reflects in general that the OBC, OBLT, and OBAE processes

[1] Gino Galvez et al., "Increasing STEM Skills, Knowledge and Interest Among Diverse Students: Results from an Intensive Summer Research Program at the University of California, San Francisco," *Innovative Higher Education*, February 23, 2024, https://doi.org/10.1007/0755-024-09701-z.

in the Science Education Study Program of FMNS Unesa have shown the compatibility between what is determined and the outputs produced within a period of one cycle. However, the unsuccessful achievements in PLO 1, PLO2, PLO6, and PLO7 indicate that the current curriculum needs improvement to support the achievement of graduate profiles. The evaluation of CPL or PLO does not stop at the macro level as shown in Figure 1. If studied based on student performance in the learning process during one cycle related to the achievement of each CPL or PLO, more specific results will be obtained as shown in Figure 2. The student performance criteria are classified into four categories, namely "Excellent", "Good", "*Satisfactory*", and "Fail". The percentage of weight of each component to the Course Learning Outcomes (CPMK) and PLO is determined in the Curriculum. The percentage of weight calculated based on the contribution of each Assessment Component to each CPL and PLO charged to the course. Weighting formula: *% Contribution ×% performance indicators* on each assessment component. The interpretation of student performance in each CPL was divided into four categories, namely: (1) Very Good (≥ 80); (2) Good (≥ 70); (3) Sufficient (≥ 55); and (4) Fail (< 55).

The process of establishing and monitoring progress towards PLO is an iterative process that occurs at the course/module level. Although a student's success in achieving PEO is an indicator of success in achieving the PLO, progress toward the PLO can be directly evaluated during and at the time of completion of the formal learning process. PLO assessments can be measured by using direct and indirect assessments during the teaching-learning process. This measurement can be done periodically per year, or every cycle according to the duration of the curriculum. The measurement of PLO achievement in a full cycle of curriculum duration will provide more insight to the Study Program regarding the design of learning activities that have been carried out and become the foundation in efforts to improve quality in a sustainable manner within the framework of the quality assurance process of higher education and relevance to the world of work.

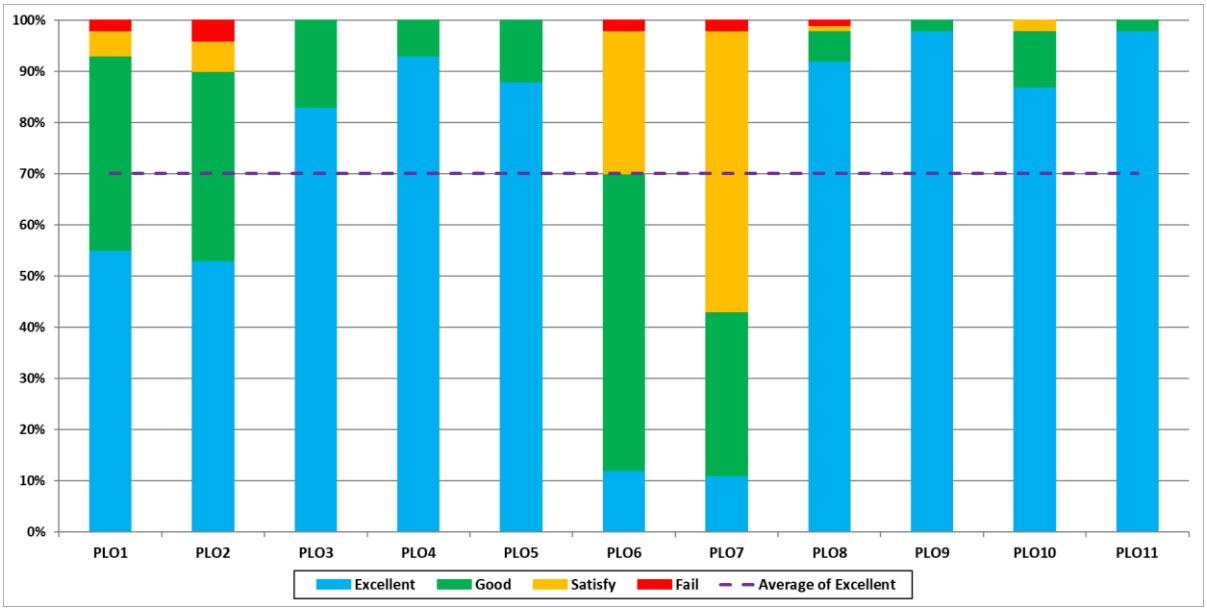

Figure 2 CPL or PLO assessment results based on student performance

The data in Figure 2 shows that the performance of students who reached the "Excellent"

category (above the average line) was in PLO3, PLO4, PLO5, PLO8, PLO9, PLO10, and PLO11. The performance of students who reached the "Excellent" category in PLO 1, PLO2, PLO6, and PLO7 is still below average. This indicates that there is a need for evaluation of all modules/courses related to PLO1, PLO2, PLO6, and PLO7. Courses embedded in PLO1 and PLO2 need to be reviewed and re-analyzed considering the needs related to basic science knowledge, integrated science, and interdisciplinary science that are the backbone of the development *of life-long learning* of graduates. In addition, the aspect of inquiry and communication skills as part of the 21st century vital skills embedded in PLO6 and PLO7 also needs attention in curriculum evaluation. However, the learning process has been quite successful, this is shown by the small percentage of students whose performance is in the "Failed" category. In addition, the category of "Failed" in the Thesis Course does not mean that students are not successful, but students who program the Thesis have not been able to complete the research and writing process in the Academic Year when programming and will continue in the next Academic Year. This is due to the rules related to the Independent Learning-Independent Campus (MBKM) activities, so that students experience obstacles when completing the Thesis Course.

