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INSTITUTIONALIZING SCIENTIFIC INQUIRY: PRINCIPAL'S STRATEGIES FOR STRENGTHENING SCHOOL LITERACY ECOSYSTEMS

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ABSTRACT

The challenges of the 21st century demand comprehensive literacy mastery as the main modality of national competitiveness. This study aims to analyze the Principal's Strategic Management in institutionalizing a research culture through a mandatory Youth Scientific Work (KIR) policy for all students. Research is generally only an optional extracurricular activity, but in SMA Negeri 1 Rembang, KIR has become a mandatory extracurricular activity and even writing a KIR report is one of the graduation requirements. The study was conducted using a qualitative approach with a case study design. Data were collected through in-depth interviews, participant observation, and documentation studies, and validated using triangulation of techniques and sources. Data analysis was conducted using the interactive model of Miles and Huberman. The research findings reveal that the successful implementation of the principal's strategy in implementing a literacy strengthening program through mandatory student KIR rests on four pillars of execution: (1) Creation of an effective organizational structure; (2) Determination of procedures; (3) Program development; and (4) Accountable resource management. This study concludes that strengthening literacy is not enough to be built with a reading movement alone, but must be institutionalized through a mandatory and structured scientific inquiry curriculum so that a research culture is formed within the school literacy ecosystem.

INTRODUCTION

Education in the 21st century presents educational institutions with the complex challenge of producing not merely memorized graduates but individuals with comprehensive literacy and critical reasoning

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skills. However, the actual state of national education shows a worrying trend. According to the latest Programme for International Student Assessment (PISA) report released by the Ministry of Education, Culture, Research, and Technology (2023), despite improvements in rankings, Indonesian students' absolute reading and science literacy scores are still declining and below the global average. This decline indicates that the education ecosystem has not fully succeeded in facilitating the development of scientific reasoning and in-depth critical thinking habits among students.

This literacy crisis is amplified at the regional level, particularly in Central Java. The latest data from the Central Statistics Agency (2024a) notes that the Community Literacy Development Index (IPLM) in Central Java still requires serious acceleration. This low index correlates directly with the low level of public reading enthusiasm (TGM) as recorded in the BPS report (2024b). This phenomenon is paradoxical amidst global demands for mastery of 21st-century skills. Anggraeni et al. (2021: 38) emphasize this urgency by stating that there are six 21st-century skills known as the 6Cs: character, critical thinking, collaboration, communication, creativity, and citizenship, which students absolutely must master from an early age. Kusripinah and Subrata (2022: 30) define literacy as the ability to support a person in listening, speaking, reading, and writing, as well as the ability to analyze information to draw conclusions. This definition places scientific research or inquiry as the pinnacle of literacy activities. The urgency of strengthening this literacy culture is supported by the empirical findings of Azizah and Darmawan (2024: 13), who stated that literacy culture plays a determinant role in determining the academic achievement of high school students. Literacy culture provides a strong internal impetus for students to actively engage in the learning process and improve academic outcomes. This is reinforced by Setiawan (2024: 431), who found that digital literacy and social capital significantly influence the academic achievement of vocational/secondary school students. More specifically, Aliyana and Prakoso (2024: 11) demonstrated that digital literacy significantly impacts academic achievement in economics. Furthermore, Rudianto et al. (2025: 19) asserted that literacy not only impacts academic success but also determines students' future quality of life. All of these research findings show that having good literacy will be very crucial for students' future. Good literacy has been a global competency demand. The literacy crisis that has happened for many years needs a strategic intervention especially at the school level. Without strategic intervention at the school level, the gap between global competency demands and local literacy realities will widen.

