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Pre-Learning Supervision Evaluation: Integration of 4Cs and 21st Century Graduate Profile Dimensions

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Abstract. The 21st century education requires the mastery of critical thinking, creativity, communication, and collaboration (4Cs) skills integrated into instructional practices. The research findings indicate that the implementation of 4Cs in Lesson Plans (Rencana Pelaksanaan Pembelajaran/RPP) remains suboptimal, both in terms of the equitable distribution of indicators and their alignment with graduate profile dimensions. This condition highlights the importance of in-depth evaluation at the pre-instructional stage to assess the readiness of lesson plans in supporting twenty-first-century competencies. The novelty of this article lies in offering a comprehensive evaluative approach to lesson plans on the topic of Redox Reactions, emphasizing the integration of 4Cs skills and eight graduate profile dimensions. A systematically developed supervision matrix instrument was employed, encompassing document components, learning objectives, instructional strategies, assessment, learning media, and classroom management, thereby providing a holistic overview of lesson plan readiness. The objectives of this study were: (1) to evaluate the pre-instructional stage through analysis of lesson plans on Redox Reactions with a focus on the integration of 4Cs and graduate profiles, and (2) to assess lesson plan readiness in supporting effective, contextual, and competency-oriented twenty-first-century learning. This study employed a descriptive qualitative approach with senior high school (SMA/MA) chemistry lesson plans as the research object. Data were collected using several triangulation techniques, including document analysis, indirect observation, and evaluator source triangulation. The results indicate that instructional planning was developed comprehensively and aligned with Problem-Based Learning

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(PBL), Understanding by Design (UbD), 4Cs, and the Pancasila Student Profile; however, it still requires strengthening through the explicit inclusion of Learning Outcomes (Capaian Pembelajaran/CP) and the completion of reflective documents such as teacher journals. Recommendations. Teachers are advised to strengthen the explicit inclusion of Learning Outcomes within the Teaching and Learning Flow (Alur Tujuan Pembelajaran/ATP) to clarify the relevance between objectives and expected achievements, as well as to incorporate teacher journals as a medium for continuous reflection. In addition, the explicit articulation of 4Cs skills and Pancasila Student Profile dimensions in lesson plan documents should be reinforced to ensure more directed instructional implementation.

Keywords: Pre-Learning Supervision; RPP Evaluation; 4C Skills; Graduate Profile Dimensions; 21st Century Competency

1. Introduction

The 21st century education requires teachers, principals, and students not only to master knowledge, but also critical thinking and problem-solving skills, creativity and innovation, collaboration, and communication (4C's). Teachers are able to transfer the 4 Cs, and the principal is able to supervise appropriately to encourage, direct, and provide proportional space so that teachers are able to transfer these 4 Cs proportionally, (Winaryati, et al, 2021).

The 4 Cs skills are a very important foundation so that students are able to adapt to very fast global changes, with a variety of very complex problems. The results of the study show that 4C skills are able to encourage a wider range of knowledge, attitudes and skills, thus impacting students' success at school, at work, and in wider life, (Wolters, 2010; Kereluik, et al, 2013). 4C skills provide opportunities for teachers to increase their pedagogic, personality, professional, and social capacity, as well as increase teachers' competence in using technology, (Sunardi, & Doringin, 2020). The results of studies that discuss the 4 Cs in the context of teacher education have shown that the 4Cs play a role in increasing the professional, personal and social capacity of teachers, (Brandt, et al, 2021).

The results of the study show that the integration of 4Cs in learning documents is still in the categories **of "Not yet reached competency"** and **"Approaching competency".** It can be concluded that the 4Cs element has begun to appear, but it has not been applied optimally and consistently by teachers. Teachers are familiar with the concept of 4Cs, and convey that 4C skills are very important, but the understanding is still lacking. This is due to limited training, and the lack of strong institutional support, (Herlinawati, et al, 2024). (Kain, et al., 2024), said that teachers, students, and policy makers are only limited to their opinions, attitudes, and perceptions of 21st-century skills. They highlight more about the benefits and impacts of 4C skills, but have not explored much of the real practice of their application in the field. The application of learning methods, assessment instruments, and integration strategies has not been explored in depth.

Teachers' performance related to the achievement of the 4Cs in learning can be assessed through supervised activities by the principal. Given the very dense performance of the principal, the assessment was carried out by cognate teachers and themselves, and the data was validated by the principal, (Winaryati, et al, 2021). The quality of supervision will significantly affect the quality of learning. Incomplete, inappropriate, and inaccurate supervision will have an impact on poor learning quality (Zhou, 2018). The results of the above research are corroborated (Daud, at al., 2018) who said that the implementation of high learning supervision can improve teachers' attitudes and teaching competence. Appropriate efforts need to be made to strengthen the implementation of supervision and supervisor support in learning, so as to produce superior teachers with good teaching competence in the classroom.

One of the aspects that greatly determines the success of learning is **pre-learning supervision**. Literature studies show that quality supervision contributes greatly to improving teacher competence, both in planning and instructional practice (Kraft et al., 2018; Mok & Staub, 2021; Ronfeldt et al., 2024). Supervised, which is structured with evidence-based feedback, has been proven to be able to strengthen the clarity of instruction, improve pedagogical competence, and shape the professionalism and reflection of teachers (Toh et al., 2022). However, various obstacles such as time constraints, lack of training, and limited resources still often hinder the effectiveness of supervision (U-Sayee et al., 2021). In fact, in the context of digitalization, supervision also needs to adapt to online platforms which pose new challenges in observation and communication (Brock et al., 2021).

In its implementation, 4C skills in schools still face obstacles. (Dahlan, 2024) emphasized that many teachers have difficulty integrating the 4Cs thoroughly in learning. The readiness of teachers can be reflected in planning documents, especially the Learning Implementation Plan (RPP). The supervision matrix instrument developed in previous research has been proven to be able to support the analysis of RPP readiness (Wiyono et al., 2022). However, several studies in Indonesia show that the integration of the 4Cs in the lesson plan is not optimal, the distribution is not even, and teachers' understanding is still limited (Herlinawati, 2024; Luthfi et al., 2023).

