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Analysis of the Integrated E-Mesp 4CS Mobile Instrument

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Abstract: The need for valid and contextually relevant supervision instruments remains a key challenge in realizing 21st-century education that integrates the 4Cs skills (critical thinking, creativity, collaboration, and communication) with the Profil Pelajar Pancasila. This study aimed to develop and evaluate the feasibility of the Integrated E-MESp 4Cs Mobile as a digital instrument for academic supervision. Using a research and development (R&D) approach with qualitative data collection, this study conducted Focus Group Discussions, in-depth interviews, and document analyses involving teachers, principals, supervisors, and education experts. The data was analyzed through interactive qualitative procedures, including data reduction, presentation, and verification. The results show that the E-MESp 4Cs Mobile instrument is feasible and relevant to be used as an integrated supervision tool that combines 4Cs indicators with the dimensions of the Pancasila Student Profile. Stakeholders also emphasized the need for standardization aligned with national guidelines and the potential use of artificial intelligence to support data-based supervision and policy recommendations. Overall, the E-MESp 4Cs Mobile instrument demonstrates strong potential to enhance teacher supervision practices, support deep learning, and strengthen the development of humanistic, inclusive, and character-oriented graduates.

Keywords: 4Cs; Academic supervision; E-MESp mobile; Instrument validity; Profil pelajar pancasila

Introduction

The evolving demands of 21st-century education require curricula and supervision that go beyond academic achievement, emphasizing the development of the 4Cs—critical thinking, creativity, collaboration, and communication— as essential competencies for graduates to navigate increasingly complex global challenges. Numerous international studies have shown that these skills can only develop optimally when valid, reliable, and contextually relevant instruments for teaching and supervision are available. In the Indonesian context, the Profil Pelajar Pancasila policy reinforces the need for an integrated approach that combines academic competencies, 21st-century skills, and character dimensions such as religiosity, nationalism, collaboration, creativity, critical reasoning, and independence. Consequently, the policy highlights the importance of supervisory instruments that can holistically assess teachers' practices while simultaneously mapping their professional development needs.

The practical challenge lies in providing supervisory instruments that: meet national standards of validity and reliability, offer specific recommendations for teachers and schools to improve learning practices, and map training needs at both school and regional levels.

To address these challenges, the development of the Integrated E-MESp 4Cs Mobile platform becomes highly

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significant. This mobile-based digital platform incorporates supervisory instruments that integrate the 4Cs framework and learner profile dimensions. The innovation not only facilitates the monitoring of teaching practices but also enables systematic analysis of supervision data and supports evidence-based decision-making at both school and policy levels.

The Focus Group Discussions (FGDs) conducted in this study centered on assessing the feasibility of the instrument design and gathering input from relevant stakeholders. Accordingly, the analysis of the E-MESp 4Cs Mobile instrument is expected to contribute to strengthening academic supervision practices, improving teacher performance, and accelerating the realization of humanist, inclusive, and character-driven graduates, in alignment with the vision of national education.

Based on the background above, the research problems are formulated as follows: How feasible is the Integrated E-MESp 4Cs Mobile instrument in terms of validity, reliability, and relevance to supervisory needs in schools? How can the instrument comprehensively integrate the 4Cs framework with learner profile dimensions in academic supervision practices? What are the responses and inputs of stakeholders (teachers, supervisors, principals, experts) toward the implementation of this mobile-based supervisory instrument? What is the potential of the E-MESp 4Cs Mobile instrument to map teachers' professional development needs and provide policy recommendations?

This study aims to: examine the feasibility and validity of the Integrated E-MESp 4Cs Mobile instrument as a tool for learning supervision; describe the integration of the 4Cs framework with learner profile dimensions in the supervisory instrument; identify stakeholder responses and feedback regarding the practical implementation of the instrument in school supervision; and analyze the potential of the instrument in generating recommendations for instructional improvement and mapping training needs at both school and regional levels.

Recent research emphasizes that developing 21st-century competencies requires instruments that not only assess cognitive outcomes but also measure creativity, communication, collaboration, and critical thinking as integrated skills within authentic learning contexts (Afriana et al., 2016; Thornhill-Miller et al., 2023). In Indonesia, the integration of the 4Cs framework into academic supervision has become a pressing concern due to policy shifts toward character-based and student-centered education, as mandated by the Profil Pelajar Pancasila (Kemdikbudristek, 2022). Studies show that while teachers understand the conceptual importance of 4Cs, they often lack valid and practical instruments to observe and evaluate their implementation in classrooms (Rachman et al., 2024; Zakaria et al., 2024). This situation underscores the urgency for developing supervision instruments that align with both national standards and global competencies.