Recognizing this urgency, SMA Negeri 1 Rembang, Rembang Regency, Central Java, implemented a radical managerial breakthrough. While in most high schools in Indonesia, Youth Scientific Work (KIR) activities are positioned as optional extracurricular activities for only a handful of students with special interests, SMA Negeri 1 Rembang took the opposite approach. This school established a policy that literacy strengthening programs are integrated through KIR activities, which are mandatory for all students. The preparation of a scientific paper report is an absolute requirement for graduation. This policy forced a cultural transformation from merely a "memorization school" to a "research school," where every student, regardless of their background, interests, and talents, must undergo a process of scientific inquiry.

Transforming the status of KIR from an optional extracurricular to a mandatory/massive co-curricular program is not merely a technical undertaking, but rather a strategic management maneuver. This change requires curriculum engineering, resource mobilization, and fundamental organizational culture changes. From a strategic management perspective, the principal plays a central role as the architect of change. David, David, and David (2023: 214) emphasize that strategy implementation is often the most difficult stage, requiring discipline and commitment from leaders. The principal functions not only as an administrative manager but also as an instructional leader who actively shapes a culture of literacy (Darling-Hammond, 2021: 78).

This research offers a strong urgency and distinction compared to previous studies. The novelty of this research lies in two main aspects: 1) The novelty of the substance (mandatory scientific writing), namely examining "Scientific Work as a Mandatory Extracurricular." The principal's strategy in managing a mandatory program for all students (not just elective students) has a much higher managerial complexity compared to conventional extracurricular management; and 2) The novelty of a comprehensive strategic governance model in realizing productive literacy through a mandatory scientific work program. This research dissects the leadership mechanism in managing the school

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ecosystem so that all students are able to produce knowledge scientifically, while also serving as a mitigation model for the challenges of academic integrity in the era of artificial intelligence.

Specifically, there is a significant research gap in the current educational management literature. The majority of previous studies (e.g., Mahfudh & Imron, 2020; Rahman, 2024; Luthfiyana & Rifqi, 2022) tend to limit the discourse on principals' strategies to the realm of receptive literacy (reading culture) and the provision of physical infrastructure. Meanwhile, studies on KIR (e.g., Nurrohmah, 2025; Wicaksono, 2022) are generally isolated to the context of elective extracurricular activities exclusively for gifted students. No study has yet been found that comprehensively analyzes the institutionalization of scientific inquiry through mandatory policies for the entire student population (inclusive) as a core instrument of school management in boosting global literacy.

Based on the background and research gaps that have been described, the problems formulation in this study are: 1. How is the principal's strategy in implementing the literacy strengthening program through the mandatory Youth Scientific Work (KIR) program for students at SMA Negeri 1 Rembang? 2. How is the implementation of the program and what are the obstacles found during the implementation? Therefore, this study aims to analyze in depth the principal's strategy in implementing the mandatory KIR program and the principal's ways to run the program and analyze the obstacles that occur during the program implementation This study is expected to fill the gap in the literature that has so far focused more on KIR as an exclusive activity, rather than as an inclusive and systemic literacy movement.

METHOD

This research employed a qualitative approach with a case study design. This approach was chosen because the research objective was to explore and understand in-depth the phenomenon of the principal's particular and unique strategy, namely the implementation of the mandatory Youth Scientific Work (KIR) policy for all students (Winarni, 2021; Sugiyono, 2023). The research was conducted at SMA Negeri 1 Rembang, Rembang Regency, Central Java. This location was chosen based on the school's uniqueness in implementing the KIR policy as a mandatory co-curricular program and graduation requirement, unlike most schools that place it as an optional extracurricular activity.

The data sources in this study were 12 informants who were determined through purposive sampling techniques to ensure that the selected informants had direct knowledge and involvement with the program. The informants in this study included: 1. The Principal: As a key informant and strategic policy maker for the school; 2. The Vice Principal for Curriculum Affairs: As the technical implementer of KIR integration into the school curriculum structure; 3. The KIR Team Leader: As the field coordinator who manages the daily operations of the student research program; 4. The Head of the Library: As a provider of literacy resources and scientific references to support research; 5. Three KIR Supervisor Teachers from: As a clinical companion who interacts directly with the student inquiry process; 6. Three Students from grade X, XI and XII: As the main subjects receiving the program to see the direct impact of the policy; and 7. Two Students' Parents: As school partners to verify external support and the impact of the program outside the school.