In addition to the 4C skills, the lesson plan should also reflect the dimensions of the graduate's profile as a whole, including literacy, character, and the ability to interact globally. International research confirms the importance of professional training for teachers to be able to design effective 4C-based learning (Salybekova, 2023). Other findings, such as the research of (Hidayah, N., et al., 2024), prove that when lesson plans and learning projects are designed contextually, students show significant improvements in creativity, communication, and collaboration.

Ganal, et al, (2019) in their research findings reveal that teachers need professional training on 21st century pedagogical skills, such as: content knowledge, the use of ICTs, strategies for developing critical and creative thinking, and research-based knowledge and principles in teaching and learning. They also need self-development training in stress management, interpersonal and communication

skills, as well as work-life balance, (Ganal, et al, 2019). Herlinawati, et al, (2024), emphasized that teachers' understanding of the 4Cs can be measured through the quality of the learning documents they produce. The better the teacher's understanding, the stronger the integration of the 4Cs in their learning and evaluation plans.

This phenomenon shows that there is a gap between the ideal concept of 4C integration and the reality of its implementation in the field. Therefore, an in-depth evaluation of the pre-learning stage is essential to ensure the readiness of the RPP in supporting 21st century competencies while reflecting the dimensions of the graduate profile as a whole. Ganal, et al, (2019), emphasizes the importance of needs assessment as the basis for planning relevant training programs to improve teacher performance and student learning outcomes. (Liu, et al., 2024), that an evaluation needs to be performed, to follow up on the results of the supervise, that the group that received peer and teacher feedback experienced the most significant improvement in almost all aspects of learning engagement. In addition, **the combination of peer and teacher feedback** has a synergistic effect in increasing public speaking engagement and performance.

The novelty of this research lies in the development and use of a more comprehensive **pre-learning supervision evaluation approach**. This study not only assesses the extent to which the 4C skills are integrated in the lesson plan, but also systematically examines how the eight dimensions of the graduate profile are reflected in the document. Through a supervision matrix that includes aspects of document preparation, learning objectives, materials, strategies, assessments, media, class management, and integration of 4Cs based on graduate profiles, this study presents a comprehensive overview of the readiness of lesson plans on the topic of Redox Reaction.

Based on this description, the **objectives of this study** are: (1) Evaluating the pre-learning stage through the analysis of the Redox Reaction topic RPP with a focus on the integration of 4C skills and the dimensions of the graduate profile; and (2) Assess the readiness of the lesson plan to support the implementation of effective, contextual, and competency-oriented learning in the 21st century.

2. Methodology

2.1 Type of Research

This study uses a descriptive qualitative approach with a focus on the analysis of the Learning Implementation Plan (RPP) document on *the topic of Redox Reaction*. This approach was chosen to understand the extent to which the lesson plan incorporates the integration of 21st century skills (4Cs) and the eight dimensions of the graduate profile holistically.

2.2 Research Subject and Object

Research object: Lesson plans on redox reactions used by teachers at the senior high school/MA level. Research subject: Chemistry teachers who developed these lesson plans.

2.3 Research Instruments

The assessment instrument is to assess the lesson plan (RPP) that has been prepared by the teacher. The lesson plan is a document as an initial readiness before learning is carried out. The assessment is based on 3 stages of evaluation of the lesson plan documents prepared by the teacher, including: Antecedent, Transaction, and Interim Products. (1) Antacedent is the preparation stage before the lesson plan (RPP) is prepared by the teacher. (2) Transaction is an evaluation of the learning planning related to the learning process that will be carried out by the teacher in the classroom. (3) Interim product is the stage of assessment planning that must be carried out by teachers in learning, as well as learning outcome planning. The instruments are compiled based on 4 characteristics of 21st century skills, including: critical thinking and problem solving, creativity and innovation, collaboration and communication. The pre-supervision stage is to assess the readiness and learning planning/lesson plan. How far is the teacher in preparing and planning learning as the basis for carrying out the learning process, as well as assessing the learning plan or Learning Program Plan (RPP) that has been prepared by the teacher.

2.4 Evaluation tools used

The evaluation stages use the 6 CELL Stages of Learning Supervision Evaluation Model, which was developed by Winaryati, et al (2021). The evaluation model developed is called: Learning Supervision Evaluation Model Based on 4 Traits of 21st Century Skills, abbreviated as MESp 4Cs. MESp 4Cs is an evaluation based on the stage of learning supervision, which is carried out by the teacher himself and cognate teachers to produce recommendations for information, so that learning improvement occurs. The stages of the evaluation model approach are based on Stage 6 of the CELL Learning Supervision Evaluation Model (fig 1).

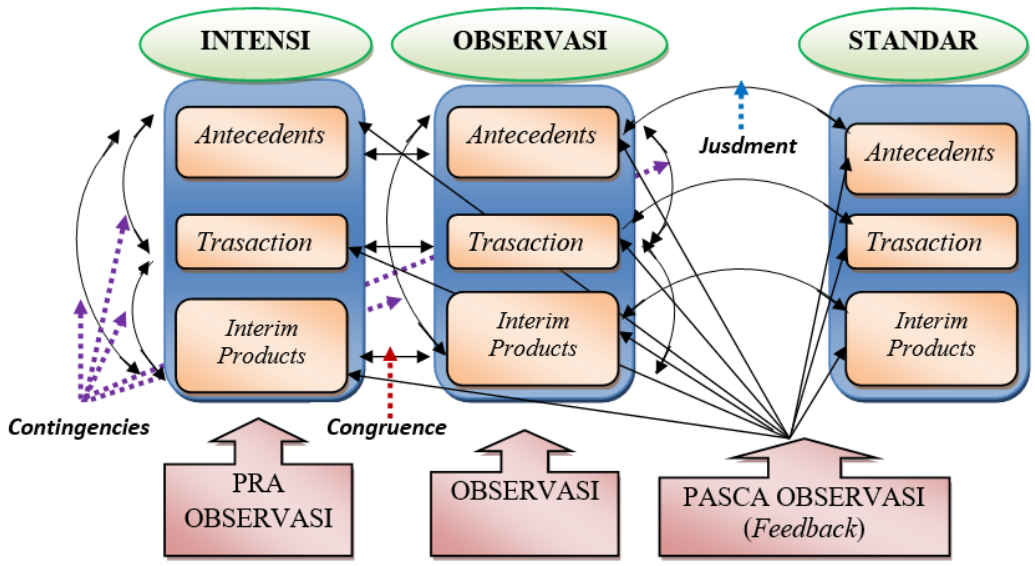

Figure 1: Stage 6 of the CELL Learning Supervision Evaluation Model

Evaluation is carried out through quantitative and qualitative assessments. The evaluation emphasizes the comparison between the standard supervision that should be and the data from document analysis based on the existing reality (Intention). Quantitative assessment was carried out by giving an assessment of 1/2/3/4, and qualitative assessment was obtained from additional descriptions provided by the evaluator. The assessment method is illustrated in table 1 below.