E. Graduate Comptency Assessment based on KKNI

KKNI level 6 has become an important reference in formulating the profile of undergraduate program graduates who are ready to enter the world of work. KKNI refers to four competencies that must be mastered by every graduate at the undergraduate level. The four competencies in question are attitude, knowledge, general skills, and special skills. The FMNS Unesa Science Education Study Program has established a matrix of conformity and harmony between PEO and KKNI as well as PLO and PEO. The results of the achievement of competencies of graduates of the FMNS Unesa Science Education Study Program for one cycle are presented in Figure 3.

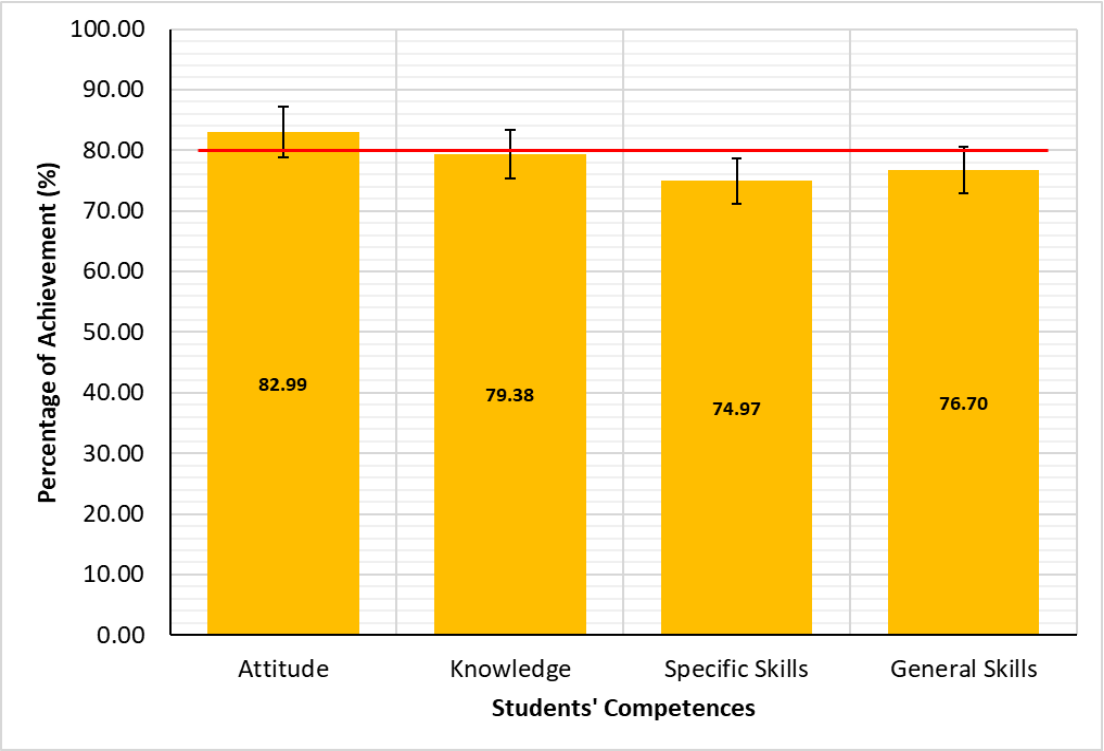

Figure 3 Achievement of graduate competencies according to KKNI criteria (*Error bars*: 5%)

The attitude of graduates has exceeded the threshold criterion (red line), which is 82.99%

while for aspects of knowledge, general skills, and special skills it is still below the threshold criterion, which is < 80%. The results further strengthen the PLO assessment on the macro (Figure 1) and the PLO assessment based on student performance (Figure 2). Aspects of attitudes, knowledge, and skills (general and special) should not be viewed separately, but must be analyzed in an integrated manner. Modern learning theory reveals that the unity of knowledge, skills, and attitudes is the basis of thinking skills.[2] These results show that the majority of graduates still need education and training before entering the world of work because of low competence in terms of knowledge and skills. The review of all Course content is absolutely carried out, especially those related to aspects of knowledge and skills.