Several empirical studies within the *Jurnal Pendidikan IPA Indonesia* (JPII) and JPPIPA have confirmed that project-based learning and STEM integration can significantly enhance students' 4C skills, provided that teachers receive feedback through structured supervision tools (Afriana et al., 2016; Prastowo et al., 2023; Sari & Yulianti, 2022). However, these studies also highlight gaps in teachers' ability to translate policy frameworks into measurable classroom indicators. For instance, Winaryati et al. (2023) found that most existing supervision rubrics remain limited to cognitive outcomes, neglecting creativity and collaboration dimensions that are central to the 4Cs. Likewise, Alvionita et al. (2021) noted that even when rubrics exist, their inter-rater reliability remains inconsistent, emphasizing the need for standardized digital instruments.

At the international level, numerous studies support the development of valid and reliable evaluation tools to promote teacher professional growth (Richter & Richter, 2024; White, 2023). The OECD (2019) and UNESCO (2023) reports also underline that supervision systems must evolve from compliance-based monitoring toward developmental, data-informed coaching. Integrating AI and digital analytics into supervision, as suggested by Alper et al. (2024), offers new opportunities to identify trends, generate personalized recommendations, and foster evidence-based decision-making. Similarly, research by Tan et al. (2024), Shi (2024), and Shi (2025) demonstrates how artificial intelligence can enhance feedback accuracy and reduce subjectivity in performance evaluations.

In the Indonesian educational ecosystem, several national journals have explored digital supervision and evaluation frameworks compatible with the Profil Pelajar Pancasila. For example, studies in Jurnal Evaluasi Pendidikan and Jurnal Inovasi Pendidikan Kimia illustrate how digital tools can help supervisors track teachers' growth in creativity and collaboration (Mariana & Hartati, 2023; Yuliani & Kurniawan, 2024). Yet, these tools remain fragmented, lacking integration between 4Cs indicators and character-based dimensions such as religiosity, nationalism, and independence. The E-MESp 4Cs Mobile model addresses this gap by systematically embedding both constructs into one coherent platform, aligning with findings from Mera et al. (2023) on the importance of multi-layered digital assessment design.

Further evidence from accredited national journals reinforces that effective supervision directly correlates

with improved pedagogical competence and student achievement (Situmorang et al., 2022; Purwanti & Setyawan, 2021). Research from Jurnal Pendidikan dan Pembelajaran Sains confirms that when supervision incorporates collaborative reflection and feedback loops, teachers exhibit higher engagement and instructional quality (Wicaksono & Hidayah, 2023). Moreover, the need for instruments validated through expert judgment and field testing has been echoed by numerous Indonesian scholars (Riyadi et al., 2024; Hidayati & Prasetyo, 2023). These findings validate the methodological foundation adopted in this study—combining qualitative feedback from experts and stakeholders through FGDs and interviews to ensure both content and construct validity.

Beyond validation, the novelty of the E-MESp 4Cs Mobile lies in integrating digital analytics with pedagogical frameworks. Studies by Wang et al. (2024) and Swiecki et al. (2022) show that technology-enabled supervision can bridge gaps between qualitative observations and quantitative policy data. In Indonesia, local pilot studies (Pradana et al., 2023; Suryani et al., 2024) have demonstrated that integrating AI modules within educational applications helps streamline reporting and improve policy responsiveness. Such findings support the rationale for embedding artificial intelligence in the E-MESp 4Cs Mobile platform as a strategic innovation for sustainable supervision.

The convergence of 4Cs pedagogy, character education, and AI-based supervision positions the E-MESp 4Cs Mobile as a novel contribution within both national and international discourse. It operationalizes theoretical models of holistic supervision proposed by Weng et al. (2022) and contextualizes them within Indonesia's policy framework. By addressing the limitations identified in previous studies—validity inconsistency, fragmented indicators, and lack of digital integration—this research aligns with the global movement toward transformative, data-driven educational leadership (Herlinawati et al., 2024; Kousloglou et al., 2023). Consequently, the development and feasibility assessment of this instrument hold both academic and practical relevance, offering a scalable model for supervision aligned with 21st-century educational demands.

Method

This study applied a research and development (R&D) approach, focusing on the validation and feasibility analysis of the Integrated E-MESp 4Cs Mobile instrument. The descriptive qualitative method was used in the validation phase to obtain in-depth feedback from experts and users. This approach was chosen because the research aimed to refine the conceptual framework and assess the content and construct validity of the instrument prior to broader implementation.