Data collection techniques were carried out in three ways: 1. In-depth Interview; 2. Participant Observation: Researchers directly observed the dynamics of the school literacy ecosystem implementing clinical guidance; 3. Documentation Study: Includes analysis of Educational Unit Operational Curriculum (KOSP) documents, Standard Operating Procedures (SOP) for guidance, mandatory KIR guide documents, and archives of student scientific works as cultural artifacts of research.

To ensure data validity, this study employed technical and source triangulation. Technical triangulation was conducted by checking the same data using different techniques. Source triangulation was conducted by comparing statements between informants. Data analysis employed the interactive model of Miles and Huberman, which consists of three simultaneous activity flows: data condensation, which focuses on selecting key points; data display to understand what is happening; and conclusion drawing/verification to answer the problem formulation.

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RESULTS AND DISCUSSION

Results

This presentation of field findings related to the principal's strategy implementation in the mandatory KIR program at SMA Negeri 1 Rembang is structured based on four main indicators of strategy implementation: (1) Organizational structure creation, (2) Procedure determination, (3) Program development, and (4) Governance and constraints. Data are supported by in-depth interviews with 12 informants, field observations, and documentation studies.

Creating an Effective Organizational Structure

The Principal of SMA Negeri 1 Rembang does not work alone, but rather forms a KIR Team. This organizational structure is directly under the control of the Vice Principal for Curriculum, emphasizing KIR's position as a mandatory extracurricular program integrated with academics, not merely a supplement. The Principal explained the team's strategic mandate as follows: "I created a team. I also asked them to set targets. Because this is a flagship program, at least in grade 10, we usually have socialization, then we have assigned mentors. Hopefully, by the second semester of grade 10, at least the sub-titles will be fixed. We monitor it and I request reports from the coordinator" (Interview with Principal, November 21, 2025). Key findings indicate that the KIR Team consists of teachers specifically appointed as coordinators and mentors. This structure is designed hierarchically, with the KIR Team Leader responsible for creating work programs and reporting progress periodically to the school leadership. The strategic aspect of this structure is evident in the mentoring ratio. The school has established a policy that each guidance teacher handles students across grades (grades X, XI, and XII), with a maximum ratio of one teacher to 36 students. This ratio is designed to balance teacher workload with the quality of guidance services to students, ensuring that "mandatory" guidance is not merely a formality but still touches on the substance of the guidance.

Establishing Standard Operating Procedures

Research findings indicate that schools have established strict procedural flows, from upstream to downstream. Procedurally, the mandatory KIR cycle begins when students enter grade 10 through socialization during the School Environment Introduction Period (MPLS), followed by the submission of the title in the second semester of grade 10. The final target is rigidly set: the report must be completed before the final exam for grade 12. To maintain process quality, the school implements a KIR Guidance Card mechanism as a monitoring tool. This was confirmed by the Vice Principal of Curriculum: "From the very beginning, when students enter SMA Negeri 1 Rembang, during the MPLS new student introduction period, the curriculum informs them that the students will have a mandatory extracurricular activity, namely KIR. We will divide the students into groups with their own KIR mentors... Then, the deadline for the students will be in grade 12, which is a requirement for graduation" (Interview with Vice Principal for Curriculum, November 20, 2025). The validity of these findings is supported by documentary evidence and field observations. Guidance Cards, which contain a record of student consultations, must be signed by the supervisor as a requirement for progress validation. Furthermore, commitment to this procedure was confirmed through participant observation conducted by the researcher on Monday, December 29, 2025. The clinical guidance process continued intensively even during the odd semester break. The supervisor provided direct feedback on the student's draft physical report, demonstrating that the guidance procedure was not merely administrative but rather a substantive academic interaction.