Assessment			Average rating			
Value	Description					
1	None		3,25-≤ 4	2,51- ≤ 3,25	1,76-≤ 2,5	1-≤ 1,75
2	Less					
3	Enough					
4	There is/according to		Category			
		Description	Complete	Accepted with minor revisions	Accepted with many improve ments	Rejected

Figure 2: Assessment Instructions: Mark √ on the value 0/1/2 in the column provided

Qualitative assessment assesses the congruence between the plan and its implementation. Instructions:

1. Circle the NUMBER on the matrix if there is congruence in the description of the implementation.
2. Cross it out if there is no congruence in the description of the implementation.
3. If there are additional descriptions, please write them in the additional narrative.

3. Data Collection Techniques

Data was collected through several triangulation techniques, including: (1) **Document study**: analyzing the lesson plan that has been prepared by the teacher, using an evaluation-learning supervision instrument based on 4 Cs integrated with the dimensions of the graduate profile that have been prepared by the researcher and have been valid. (2) **Indirect observation:** assessing the completeness and suitability of the RPP with the 4C indicator and the dimensions of the graduate profile. (3) **Triangulation of assessor sources:** the evaluator is carried out by 3 (three) chemical education lecturers, who have more than 10 years of teaching experience.

4. Data Analysis Techniques

Data was analyzed using qualitative descriptive analysis with the following stages: (1) **Data reduction:** selecting relevant information from the RPP related to the integration of the 4Cs and graduate profiles. (2) **Data presentation:** compile findings in the form of a supervision matrix table that shows the achievement of

indicators. (3) **Verification and interpretation:** assessing the readiness of lesson plans to support effective, contextual, and competency-oriented learning in the 21st century. Quantitative data is obtained by assessing the existing assessment matrix.

5. Discussion and Result

The government has stipulated the Regulation of the Minister of Primary and Secondary Education of the Republic of Indonesia Number 10 of 2025 concerning Graduate Competency Standards in Early Childhood Education, Basic Education, and Secondary Education. In Chapter II of the Scope of Graduate Competency Standards, article 4, paragraph 1 is conveyed about the Graduate Competency Standards are expected to include 8 (eight) dimensions of the graduate profile, which must be mastered at the end of each level of education. The eight graduate profiles include: Faith and piety towards God Almighty, Citizenship, Critical Reasoning, Creativity, Collaboration, Independence, Health. The Ministry of Education has decided on deep learning *as* the main approach in learning in schools. The discussion in this article is based on strengthening the 4 C's skills, based on the input during the FGD, there are additions related to 8 graduate profiles.

Based on the explanation above, supervise activities include: (1) planning, as a preparation of lesson plan documents including accompanying document tools, (pre-learning). (2) The implementation of learning is a learning process from preliminary activities, core learning, and assessment. (3) Post-learning reflection is carried out as an evaluation activity, in order to produce recommendations for better future learning improvements. This article focuses more on special evaluation on supervising the pre-learning stage. The evaluation includes 3 stages, namely: (1) Preparation (Antecedent); (2) Planning (Transaction); (3) Learning Outcome Planning (Interim Product). The essence of the evaluation activity in the special supervision at the pre-learning stage is to evaluate the readiness and learning planning that has been prepared by the high school chemistry teacher.

The assessment includes: (1) Preparation of documents (ATP, RPP). (2) Formulation of learning objectives (specific, operational, measurable). (3) Preparation of learning materials and strategies that are appropriate to the context. (4) Integration of 4C (Critical Thinking, Creativity, Communication, Collaboration) skills. (5) Integration of the dimensions of the graduate profile (Faith and piety towards God Almighty, Citizenship, Critical Reasoning, Creativity, Collaboration, Independence, Health. (6) Assessment planning (cognitive, affective, psychomotor domain). (7) Media and learning facilities. (8) Classroom management and active learning strategies. The information from the evaluation of the pre-learning supervision based on the 4 Cs, was used to answer the research objectives.

5.1 Evaluation Results

This article only discusses pre-observation activities, based on the RPP document in the field of Chemistry, the topic of redox. The instruments used have been

validated and have been implemented in schools. The evaluation was carried out based on the model that has been built by Winaryati, et al, (2021), with Stage 6 of the CELL Learning Supervision Evaluation Model. The evaluation stage includes three stages, namely:

a) **Antecedent** is the condition that exists before the program/activity is carried out/implemented. *Antecedents* are the sources/inputs that exist in the system to be developed, such as energy, student characteristics, and goals to be achieved, the conditions that exist before instruction that may be related to the outcome. Related to learning planning, the antecedent is the source stage or input related to the preparation of learning planning, including learning outcomes, learning objectives, learning objectives flow, readiness of teaching modules, 4 Cs, graduate profile dimensions, which are understood by teachers.

b) **Transactions** are dynamic experiences and processes that occur during the implementation of learning activities. *Transactions*, include activity plans and implementation processes in the field, including the sequence of activities, time scheduling, form of teacher-student interaction, assessment, how to assess learning outcomes, etc. sequential involvement or dynamic meetings which are instructional processes. *Transaction* is a planning that has been understood by teachers including: planning in the management of learning based on the 4 Cs, including the analysis of student needs and characteristics, time allocation, achievement of 4 Cs competencies, formulation of learning objectives based on the 4 Cs, learning materials, learning strategies and methods, learning activities, assessment planning, selection of learning media and resources, classroom management planning, integration of 4 Cs based on 8 dimensions of the profile graduates.