F. Input from Academics, Alumni, and Graduate Users (Industry)

In addition to evaluating the curriculum from the CPL or PLO assessment, then *a review* is carried out by experts. The FMNS Unesa Science Education Study Program held *a curriculum review* by bringing in an expert from the University of Education Indonesia, namely Prof. Dr. Ida Kaniawati, M.Si. on October 23, 2023. The results of the experts' input are specialized in three aspects, namely the relevance of the curriculum, curriculum development, and the substance and integration of the curriculum. The description of input on the curriculum document from academic/professional elements is described as follows: (a) it is necessary to include the mission of the Study Program related to "Community Service" to meet one of the indicators of the Independent Accreditation Institute for Education (LAMDIK) Standards in the form of integration of research and community service; (b) there has not been a mapping of curriculum study materials that have been in accordance with the composition of the Main Science and Technology base, Supporters, Characteristics, and Additions of the Natural Sciences Education Study Program; (c) there is no description of the Course Preparation that is in accordance with the mapping of the study material and in accordance with the CPL or PLO charged to each Course; (d) the curriculum structure lists 5 courses as many as 11 credits of Elective Courses, while in the description there are 31 elective MK credits available, it is better to complete all elective courses in the curriculum structure; (e) there is no description of the Curriculum supporting learning flexibility (face-to-face, network-facilitated, hybrid, and fully online); and (f) there is no description of the Curriculum that has explicitly contained the Independent Learning Independent Campus or MBKM program (in PT, other PT, and Non-PT) as well as credit recognition and equalization procedures.

Alumni input is screened by distributing questionnaires. The indicators measured in this survey are curriculum evaluation and learning experience. The recapitulation of the results of alumni input is described as follows: (a) it is necessary to strengthen the literacy and numeracy aspects of prospective science teachers; (b) strengthening aspects of high-level thinking skills; (c) digital and futuristic learning; (d) scientific article writing skills; (e) need to be added to the study of ethnoscience and informatics; (f) strengthening microteaching; and (g) adding studies related to the development and evaluation of dynamic school curriculum. The results of this alumni input are in line with the results of the PLO assessment and the graduate competency assessment, namely the emphasis on the competency aspects of knowledge and skills. Another interesting thing, the alumni

[2] Donald C Orlich et al., *Teaching Strategies: A Guide to Effective Instruction* (Boston: Wadsworth Publishing, 2010).

mentioned the importance of emphasizing the study of science, ethnoscience, informatics, and project-based digital and futuristic learning and internships as curriculum evaluation materials for the FMNS Unesa Science Education Study Program.

The alumni (industry) users were carried out by conducting a user survey through a questionnaire. The indicators measured in this survey of alumni users (industry) are the quality of graduates and the experience of working with graduates. In general, alumni users (industry) are satisfied with the performance of alumni. Some suggestions for improvement from alumni users (industry), namely adding technical training such as graphic design skills, visual communication, and other skills. In addition, the industry also emphasizes on mastering the knowledge and skills of graduates in the field of foreign languages, writing and scientific publication skills, leadership skills in classroom learning management, and strengthening the preparation, implementation, and evaluation of programs that have a positive impact on schools. Industry circles also emphasize mastery of technology development, especially in the learning process. The FMNS Unesa Science Education Study Program also needs to hold graduate competency training and certification in accordance with the Indonesian National Work Competency Standards (SKKNI) to ensure the readiness of graduates to enter the world of work.

G. PLO Evaluation based on PLO *Assessment* and Alumni and Industry Assessment

The consolidation of PLO achievement data is carried out by integrating assessment data from three sides, namely internal assessment (PLO *Assessment*), alumni assessment, and feedback from industry. The evaluation mapping of the results of the PLO *Assessment*, alumni, and industry based on student performance measurements, surveys/ questionnaires, and focused group discussions that have been quantitatively analyzed is presented in Figure 4.