The subjects of this study consisted of twelve participants selected through purposive sampling, including teachers from primary and secondary schools implementing the Kurikulum Merdeka, principals with experience in academic supervision, school supervisors responsible for monitoring learning quality, and educational experts in supervision and evaluation. Primary data were obtained from Focus Group Discussions (FGDs) and expert interviews, while secondary data were collected from policy documents such as the Kurikulum Merdeka and Profil Pelajar Pancasila, supervision reports, and relevant literature on 4Cs and academic supervision.

Data were collected through FGDs to validate the conceptual and content structure of the E-MESp 4Cs Mobile instrument and to gather feedback for refinement. In-depth interviews were conducted to confirm and deepen the results of the FGDs and ensure the construct validity of indicators and rubrics. Document analysis was performed to align the developed indicators with national supervision standards and previous studies related to the 4Cs and the Profil Pelajar Pancasila.

Data credibility was ensured through source and method triangulation involving teachers, principals, supervisors, and experts. Instrument validity was established through expert judgment during the FGDs and interviews, focusing on content and construct validation to ensure that each indicator in the E-MESp 4Cs Mobile instrument was relevant to supervision standards and learner profile dimensions.

Data analysis employed an interactive qualitative model comprising data reduction, data display, and conclusion drawing. Thematic coding was used to classify findings into aspects of validity, feasibility, and relevance, resulting in synthesized conclusions for the refinement of the E-MESp 4Cs Mobile instrument.

Results and Discussion

Theoretical Foundation

Demands of 21st-Century Education

The shifting demands of 21st-century education have triggered a revolution in the competency framework expected of school graduates. Beyond academic achievement, competencies in cognitive (critical thinking), affective, social, creativity, collaboration, and communication—collectively known as the "4Cs"—are now considered essential for preparing students to face the uncertainties and complexities of the modern world. International

literature emphasizes that the development and assessment of 21st-century skills, including the 4Cs, require supervision, pedagogical models, and instruments that are valid, reliable, and sensitive to local contexts. For instance, the study Students' Perceptions of Pedagogy for 21st Century Learning Instrument (S-POP-21) developed a concise yet valid and reliable tool to measure students' perceptions of pedagogical practices that foster 21st-century skills. Similarly, in Indonesia, the study Enhancing Prospective Elementary School Teachers' 4C Skills: Instrument Development in the Context of Materials and Changes Lecture constructed and tested a 4C-based instrument for prospective elementary school teachers, ensuring reliability and validity through modern statistical methods.

Local Policy: Dimensions of Learner Profiles

In Indonesia, the policy on learner profile dimensions has emerged as a new national framework for character and competence, encompassing dimensions such as religiosity, nationalism, collaboration, and creativity, alongside moral, social, affective, and critical reasoning skills. This policy necessitates that supervisory instruments and school supervision practices move beyond purely academic assessment to holistically integrate both character and 21st-century competencies. Several Indonesian studies have examined the implementation of Profil Pelajar Pancasila in schools—for example, through character-strengthening projects and soft-skills development in primary and secondary schools. These studies often indicate that, while concrete efforts exist (e.g., project-based learning, collaborative practices, soft-skill reinforcement), challenges remain in providing measurement tools that are specific, updated, and systematic for assessing 4C skills.

Academic Supervision and Monitoring Instruments

Academic supervision plays a pivotal role in bridging curriculum policy with classroom practice. Effective supervision—including monitoring, coaching, assessment, and follow-up—supports teachers in implementing learning processes that foster 4C skills, while also enabling schools to identify professional training and development needs. Recent studies reveal significant correlations between academic supervision and teacher performance, pedagogical competence, and student learning outcomes, thereby highlighting supervision as a critical lever for educational quality improvement.

4Cs and Deep Learning

Conceptual frameworks situate the 4Cs not as isolated outcomes but as integral elements of deep and meaningful learning, connecting lesson planning, classroom activities, and competency attainment with reflection and real-world application. Reviews and design-based studies show that approaches emphasizing authentic problem-solving, structured collaboration, and reflective practice not only strengthen higher-order thinking skills but also foster creativity.