c) **Interim products** are to assess the relationship of changes between *the Antecedents* and *the Transactions* (which are likely to change) and the processes used to affect those changes. Describe the relationship between *the Antecedents* and *Transaction processes* as well as as temporary products, because through the information generated from the evaluation, it will be used to make subsequent improvements. The idea is to pay attention to progress and then determine the initial impact, influence, or effect. Examining this context, in line with the process *of feedback* activities (Provus, 1969; Kaufman, & Thomas, 1980; APSI, 2006). *The interim product* is the impact of the availability of learning documents including the impact of classroom management and the impact of the 4 Cs, related to learning planning. The content includes: (1) Planning related to learning management results, including: assessment planning, assessment planning content, including the planning of supporting documents; (2) Planning of learning outcomes related to the 4C's, containing: assessment planning containing 4Cs and 8 graduate profiles.

5.2 Standard, Intense and Observational

Standard is a benchmark/measure that must be met, and that is expected by stakeholders/governments and has been set (Stake, 1977). In this study, the standard formulation is based on a combination of **Academic Supervision Instruments;** Evaluation of Supervision Programs; 4 Cs; A *Guidebook for Peer*

Evaluation, Permendikmen RI, Number 10 of 2025 concerning Graduate Competency Standards in Early Childhood Education, Basic Education, and Secondary Education. Isupervise instruments that are flexible, reflective, oriented towards meaningful learning, as well as strengthening the Pancasila Student Profile and the 4Cs. In the above regulation, it contains 8 (eight) dimensions of graduate profiles that must be mastered at the end of each level of education, namely: 1) faith and piety towards God Almighty; 2) citizenship; 3) critical reasoning; 4) creativity; 5) collaboration; 6) independence; 7) health; 8) communication.

a) **Intense** is the deep depiction of what the teacher perceives and intends and strives for in learning practice (Stake, 1977). The intention of the above statement is that supervision evaluation does not only assess what appears on the surface, but tries to capture the meaning, purpose, and pedagogical considerations that underline the teacher's actions in the classroom. This intense position supervision as an interpretive and reflective process, in which supervisors seek to understand the fit between planning, implementation, and learning outcomes. The intention in supervising learning evaluation will help teachers reflect on their practice, identify strengths, and find room for improvement constructively.

   Intentions in the context of the independent curriculum are very relevant because learning emphasizes flexibility, differentiation, and the meaning of learning. Supervisors need to explore whether what teachers plan regarding the chosen learning strategies leads to the development of students' potential, fostering learning independence, and strengthening 21st century character and competencies. Learning supervision will measure the achievement of indicators about what teachers mean and what students experience in the learning process.

b) **Observation** is what the observer feels, experiences, and understands during the observation process (Stake, 1977). Observation is not limited to recording apparent behavior but also includes the supervisor's professional interpretation of the teacher's learning design. Observation is an interpretive process that requires sensitivity, experience, and reflection from the observer. What observers "understand" reflects the extent to which meaningful learning planning, which is in line with the goals of the Independent Curriculum, the Pancasila Student Profile, and the strengthening of 4C skills, is planned by teachers.

   Pre-learning supervision places observation as the main instrument to capture the quality of lesson plans, with the reality that may occur. The observation of the lesson plan includes: from CP, learning objectives, to learning strategies that may occur and the forms of evaluation that occur. The results of observation become meaningful information data to provide constructive feedback, encourage teacher reflection, and design follow-up professional development, and in the long term there will be continuous improvement in the quality of the learning process and outcomes.

5.3 Implementation of evaluation using the MESp 4 Cs model

The implementation of the evaluation is carried out through three stages, namely: (1) Judgment activities, (2) Congruence activities; (3) Contingencies (logical relationship) activities. The evaluation method is illustrated with the following matrix table 2:

Table 1: Matrix of MESp 4Cs evaluation model

Contingencies	***ANTACEDENT***			
	Description mantrix		***Judgment mantrix***	
	Intense	*Observations*	*Standards*	*Jugments*
	Congruence			
	TRANSACTION			
	Description mantrix		***Judgment mantrix***	
	Intense	*Observations*	*Standards*	*Jugments*
	Congruence			
	INTERIM PRODUCT			
	Description mantrix		***Judgment mantrix***	
	Intense	*Observations*	*Standards*	*Jugments*
	Congruence			

The explanation from the table above is:

5.3.1. Data judgment activities between observation results and standards

The assessment is carried out by observing by comparing it with predetermined standards. The observer assesses from the expected (standard) to the occurrence (discrepancies), (Stake, 1977). The results of the assessment were obtained on the graph as follows:

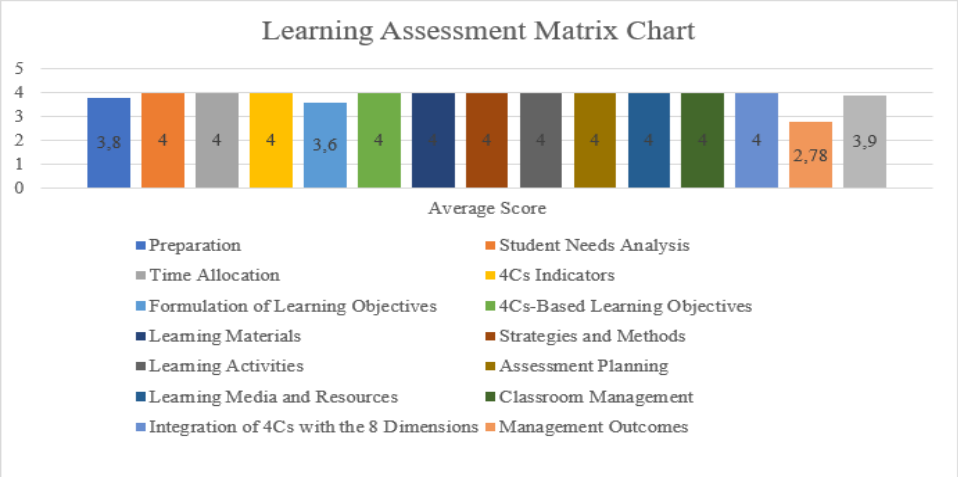

Figure 3: Lesson Plan Assessment Matrix

5.3.2. Congruence (suitability) of data between observations and intensity

Intense (what is intended/understood by the teacher) compared to its suitability with what occurs/results from each antecedent activity, transaction, and interim product. Pre-learning supervision based on 4 Cs, intense substance on

antecedents, transactions, and interim products. Congruence activities (suitability) of data between observations and intensity, from each antecedent activity, transaction, and interim product.