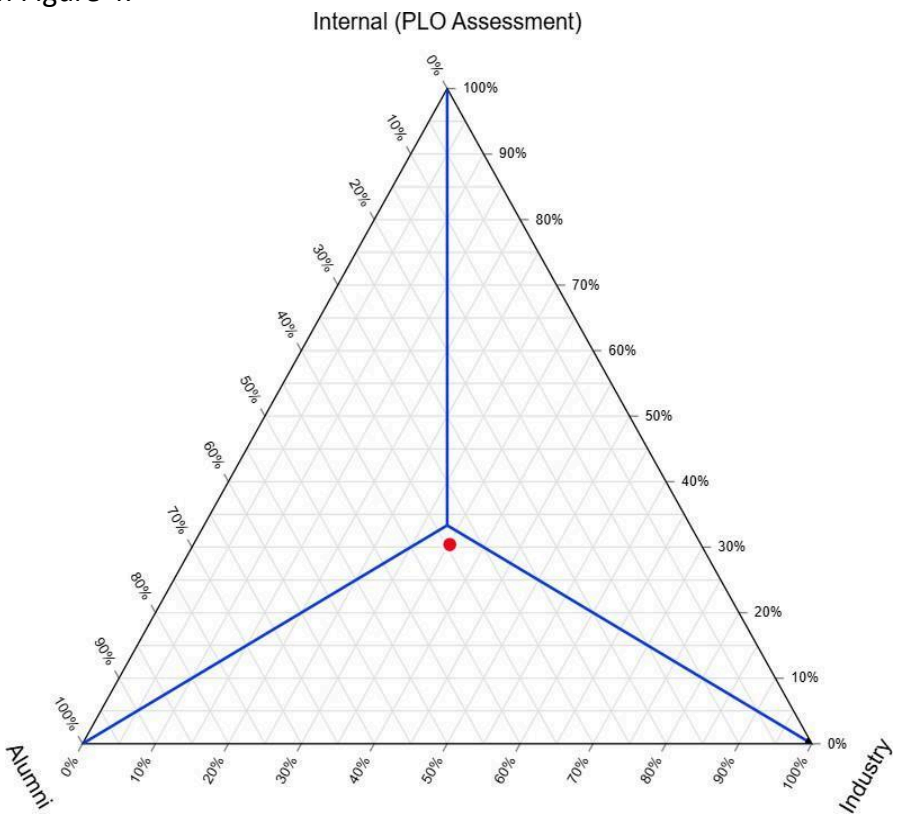

Figure 4 Results of evaluation mapping from internal Study Program parties, alumni, and industry

Based on the data in Figure 4, it appears that the curriculum of the FMNS Unesa Science Education Study Program has received positive aspects (heavy points) from industry or graduate and alumni users (red dots). Based on the data in Figure 4, the required curriculum revision should include increasing linkages to industry needs, strengthening real-world experiences, refining PLO achievements, and balancing theory and practice. The curriculum of the FMNS Unesa Science Education Study Program needs to be evaluated to meet input from industry and alumni.

Strengthening the relevance of post-campus experience and industry needs will increase the competitiveness of graduates of a Study Program. The involvement of alumni and industry circles in the process of evaluation, restructuring, and curriculum transformation is very important to create an educational curriculum that is adaptive and able to teach students with the basic competencies needed. In addition, graduates must also be able to develop themselves sustainably through *a life-long learning process* that can be trained through the refraction of *self-regulated learning* during the educational process at the undergraduate program level.

H. Tracer Study *Results*

The latest tracer study will be conducted by Unesa in 2023, while the *tracer study* in 2024 is still in process. The entire *tracer study population* in 2023 is alumni who graduated in 2022. The number of alumni of the FMNS Unesa Science Education Study Program who graduated in 2022 is 90 alumni and those who have filled as many as 79 or 87.78%. Of the entire population, there are 52 (57.78%) alumni whose status is either *part-time*/*full-time*, there are 6 (6.67%) alumni who are not yet able to work or are not working but are looking for a job. Alumni who are entrepreneurs are only 2 (2.22%) alumni, and those who continue their studies are 15 (16.67%) alumni. Of the 58 alumni who worked, only 34 (37.78%) alumni got their first job in less than 6 months, while of this number, it turned out that only 15 (16.67%) received an income greater than 1.2 × the Provincial Minimum Wage. Based on this data, the quality of alumni of the FMNS Unesa Science Education Study Program who graduated in 2022 where they worked for less than 6 months and at the same time had a salary of 1.2 × UMP/entrepreneurship/further study as many as 32 (35.56%) which were included in the *Gold Standard* Main Performance Indicator I of the State University of Surabaya.

Alumni of the FMNS Unesa Science Education Study Program who have obtained jobs for alumni who graduated in 2022 as many as 51 alumni, are divided into several levels of work, namely local/regional jobs as many as 0 alumni (0%), national-level jobs are as many as 51 alumni (100%), and there are no alumni who work for companies at the international/multinational level. This shows that the majority of the work of national-level alumni who accept alumni of the FMNS Unesa Science Education Study Program. The absence of alumni of the FMNS Unesa Science Education Study Program who work in international institutions needs to be evaluated in order to remember that the FMNS Unesa Science Education Study Program has received positive accreditation from a credible international accreditation institution, namely ASIIN. These results are also in line with

feedback from alumni regarding foreign language mastery which is an obstacle for them to have a career at the international or multinational level.
Based on *tracer study* data, the majority of alumni of the FMNS Unesa Science Education Study Program who graduated in 2022 working as School Administration Personnel are 1 alumni (1.96%). Next, there are 46 alumni (90.19%) who work as educators. In addition, there is 1 alumni (1.96%) as others. Then there are 3 alumni (5.89%) who work as private employees. Based on the results of the *tracer study*, the majority of graduates of the Science Education Study Program are educators. In particular, the FMNS Unesa Science Education Study Program has also collected input related to alumni work associated with graduate profiles. The tabulation of alumni of the FMNS Unesa Science Education Study Program is reviewed from the graduate profiles presented in Table 6.