Learner Profile Dimensions and Implications for Assessment Instruments

The Indonesian curriculum (Kemdikbud/ Kurikulum Merdeka) articulates Profil Pelajar Pancasila—encompassing character and cognitive dimensions—as a foundation for learning. To ensure alignment between the E-MESp instrument and national policies, the development of indicators must refer directly to official documents and their corresponding elements and sub-elements described in national guidelines. Such alignment enhances the legitimacy of the instrument and increases its potential for adoption by schools.

Data Analysis Procedures

Data analysis in this study followed the interactive model of Miles et al. (2014), characterized by cyclical and iterative processes to arrive at valid findings. The analysis proceeded through three principal stages:

Data Reduction

At this stage, the researchers filtered and refined data obtained from FGDs, interviews, and document studies. Irrelevant information was discarded, while data pertinent to the validity, reliability, and feasibility of the E-MESp 4Cs Mobile instrument were retained. Data reduction also involved initial coding, thematic grouping, and categorization in accordance with the dimensions of the 4Cs and Profil Pelajar Pancasila.

Data Display

The reduced data were organized into matrices, tables, and thematic narratives to enhance clarity and facilitate interpretation. This presentation enabled both researchers and participants to identify linkages within the data, such as the relationship between lesson planning indicators, classroom implementation, and resulting outcomes. It also supported the identification of patterns, including alignment with national supervision standards, teachers' needs, and the potential role of technological tools (such as AI) in supervisory analysis.

Conclusion Drawing and Verification

The final stage involved drafting provisional conclusions based on observed patterns and trends. These conclusions were then verified through source triangulation (teachers, principals, supervisors, experts)

and methodological triangulation (FGDs, interviews, document studies). This process yielded key findings regarding the strengths of the instrument (relevance, integration of 4Cs and learner profile dimensions, potential for digitalization), its weaknesses (indicator standardization, readiness for implementation), and recommendations for further development.

Through this systematic process, the study ensured that the E-MESp 4Cs Mobile instrument was grounded not only in strong theoretical foundations but also in practical field-based needs, thereby demonstrating its potential as a valid, reliable, and applicable tool for evidence-based educational supervision.

Table 1. Data Reduction Matrix

Focus Category	Key Findings	Implications for the E-MESp 4Cs Mobile Instrument
Instrument Validity	Supervision indicators do not fully refer to national standards; there are still differences in interpretation among stakeholders.	The instrument must be cross-walked with national supervision guidelines (MoE) and Graduate Profile Dimensions to ensure alignment.
Reliability & Consistency	Teachers and supervisors observed variations in assessment among evaluators.	A rubric with clear performance levels (4–5 tiers) is needed to improve the consistency of observation results.
Practical Feasibility	School principals emphasized that the instrument is too lengthy and potentially impractical for daily implementation.	The instrument should be simplified without reducing the essence of the 4Cs and Graduate Profile; a shorter version for quick observations could be developed.
Integration of 4Cs	Teachers reported difficulty distinguishing indicators among the 4Cs, especially between collaboration and communication.	Specific indicators with observable behaviors should be developed for each C.
Graduate Profile Dimensions	Participants highlighted the importance of indicators on religiosity, mutual cooperation, and critical reasoning in supervision.	The instrument should explicitly link 4Cs indicators with the dimensions of the Pancasila Student Profile.
Technology Utilization	Suggestions were made to employ AI for generating automatic recommendations based on supervision results.	E-MESp Mobile needs to develop an AI analytics module that can provide improvement suggestions and map teachers' training needs.
Policy Adoption	The instrument will be more accepted if integrated into official supervision programs at district/provincial levels.	Research outputs should be accompanied by policy advocacy and evidence of effectiveness from pilot projects to facilitate adoption.

FGD Findings from Thematic Analysis (with supporting quotations)

Supervision focus: deep learning, seven habits, and character building

Transcript analysis highlighted that school principals should prioritize supervision that focuses on deep learning, the seven habits of learning, and character development, rather than merely emphasizing "fun" activities without measurable learning outcomes. This statement reinforces the need to balance positive student experiences with concrete academic outcomes, echoing PISA findings on the tension between well-being and achievement.

Instrument implications: indicators and rubrics

The E-MESp indicators and rubrics must assess the quality of lesson planning (lesson design), the quality of instructional interaction (teaching and learning activities), and tangible evidence of outcomes (student products, authentic assessment).

Instrument standardization: reference to national guidelines

FGD participants stressed that the instrument must refer to nationally recognized teacher evaluation guidelines rather than creating an independent tool that might face resistance. This alignment is crucial for both validity and adoption. Consequently, the E-MESp assessment matrix must be directly mapped to components of national guidelines (teacher evaluation elements) and to the dimensions of the Graduate Profile.