5.4 Antecedent

The results of the evaluation at the pre-learning stage, including ATP and lesson plan/learning planning, were obtained as follows:

Table 2: Evaluation of Pre-Learning Supervision, at the Preparation stage (Antecedent)

Aspects Evaluated	Evaluation Results
Relationship of ATP to CP	The ATP already contains relevant learning objectives and assessments, but the CP has not been listed so the relationship between the goals and achievements cannot be fully assessed.
Relevance of learning objectives	The learning objectives according to phase F require students to be able to classify, not just explain.
Learning model	The Problem Based Learning (PBL) model is used, encouraging the strengthening of the 4C's (Critical Thinking, Creativity, Communication, Collaboration) skills.
Integration of Pancasila Student Profiles	ATP integrates the dimension of Pancasila Students (P5), for example fostering gratitude for the order of nature through the concept of redox reactions.
Diagnostic assessment	Diagnostic assessments (cognitive and non-cognitive) have been designed according to assessment techniques.
TP Formulation	The Learning Objectives (TP) are compiled, systematically, accompanied by assessments for their achievement, even though the CP has not been written.
Learning context	The learning objectives are associated with real contexts, for example corrosion of iron through the image of a rusty keris.
Learning planning	Planning is derived from ATP, using a clear syntax and oriented towards Critical Thinking (CRT).
Availability of teaching modules	The teaching module is prepared for meetings 1–4, targeting all TP.
Adaptation to pupil characteristics & environment	ATP has been adjusted to the characteristics of students, school environment, and local wisdom, as evidenced by diagnostic assessments.

The RPP has contained environmental characteristics, which are illustrated in the following figure 3:

Dalam suatu proses pemurnian logam, digunakan senyawa kalium dikromat ($K_2Cr_2O_7$). Senyawa ini banyak digunakan dalam proses oksidasi karena ion kromat dalam senyawa tersebut memiliki kemampuan sebagai pengoksidasi yang kuat.

Ketika senyawa kalium dikromat dilarutkan dalam air, senyawa tersebut dapat berperan sebagai agen pengoksidasi yang mengoksidasi senyawa lain. Salah satu reaksi dalam pemurnian logam menggunakan kalium dikromat melibatkan perubahan bilangan oksidasi ion kromium (Cr).

Figure 4: Integration of Problem-Based Learning (PBL)

5.5 Evaluation at the Planning stage (Transaction)

The Planning (Transaction) stage contains planning in the management of learning based on the 4 Cs, consisting of: a.) Analysis of Student Needs and Characteristics; b) time allocation; c) Competency achievement indicators 4 Cs; d) Formulation of learning objectives; e) Learning objectives based on 4 Cs; f) Learning materials; g) Learning Strategies and Methods; h) learning activities; i) assessment planning; j) Selection of Media and Learning Resources; k) classroom management planning; l) Integration of 4 Cs based on 8 Dimensions of Graduate Profiles. The following are the results of the evaluation at the Planning (Transaction) stage.

Table 3: Transaction Evaluation Resume

Aspects Evaluated	Evaluation Results
Analysis of Students' Needs & Characteristics	There are cognitive diagnostic assessments (circles, equalization of reactions) & noncognitive (auditory, visual, kinesthetic learning styles). The differentiation of high/medium/low students is described by TaRL.
Time Allocation	10 × 45 minutes divided into 4 meetings; Each meeting focuses differently (redox concepts, circles, equalization, applications).
Learning Indicators & Objectives	It is formulated with an operational verb (ABCD). Contains the 4C's (critical, creative, collaborative, communicative) even if they are not explicitly written. Aligned with Phase F Chemical CP (redox KD).
Learning Materials	Collapsed matter (simple → complex): redox, circles, classification, equalization, application. Contextual with life

	(corrosion on the keris, batteries, metabolism, environmental & energy issues). Loaded with cultural values, character, and faith.
Learning Strategies & Methods	Use **PBL** with clear syntax. Collaborative activities in heterogeneous groups (high/medium/low) with a division of roles (recorder, presenter, researcher).
Learning Activities	Discussion, investigation, creation of works (posters/media), presentations, reflections. Contextual with real phenomena to build critical & creative.
Media & Learning Resources	LKPD, PPT, textbook, video, Kahoot, internet, real environment. Supports auditory, visual, kinesthetic learning styles.
Assessment Planning	Based **on UbD** (objectives, assessments and new learning strategies). Cognitive, noncognitive, attitude, skill assessment of the 4C's. Instruments: rubrics of collaboration, communication, work, presentations, group projects.
Class Management	Heterogeneous groups based on ability. The learning atmosphere is positive, inclusive, participatory, fun. All students have specific roles.
Integration of the 4C's & Pancasila Profile	The 4C's are integrated at all stages, although they are not explicitly written. The Pancasila Student Profile can be seen through mutual cooperation, critical, creative, independent, and globally diverse.