Table 6 Alumni job profiles based on *tracer study*

No.	Graduate Profile	Percentage (%)
1	Science Educator	66,67
2	Educational Researcher	6,67
3	Educational Institution Manager	0,00
4	School Laboratory Manager	0,00
5	Entrepreneur/Practitioner	26,67

Based on the data in Table 6, there are two graduate profiles that have not been seen from the job profiles of alumni of the FMNS Unesa Science Education Study Program who graduated in 2022, namely as managers of educational institutions and managers of school laboratories. Both graduate profiles require complex experience and competencies. Alumni career achievements as managers of educational institutions and/or school laboratory managers take a long time. The Study Program needs to conduct *a tracer study* with a wide graduate time span in order to map the profile of alumni graduates who graduated from the FMNS Unesa Science Education Study Program from the first graduate to the graduates of the 2022/2023 Academic Year.

All alumni of the Science Education Study Program with the 2022 graduation year who have gotten a job, have a level of compatibility between the field of study that has been taken in lectures and the work currently undertaken, as much as 72%, alumni consider that the field of study that has been taken in lectures and the work currently undertaken is very close, there are 12% feel that the closeness between the field of study that has been taken in lectures and the work undertaken during This is close, as many as 4% assessed it quite closely between the field of study that has been taken in lectures and the work undertaken, there are 6% of alumni who consider it not at all close, and the rest do not consider it close at all as much as 6% (see Figure 5). This shows that the majority assess that the field of study is quite close between the field of study and the field of work that alumni are currently engaged in.

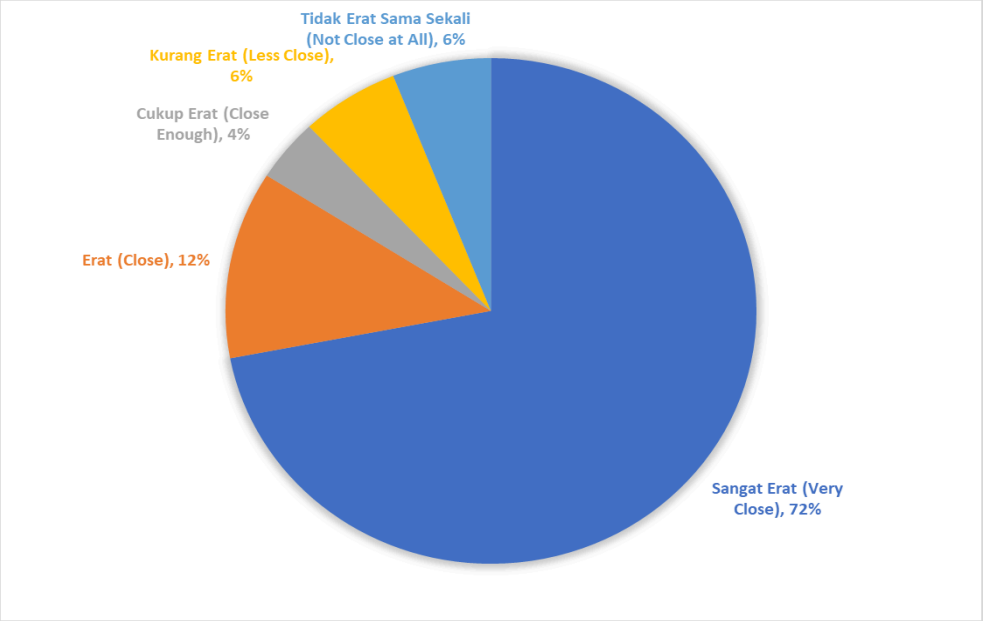

Figure 5 Suitability of the field of alumni science with the field of work

On the other hand, all alumni of the FMNS Unesa Science Education Study Program in obtaining the current job, have a different level of accuracy between their current job position and the level of education that has been taken. It can be concluded that alumni jobs who graduated in 2022 currently do not require higher education by 1.7%, alumni jobs that currently require lower-level education by 8.6%, alumni jobs that currently require higher education by 6.9%, and alumni jobs that currently require the same level of education by 82.8%. This signifies that the majority of alumni jobs graduating in 2022 currently require a level of education equivalent to higher education (see Figure 6).