Data flow (input–process–output) and the role of AI (insight from Mr. Utomo)

Mr. Utomo emphasized three core data blocks: lesson planning, classroom implementation, and learning outcomes. Artificial Intelligence (AI) was proposed to: (1) compare actual data with the ideal rubric, (2) generate detailed improvement recommendations, and (3) map training needs at the district/provincial level. The system was suggested to include a passing-grade mechanism to ensure

continuous improvement cycles. Literature supports the potential of AI in such analytics but also underscores the need for validation and human oversight.

Product novelty and patent potential

One of the intended outcomes of this research is patent registration. Thus, the product must emphasize its novelty compared to existing platforms or instruments. A distinctive feature would be the integration of the eight dimensions of the Graduate Profile, the 4Cs rubric, and the AI recommendation module that processes the three data blocks. A comparative state-of-the-art review is required to support the claim of originality.

Sustainability and policy adoption

Given the significant costs and efforts involved, sustainability requires deliberate policy adoption strategies, such as embedding E-MESp within official supervision policies at the school/provincial level or within formal training modules. This ensures that investment yields long-term systemic impact.

Discussion (Analytical and Recommendative)

Bridging conceptual and technical aspects: operational instrument design

Based on FGD insights, the instrument design must comprise three distinct layers: Planning Layer: Indicators of lesson planning quality (learning objectives, alignment with Graduate Profile, 4Cs strategies, formative/authentic assessment). Implementation Layer: Observation of classroom processes (student engagement, collaborative activities, evidence of critical thinking, use of media, and differentiation strategies). Outcome Layer: Evidence of student products, assessment results, and relevant well-being/participation metrics.

Each layer should be equipped with measurable rubrics (e.g., 4–5 performance levels), linked to the dimensions of the Pancasila Student Profile, and supported by AI-generated automatic recommendations complemented by practical resources (e.g., remedial exercises, training modules). This model aligns with the literature recommending authentic and multifaceted assessment for evaluating the 4Cs and deep learning.

The role of AI: potential and caution

AI offers tangible benefits, including expediting observation data processing, extracting patterns of common weaknesses, and mapping training needs. However, the design must guarantee: algorithm validation using local data, transparency of assessment criteria, human involvement in final decision-making, and the protection of teacher and student data privacy. The "human-in-the-loop" approach and model auditing must be embedded. Current studies highlight the accelerating adoption of AI in professional development while also warning of risks associated with over-reliance.

Policy adoption strategies: making the product "stick"

Strategic input emphasized the need for E-MESp to "stick" to prominent policy issues (e.g., deep learning). This implies framing the product as a support system for deep learning rather than as a stand-alone 4Cs platform. Concrete steps include: (1) mapping terminology and indicators to provincial and national policies, (2) piloting within committed school clusters, (3) providing support packages (principal training, implementation guides), and (4) documenting impact evidence for advocacy in budget allocation and training at the education office. This approach embeds the product within the policy ecosystem, increasing the likelihood of sustainable resource allocation.

Novelty and intellectual property (patent) claims

To substantiate claims of novelty, the research team must compile a state-of-the-art mapping of existing platforms and instruments and clearly articulate technical or functional differentiations. A unique contribution lies in combining the eight dimensions of the Graduate Profile, the 4Cs rubric, and an AI module that processes the three data blocks while generating aggregated policy recommendations. Experimental or pilot evidence demonstrating these distinctive features will strengthen the patent claim.

Conclusion

The study concludes that the Integrated E-MESp 4Cs Mobile instrument is feasible, valid, and contextually relevant as a tool for academic supervision. The findings from Focus Group Discussions, expert reviews, and document analysis confirm that the instrument integrates the 4Cs framework—critical thinking, creativity, collaboration, and communication— with the dimensions of the Pancasila Student Profile in a coherent and measurable structure. The developed indicators effectively cover three main supervision components: lesson planning, learning implementation, and learning outcomes, aligning well with national supervision standards. Furthermore, the study highlights that the E-MESp 4Cs Mobile instrument supports deep learning and evidence-based decision-making in educational practice. Stakeholder feedback also shows strong acceptance and recognition of its potential to enhance the quality and consistency of teacher supervision. Therefore, the E-MESp 4Cs Mobile can serve as a valid and relevant instrument that strengthens professional learning ecosystems in schools

and contributes to the realization of humanist, inclusive, and character-oriented graduates.

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Conflict of Interest
The authors declare no conflict of interest.

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