The explanation of Understanding by Design (UbD), has been written by the teacher in the lesson plan illustrated in figure 5 below:

KOMPONEN INTI (*Understanding by Design* (UbD))

A. TUJUAN PEMBELAJARAN

Tujuan yang ingin dicapai dari pembelajaran pada pertemuan I adalah:

1. Peserta didik (A) dapat mengklasifikasi (B) konsep reaksi oksidasi-reduksi ditinjau dari pengikatan dan pelepasan oksigen, pelepasan dan penerimaan elektron, serta peningkatan dan penurunan bilangan oksidasi (C) dengan pemahaman yang akurat dan lengkap (D).
2. Peserta didik (A) dapat menentukan (B) bilangan oksidasi unsur-unsur dalam senyawa (C) dengan ketepatan yang sesuai dengan aturan bilangan oksidasi (D).
3. Peserta didik (A) dapat mengklasifikasikan (B) suatu reaksi tergolong reaksi redoks atau bukan (C) dengan menggunakan konsep bilangan oksidasi secara tepat (D).
4. Peserta didik (A) dapat membedakan (B) reaksi autoredoks dan reaksi konproporsionasi (C) dengan pemahaman yang mendalam tentang perbedaan kedua jenis reaksi tersebut (D).
5. Peserta didik (A) dapat menentukan (B) reaksi redoks yang spesifik (C) dengan ketepatan dalam mengidentifikasi zat pereduksi (reduktor), zat pengoksidasi (oksidator), hasil oksidasi, dan hasil reduksi dari suatu reaksi redoks (D).
6. Peserta didik (A) dapat menyetarakan (B) reaksi redoks dengan metode setengah reaksi dan metode perubahan bilangan oksidasi (C) dengan menggunakan kedua metode yang relevan dan menghasilkan keseimbangan yang tepat (D).

Figure 5: Integration of Understanding by Design (UbD)

5.6. Learning Outcome Planning (Interim Product)

Learning Outcome Planning (Interim Product), including: (1) Planning related to learning management outcomes, including: a) assessment planning b) assessment

planning content; c) Planning supporting documents. (2) Planning of learning outcomes related to the 4C's, including: a) Assessment planning containing the 4C's; b) Assessment planning based on the 4C's. The results of the evaluation are as follows:

Table 4: Pre-Learning Supervision Evaluation Resume (Learning Outcome Planning)

Aspects	Evaluation Results
Assessment Awal	There are already diagnostic assessments (cognitive & non-cognitive) with the ignition questions: rust case, battery, oxidation number.
Assessment Type	Formative: any learning objective between Summative: real case analysis based on environment & local wisdom (CRT).
Instruments & Documents	Grids, analytical rubrics, LKPDs, handouts, modules, PPTs, and learning videos are available. There is no teacher's journal/diary yet.
Assessment Techniques	Independent & group, presentation, work. Assessment: comprehensive, objective, fair, transparent, sustainable.
4C's Integration	**Critical Thinking & Problem Solving:** Redox case analysis, real problem solving. **Creativity & Innovation:** original products, innovative solutions, presentations. **Collaboration:** division of tasks, teamwork, conflict resolution, respect for diversity. **Communication:** discussion, presentation, visual appearance & content.
Pancasila Student Profile	The assessment instrument already integrates 8 profile dimensions.
Pendekatan	Using **UbD** (all measurable goals) and **PBL** (creative products, innovative solutions in syntax 4–6).
Assessment Outcomes	Measure individual & group contributions, content quality, visual design, creativity, innovation, decision-making, adaptation, mutual aid, and communication.

Local wisdom, (Culturally Responsive Teaching / CRT), has been designed in the lesson plan that has been prepared by teachers. This is illustrated in the following figure 6:

Mr. Budi has a keris that has been used for 2 months and is starting to rust. Explain the process of corrosion in iron (keris) based on the concept of redox and the identification of substances that undergo oxidation and reduction!

Figure 6: Corrosion on keris contextualized with local wisdom

5.7 Activities Contingencies (logical relationship) data between antecedents, transactions, and interim products.

A logical relationship between goals, strategies, and outcomes is good in learning planning. Planning includes conditions and behaviors, including what is desired, anticipated, and their effects, (Stake, 1977). Stake involves the evaluator continuously describing and considering from the beginning, during, and at the end of the instructional. The logical relationship between *the antecedent, transactional, and interim product* dimensions in *intensity* and *observation* is: (1) The relationship between antecedend and transaction; (2) The relationship between transactions and interim products. (3) The relationship between antecedent, transaction and interim product.

a) Relationship between Antecedent to Transaction

Antecedent is an initial condition that includes learning objectives, student characteristics, teacher competence, curriculum, and facilities and infrastructure. This condition determines and limits the form of transactions that occur in the classroom.

The lesson plan prepared by teachers has directed the goals and resources that have been designed at the antecedent stage. The lesson plan prepared has illustrated the influence on learning strategies, methods, media, and teacher-student interaction in transactions. There has been a compatibility between the antecedent and the transaction, which indicates that there has been adaptation of the teacher to the initial conditions.

b) Relationship between Transaction and Interim Product

Transaction is a learning implementation process that reflects the realization of the planned that has been designed, including: strategies, methods, media, and teacher-student interaction patterns. The quality and consistency of transactions

greatly determine the formation of interim products, namely the overview of temporary learning outcomes that are likely to appear during and immediately after the learning plan.

The lesson plan prepared has described the readiness of learning planning that is tailored to the goals, characteristics of students, and available resources. This allows learners to show gradual development in aspects of knowledge, skills, and attitudes. The direction of the Interim product is reflected in the planning, which describes the opportunities for active involvement of students, understanding of initial concepts, critical thinking skills, and the results of formative assessments that will be obtained during the learning process.

There has been a mismatch between planning and learning outcomes that will have direct implications for the quality of interim products. The more effective the learning strategy, class interaction, and the use of media in transactions, the more optimal the achievement of temporary learning outcomes which is an indicator of the achievement of learning objectives and the basis for further learning improvement.

c) Relationship between Antecedent, Transaction, and Interim Product

These three dimensions form a systemic unity. Antecedent provides direction and prerequisites (readiness), transactions are the learning planning mechanism, and interim products are the initial indicators of the success of learning planning programs. This relationship is analyzed by comparing intent (what is planned) and observation (what happens). There has been an interdimensional conformity, so that it can be seen as a success, and as an evaluative reflection material for continuous improvement, as affirmed.

The logical relationship in contingencies activities emphasizes that the success of learning is highly determined by the alignment between the initial conditions (antecedent), learning planning (transaction), and interim learning outcomes (interim product). Continuous supervision evaluation allows for more informed decision-making to improve the quality of learning systematically and reflectively.