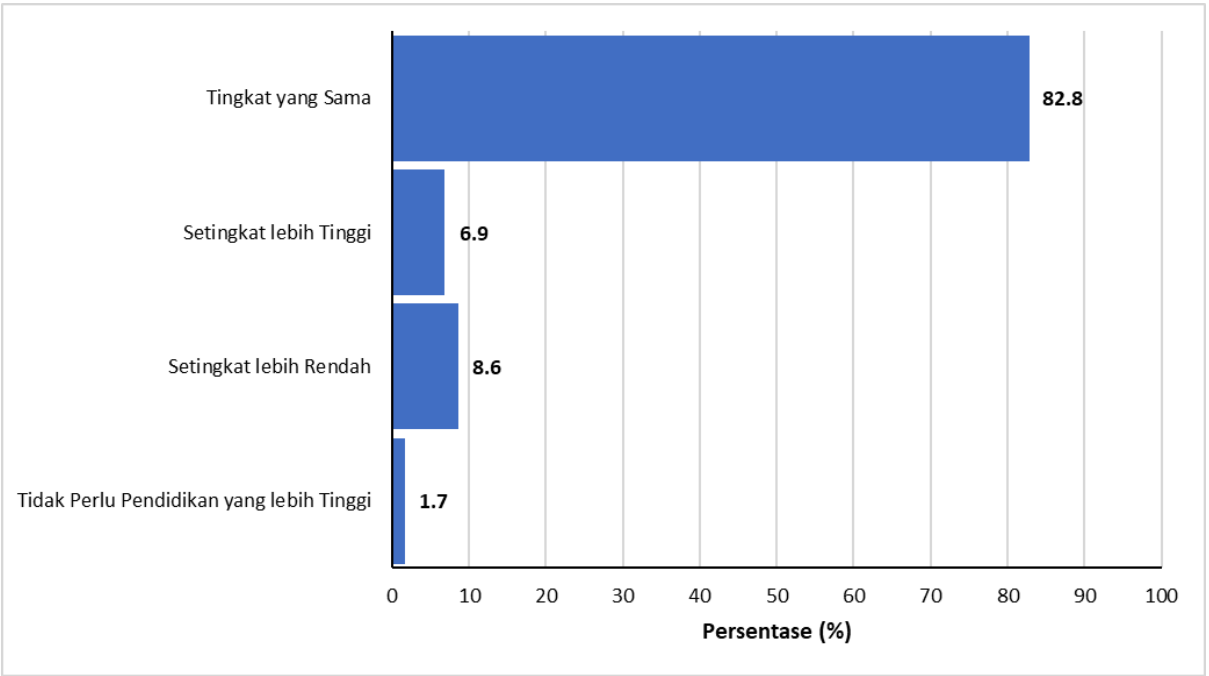

Figure 6 The level of education achieved by the alumni job qualification

The data in Figure 6 also shows that the interest of alumni to continue their studies at the

professional, master's, or doctoral education level is still relatively low. Although the profile of the majority of alumni job graduates does not require a higher level of education, the demand to become a teacher in the future requires having an educator certificate obtained through teacher professional education. The Science Education Study Program of FMNS Unesa needs to prepare its curriculum to help students more easily pursue teacher professional education. The current teacher professional education process which is still managed is centralized by the Directorate General of Teachers and Education Personnel, Ministry of Education, Culture, Research, and Technology. In addition, the interest of alumni of the FMNS Unesa Science Education Study Program to continue their studies to the master's and/or doctoral level is still low. This needs to be a reflection so that graduates do not only stop at the undergraduate level. The learning experience while being a student of the FMNS Unesa Science Education Study Program needs attention so that alumni want to continue their academic education to the master's and/or doctoral level. The initiation *of the fast track* program initiated by Unesa needs to be carefully studied to ensure that alumni get the opportunity to continue their higher academic education in a relatively fast time. The success of this *inter-level fast track* program requires a good curriculum connection between bachelor's, master's, and/or doctoral programs.

I. Assessment and Evaluation of PEO

The FMNS Unesa Science Education Study Program has established a matrix of alignment between PEO and PLO (see Table 5). Based on this matrix, a joint evaluation was carried out based on the results of the PLO *Assessment* and the results of gathering input from alumni and graduate users (industry). The achievement of the PEO results of the FMNS Unesa Science Education Study Program in one cycle of the curriculum duration is presented in Figure 7.