5.8 Explanation of the results of the Evaluation

5.8.1. Persiapan (Antecedent)

The results of the pre-supervision stage assessment on the antecedent aspects of ATP and learning planning showed an average score of 3.94. Almost all indicators achieve a value of 4, except for the indicator "ATP contains objectives relevant to CP and class phases." Although the ATP has listed learning objectives along with an assessment design to achieve them, Learning Outcomes (CP) have not been explicitly listed. As a result, the relationship between goals and achievements cannot be fully assessed. This is important, because previous research emphasized that the clear relationship between learning objectives and competency achievement is one of the key factors for the effectiveness of PBL implementation and competency-based learning (Markula & Aksela, 2022).

In general, the results of the evaluation show that the learning objectives are in accordance with **phase F**, where students are required to be able to classify, not just explain. In addition, the chosen learning model, namely **Project-based Learning (PBL),** supports strengthening 21st century skills (4C: *Critical Thinking, Creativity, Communication, Collaboration*) (Rehman et al., 2024). International studies have also shown that PBL encourages higher student engagement, gives real context to learning, and facilitates the integration of the 4Cs in science learning (Nicholus et al., 2023; Jumhur et al., 2024).

This ATP also integrates the **dimension of the Pancasila Student Profile**, for example fostering gratitude for the order of nature through understanding the concept of redox reactions associated with local phenomena such as corrosion in keris. This approach is in line with Herlinawati's (2024) findings that the integration of 21st-century skills and local context-based character in learning planning can strengthen students' learning relevance and motivation.

In terms of assessment, teachers have designed diagnostic assessments both cognitive and non-cognitive in accordance with the recommended assessment techniques. (Jumhur et al., 2024) also emphasizes the importance of repeated assessments in the PBL cycle so that students' critical thinking skills can develop optimally. In addition, learning planning is derived sequentially from ATP using a clear PBL syntax and accompanied by teaching modules for several meetings (1–4). This is in accordance with the recommendations of the literature that systematic and sustainable planning is a determining factor for the success of PBL (Rehman et al., 2024).

However, the weakness that is still found is that **the CP** has not been explicitly included in the ATP document. This has the potential to weaken the consistency between learning objectives and student competency achievements. Markula and Aksela (2022) also noted that unclarity in determining achievements or *driving questions* is often the main obstacle to the effectiveness of PBL. Therefore, the improvement that needs to be made is to add CP explicitly so that the linkage of goals, achievements, and assessments is stronger, while increasing the accountability of learning planning.

5.8.2. Planning (Transaction)

The evaluation of the planning stage (Transaction) has 12 dimensions, and 65 indicators, with a total value of 4. This assessment is supported by the results of the qualitative evaluation as follows: 4C's (Pre-Supervision – Transaction) Evaluation Resume.

The results of the evaluation of the planning stage (transaction) in the 4C-based RPP showed excellent readiness, with an average score of 4 out of 12 dimensions and 65 indicators assessed. This indicates that teachers have prepared learning plans in a systematic, structured, and in accordance with the demands of 21st century competencies. *First*, teachers have conducted an analysis of students' needs and characteristics through cognitive diagnostic assessments (e.g. oxidation numbers and redox reaction equalization) and noncognitive (auditory, visual, and

kinesthetic learning styles). The differentiation of students based on high, medium, and low ability levels is designed with the Teaching at the Right Level (TaRL) approach. This is in line with the findings of Davis and Autin (2020) who emphasize the importance of differentiation and formative assessment in designing learning activities that are responsive to student profiles.

E. TARGET PESERTA DIDIK **(Pembelajaran Berdiferensiasi (DAP) & *Teaching at the Right Level* (TaRL))**
1. Peserta didik tingkat tinggi: Mampu menerapkan konsep redoks dalam permasalahan yang lebih kompleks dan menganalisis berbagai metode penyetaraan reaksi redoks.
2. Peserta didik tingkat sedang: Mampu menyelesaikan masalah redoks dengan panduan dan menerapkan metode penyetaraan reaksi redoks yang telah dipelajari.
3. Peserta didik tingkat rendah: Mampu memahami konsep dasar redoks dan melakukan penyetaraan reaksi redoks sederhana dengan bantuan.
4. Kelompok heterogen: Setiap kelompok akan dibagi berdasarkan variasi kemampuan agar tercipta interaksi belajar yang kolaboratif.

Figure 7: Differentiated learning (TaRL)

Second, the time allocation is arranged proportionally, namely 10 × 45 minutes for four consecutive meetings from the basic concepts of redox, oxidation numbers, reaction equalization, to real-life applications. This progressive meeting structure makes it easy for students to understand material from simple to complex. *Third,* learning objectives and indicators are formulated using operational verbs with the ABCD model, which, although not always explicitly mentioning "4C", includes elements of Critical Thinking, Creativity, Collaboration, and Communication.

This is in line with the learning outcomes of phase F. However, the literature emphasizes the importance of explicit clarity in formulating the 4Cs to facilitate evaluation and reflection (Rehman et al., 2024). *Fourth,* the learning material is arranged in a series of ways by including real contexts such as corrosion in keris, batteries, and environmental and energy issues. The integration of cultural and local contexts has been proven to strengthen student engagement and increase the relevance of learning (Herlinawati, 2024).

Fifth, the learning strategy uses Problem-Based Learning (PBL) with a clear syntax: discussion, investigation, creation of works, presentations, and reflections. Collaborative activities in heterogeneous groups are also designed with specific roles sharing. Rehman et al. (2024) show that structured and collaborative PBL can significantly improve students' mastery of 4C skills. Sixth, learning media is prepared in a variety of ways, ranging from LKPD, textbooks, PPT, videos, applications such as Kahoot, to the use of the real environment.