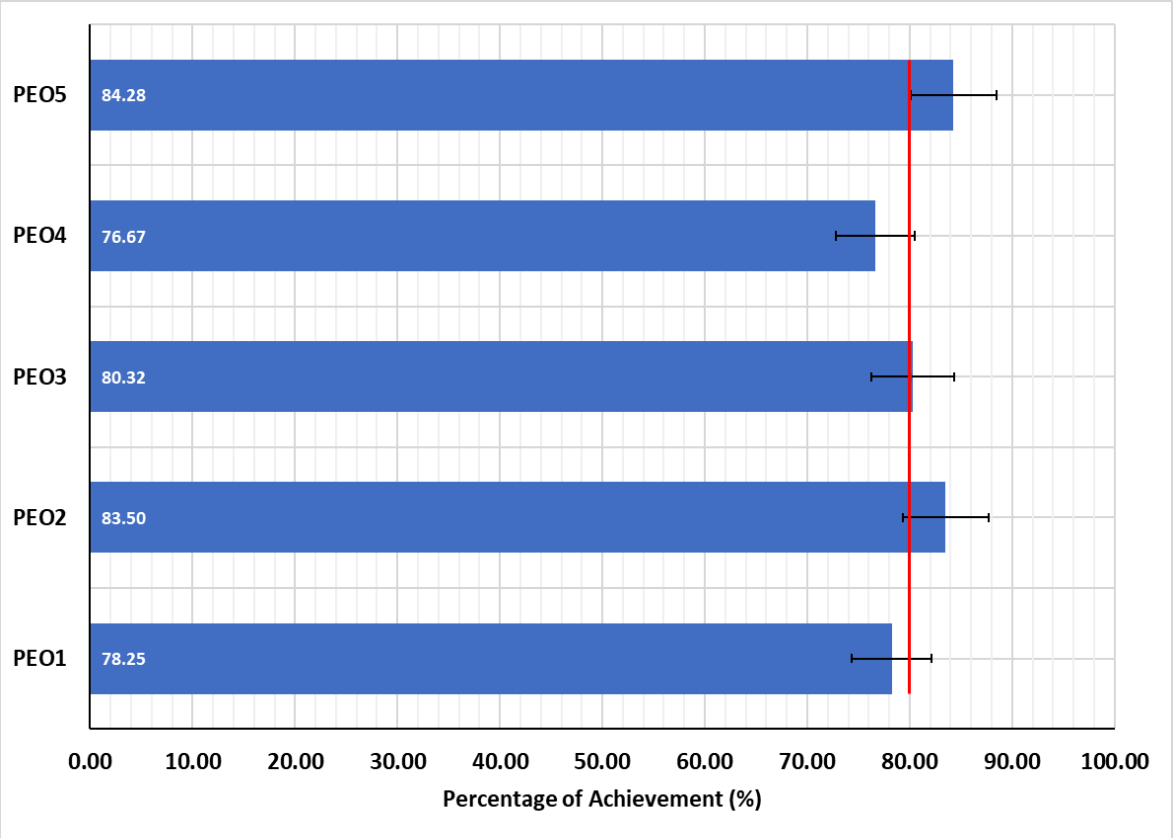

Figure 7 Results of PEO achievement in a cycle (*Error bars*: 5%)

Based on the data in Figure 7, it appears that PEO1 and PEO4 have not reached the minimum achievement criteria (≥ 80%–vertical red line). PEO1 is closely related to PLO1 and PLO2 which are related to the aspects of basic science knowledge and integrated and interdisciplinary science. On the other hand, PEO4 is closely related to PLO6 and PLO7. Based on the results of the PLO *Assessment*, PLO1, PLO2, PLO6, and PLO7, the percentage of student performance that reaches the "Very Good" category is still relatively low compared to the performance of students in other PLOs. If analyzed more deeply, the relationship between PEO1 and PLO1 and PLO2 shows that students still have difficulties in mastering basic and integrated knowledge in the field of science. This can be caused by several factors, such as less effective learning methods, lack of deepening of concepts, or the level of suitability of material that is not in accordance with *the Zone of Proximal Development* and *the Zone of Actual Development* of student[3]. PEO4, which is closely related to PLO6 and PLO7, indicates that students are still undertrained in conducting experiments and communicating their research results. Lack of practicum experience and opportunities for active group discussions can be the main cause of this problem. The lack of optimal achievement of PEO1 and PEO4 indicates that there is a gap between the theoretical knowledge possessed by students (alumni) and their ability to apply this knowledge in a broader context (transfer). Improvements need to be made in learning methods, such as the use of more interactive learning media, the provision of more challenging tasks, and the organization of materials more systematically. In addition, it is

necessary to increase the frequency of practicums, provide opportunities for students to design their own experiments, and provide special training in terms of scientific communication. Increased collaboration can be done by facilitating collaborative project-based learning activities to improve students' ability to work together and communicate. Lectures by presenting practitioners can broaden students' horizons. The use of evaluation instruments that not only measure aspects of knowledge, but also students' practical and social skills. On the other hand, it is also necessary to review the suitability of the material in Courses related to PLO1, PLO2, PLO6, and PLO7.

J. Internal and External Challenges and *Sustainable Development Goals*

The evaluation of the curriculum of the FMNS Unesa Science Education Study Program needs to consider the current internal and external challenges. In addition, integration with *the Sustainable Development Goals* (SDGs) is an important part of ensuring the relevance of the study program to global needs.

1. Internal Challenges

The change in the status of the State University of Surabaya (Unesa) to a Legal Entity State University (PTNBH) in accordance with Government Regulation Number 37 of 2022 concerning Legal Entity State Universities of the State University of Surabaya, has major implications for the policy and operational direction of Unesa. One significant change is the

[3] Keith S. Taber, "Constructivism as Educational Theory: Contingency in Learning and Optimally Guided Instruction," in *Educational Theory*, ed. Jaleh Hassaskhah (Hauppauge, N.Y.: Nova Science Publishers, 2011), 39– 61.

development of an entrepreneurial oriented vision, mission, goals, values, and work culture. This change requires the FMNS Unesa Science Education Study Program to adjust its curriculum in order to meet these demands. FMNS Unesa also follows the new direction of Unesa PTNBH by developing the characteristics *of edu-ecopreneurship*.

The curriculum of the FMNS Unesa Science Education Study Program must not only include natural sciences and science education, but also entrepreneurial skills related to ecology and sustainability. These changes require the study program to adapt to an interdisciplinary approach, where science teaching not only focuses on scientific theory and practice, but also integrates entrepreneurial and sustainability values. Another internal challenge is the development of a work culture that focuses on efficiency and effectiveness, in line with PTNBH's goal to increase the competitiveness of universities at the national and international levels. Study programs must innovate in teaching and learning methods, as well as develop a curriculum that is flexible, adaptive, and results-oriented (OBE). This also has implications for the change in the scientific vision which is the characteristic and basis for the development of the curriculum of the FMNS Unesa Science Education Study Program.