This multimodal approach is in line with the findings of international studies that emphasize that media variations support different learning styles and facilitate the integration of 4C skills (Rahmadani et al., 2021). Seventh, assessment planning is based on the Understanding by Design (UbD) framework with a sequence of

objectives, assessments, and learning activities. The assessment covers cognitive, non-cognitive, attitude, and skill aspects of the 4Cs, using collaboration rubrics, group projects, presentations, and creative works. (Newell et al., 2023) supports the effectiveness of UbD in aligning learning objectives, assessments, and activities, particularly in the context of authentic and formative assessments. *Eighth,* classroom management is designed to be inclusive and participatory with heterogeneous groupings, thus providing space for all students to contribute. This is consistent with differentiated instruction theory which emphasizes the importance of learning that is equitable and responsive to student diversity (Davis & Autin, 2020).

Overall, the lesson plan shows mature planning with the main advantages in the clarity of the planning flow (objectives → assessment → activities), integration of real contexts, media variations, and the implementation of 4C-based PBL. However, the area for improvement lies in the need to write explicit learning outcomes (CP) and the formulation of 4C skills to make them easier to measure and evaluate.

5.8.3. Learning Outcome Planning (Interim Product)
Learning Outcome Planning (Interim Product), there are 2 variables, 5 dimensions, and 22 indicators, with a total assessment of all values of 4, except for the **dimension of Planning supporting documents, with** the indicator Teacher journal/learning diary rated 2, for the following reason: " In the planning it has not contained the teacher's journal/learning daily record".

Evaluation includes: (1) Planning related to learning management results, including: a) assessment planning b) assessment planning content; c) Planning supporting documents. (2) Planning of learning outcomes related to the 4C's, including: a) Assessment planning containing the 4C's; b) Assessment planning based on the 4C's.

The planning of learning outcomes at the pre-learning supervision stage has been designed quite comprehensively by emphasizing diagnostic assessments, both cognitive and non-cognitive. The lighter questions used, for example related to real cases such as rust, batteries, and oxidation numbers, have been proven to help explore students' initial understanding while encouraging critical thinking from the beginning of learning. This is in line with the findings that real-world context-based diagnostic assessments can increase student engagement in science learning (Kyaruzi et al., 2019).

The assessment instruments are also complete, including grids, analytical rubrics, LKPDs, handouts, modules, and supporting media such as PPT and videos. Formative assessments are designed for each intermediate learning objective, while summative assessments are focused on environment-based case analysis and local wisdom. This approach is in accordance with the principle of Understanding by Design (UbD) which emphasizes the measurability of learning objectives through planned assessments (Furtak & Penuel, 2019).

The assessment techniques used include independent assignments, group work, presentations, and work products. The assessment is comprehensive, objective, fair, transparent, and sustainable, with the support of an analytical rubric. This kind of assessment model allows for a more thorough evaluation of students' competencies, not only from cognitive aspects but also social and collaborative skills (Anderson & Huttenlocher, 2020).

The 4C's skill integration is already apparent:

1) Critical thinking is developed through case analysis of redox reactions and real problem solving.
2) Creativity is realized through original products and innovative solutions presented.
3) Collaboration is strengthened through task sharing, teamwork, conflict resolution, and appreciation for diversity.
4) Communication is trained through discussions, presentations, and the presentation of content in visual form.

This integration not only supports 21st century competence but is also in line with the 8 dimensions of the Pancasila Student Profile, especially the dimensions of mutual cooperation, critical reasoning, and creativity. International research has also shown that the integration of the 4C's into assessment can improve students' readiness to face global challenges (Trilling & Fadel, 2021). The learning approach using Problem Based Learning (PBL) combined with UbD makes learning objectives easier to measure. PBL, especially in the fourth to sixth grades, encourages students to produce creative product-based solutions. Recent studies confirm that PBL is effective in developing collaborative and innovative skills, especially when associated with contextual issues (Dolmans et al., 2021).

However, there is one weakness that still needs to be considered, namely the absence of a teacher's journal or learning diary. In fact, teachers' journals function as a means of continuous reflection, which can improve the quality of planning and the effectiveness of learning strategies (Farrell, 2020). Thus, even though the assessment planning is thorough and relevant to the 4C's competencies and the Graduate Profile Dimensions, improvement is still needed through reflective documentation of teachers.

6. Conclusion

Overall, the learning plan has been well prepared, comprehensive, and in line with the principles of **Problem Based Learning (PBL),** 4C's (Critical Thinking, Creativity, Communication, Collaboration) **skills**, and the integration of **the Pancasila Student Profile**. (1) **Preparatory stage (Antecedent).** The ATP has contained learning objectives, assessments, and sequential learning steps, although **the CP has not been explicitly listed** so that the connection between the goals and achievements is not fully clear. However, planning remains contextual, adjusting to the characteristics of students, the school environment, and local wisdom. (2) **Planning Stage (Transaction).** Teachers have conducted **needs analysis through diagnostic assessments**, designed differentiations according to students' abilities, and developed goals with operational verbs that are in line with

CP Phase F. PBL-based planning supports contextual, collaborative, and structured learning activities. The assessment has also used **the Understanding by Design (UbD) approach**, covering cognitive, non-cognitive, attitude, and 4C's skills. However, the explicit mention of the 4C's dimension and the Pancasila Student Profile in the document is still limited. (3) **Learning Outcome Planning Stage (Interim Product).** Learning outcome planning is **comprehensive, innovative, and contextual**, equipped with various assessment instruments (rubrics, grids, LKPDs, handouts, modules, digital media). The 4C's skills are fully integrated in the assessment. One weakness that is still visible is the **absence of teacher journals/learning diaries**, so that reflection and continuity of planning are not optimally documented. In summary**:** The learning plan is mature, in line with PBL, UbD, 4C's, and Pancasila Student Profiles, but it still needs to be strengthened by the explicit inclusion of CP and the completion of reflective documents such as teachers' journals.

7. Recommendations

Teachers are advised to strengthen the inclusion of CP in the ATP to clarify the relevance of goals to achievements, as well as add teacher journals as a means of continuous reflection. In addition, the explicit mention of the 4Cs and the dimensions of the Pancasila Student Profile in the RPP document needs to be strengthened so that the implementation of learning is more directed.

8. Conflict of Interest

The authors declare no conflict of interest. The funders had no role in study design, in data collection, analysis, or interpretation; in script writing; or in the decision to publish results.

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