2. External Challenges

On the external side, the need for *knowledge workers* who have skills and knowledge in the STEM field is increasing. This is a response to the industrial revolution 4.0 and other global challenges such as climate change and the natural resource crisis. The FMNS Unesa Science Education Study Program must prepare its graduates to have skills that are relevant to the world of work that is increasingly based on technology and innovation. In addition, graduates are also required to have the ability to think critically, creatively, and be able to solve complex problems related to science and technology. This is in line with UNESCO's policy on *Indigenous Knowledge in Global Policies and Practice for Education, Science, and Culture*, which emphasizes the importance of integrating local knowledge with global knowledge in education, science, and culture. Study Programs need to consider the fusion of local and global knowledge to provide a holistic and contextual education for students.

3. Relevance to *the Sustainable Development Goals* (SDGs)

The evaluation of the curriculum of the FMNS Unesa Science Education Study Program must also consider its contribution to the achievement of the SDGs, especially those related to education, science, and technology. The following are some of the relevance of the SDGs to the curriculum evaluation process:

a. SDG 4: Quality Education

1) **Target 4.4**: Increase the number of youth and adults with relevant skills, including technical and vocational skills, for employment, decent work, and entrepreneurship. The Science Education Study Program, in the context of target 4.4, must prepare graduates who are not only to become educators, but also as *knowledge workers* who are able to innovate and work in various sectors related to STEM.
2) **Target 4.7**: Ensure that all learners acquire the knowledge and skills needed to promote sustainable development. The Study Program must integrate sustainable development concepts into the curriculum, including issues of climate change, global citizenship education, and appreciation of cultural diversity.

b. SDG 17: Partnerships to Achieve the Goals

1) **Capacity Development *topics* related to *micro-, small, and medium enterprises* (MSMEs):** The Study Program must provide entrepreneurial provisions to students, especially related to the development of micro, small, and medium enterprises (MSMEs) based on science and technology.
2) **Technology Topics**: Given the role of technology in achieving sustainable development goals, the study program needs to strengthen the technological aspect in its curriculum, so that graduates are able to utilize technology to solve problems and create innovations in various fields such as artificial intelligence and *machine learning*.
3) ***Chapter 35 Agenda 21 - Science for Sustainable Development***: The curriculum needs to cover science-related topics for sustainable development, focusing on how science can be used to address global challenges, including climate change, biodiversity, and natural resource sustainability.

Taking into account these internal and external challenges, as well as the linkage with the SDGs, the FMNS Unesa Science Education Study Program must conduct a comprehensive curriculum revision. The goal is to ensure that graduates of this study program are not only prepared to become competent educators, but also individuals who are able to adapt to global change and contribute significantly to sustainable development.

K. Recommendations for Improving Curriculum Quality

Based on curriculum evaluation through a one-cycle PLO Assessment, alumni and industry input, and analysis of internal and external challenges, there are several recommendations to improve the quality of the curriculum of the FMNS Unesa Science Education Study Program, through efforts to restructure, revitalize, and develop the curriculum in Table 7.

Table 7 Recommendations for improving the quality of the curriculum

No.	Aspects	Recommended Improvements/Improvements
1	Strengthening of STEM knowledge and skills	● The achievement targets for PLO1, PLO2, PLO6, and PLO7 and related to PEO1 and PEO4 have not been achieved, so a review of all courses related to the four PLO is needed ● Repositioning or integration of courses is necessary by incorporating more STEM-based content and skills with basic science, integrated science, and interdisciplinary science approaches, as well as informatics in science
2	Improving global competence through MBKM	● Facilitate students to participate in international student exchange programs, global seminars, or other international cooperation initiatives through MBKM schemes that are accommodated in the curriculum (within universities, other

No.	Aspects	Recommended Improvements/Improvements
		universities, and/or outside universities). ● The placement of the MBKM scheme in the curriculum structure should be in the 3rd year of lectures
3	Improving sustainability in the curriculum through the SDGs	● Integrate topics relevant to the SDGs into the curriculum, especially those related to quality education (SDG 4), partnerships to achieve goals (SDG 17), and technological innovation for sustainability (SDG 9). ● The curriculum needs to cover science-related topics for sustainable development, focusing on how science can be used to address global challenges ● The curriculum needs to integrate local knowledge with global knowledge in education, science, and culture to provide a holistic and contextual education for students
4	Futuristic digital knowledge and skills strengthening	● Study programs need to strengthen the technological aspects in their curriculum, so that graduates are able to utilize technology to solve problems and create innovations in various fields ● The use of contemporary interactive technology in the implementation of the learning and assessment process
5	Integration of the vision of Unesa PTNBH and FMNS in the curriculum vision of the Study Program	● The curriculum of the Study Program which is based on scientific vision must be immediately aligned with the vision, mission, goals, basic values, and work culture of Unesa PTNBH and FMNS Unesa which are characterized by *edu-ecopreneurship* ● Increasing the proportion of learning by implementing *team-based projects* and *case studies* as well as collaborative work to support student competency development