Program Development

The principal's strategy does not stop at establishing rules, but also includes developing a capacity-building program. The school holds In-House Training (IHT), or research methodology training, at the beginning of the school year, for both teachers and students. The Vice Principal for Curriculum stated: "These mentors also need to update their skills every year with special training on research methodology. So sometimes we bring in KIR resource persons." (Interview with Vice Principal for Curriculum, November 20, 2025). Flexibility is key to developing this program. The mentoring method is open through two channels: face-to-face (offline) and online, providing room for adaptation for students and teachers. The output of this program is not simply a pile of reports. The school has developed an incentive and appreciation system by selecting the best KIR reports for submission to tiered research

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competitions. The successful development of this program is documented in the school archives in the form of standardized student final products in the form of scientific reports. The school also implements knowledge management by requiring the submission of reports in both printed and soft files. The school library serves as a repository of knowledge. Archives from the past four years are neatly organized and soft files are stored on the library's computer drive, creating a continuous reference cycle for juniors. This was confirmed in an in-depth interview with the head librarian. "When they complete their KIR, they are required to submit two types of KIR reports.The files will be stored on the library's computer. The book-based ones will be collected according to the year of completion" (Interview with Head Librarian, November 20, 2025).

Governance and Obstacles

Although the strategy has been implemented, field findings also revealed obstacles that pose governance challenges. Psychological resistance emerged from some students and teachers who perceived this mandatory program as an additional burden. The dominant technical obstacles included time constraints due to the tight schedule of extracurricular activities, as well as a skills gap where the academic backgrounds of supervising teachers did not always align with the research topics of interest to students. Furthermore, developing basic scientific writing skills for tenth-grade students remains a challenge. Another important finding related to academic integrity is the lack of an integrated digital system for plagiarism detection (plagiarism checker) within the school. This represents a governance gap that needs to be mitigated to avoid duplication of report titles or content between classes, given the thousands of papers produced.

Recapitulation of Findings

In summary, the main findings of this study are presented in the following table:

Table 1.1 Summary of Strategy Implementation Findings

Strategic Management Elements	Key Findings
Creation of an effective organizational structure	The KIR team is formed by the principal under the supervision of the vice principal for curriculum affairs. The KIR team consists of teachers who serve as KIR mentors. The KIR team leader develops the KIR team work program. The KIR team leader coordinates and reports the progress of the KIR report to the principal and vice principal for curriculum affairs. Each mentor teacher mentors a maximum of 36 students from grades X, XI, and XII.
Determining procedures for KIR program	Socialization during the Grade X MPLS (Research Learning Outreach Program) IHT (research training) at the beginning of the school year. KIR program evaluation meeting at the end of the school year. Individual KIR mentoring process with KIR mentors according to the agreement between the students and the KIR mentor. Research title submission in the second semester of grade X, with the target completion of the KIR report before the final exam for grade XII.
Strategic Management Elements	Key Findings
Program development:	KIR Guidance Card as a control card for the mentoring process. Providing research methodology materials early during the Grade X MPLS. KIR mentoring is conducted systematically. Individual or group guidance as agreed Online or offline KIR guidance as agreed

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	The KIR process is recorded via the KIR guidance card or via a Google form, as agreed.
	Printed and soft-file KIR reports in the library serve as supporting references for the KIR program.
	The best KIR reports are selected to participate in research competitions.
	The KIR program is being developed as a platform for identifying high-quality emerging researchers.
	The KIR program receives full support from parents.
Governance (Obstacles)	Resistance from teachers and students who consider the mandatory KIR program a burden. Time constraints due to the busy schedules of supervising teachers and students. Differences in the academic background of supervising teachers and the type of research chosen by students. Limited facilities and infrastructure available to students to support the KIR program. Students' low research writing skills. There is no digital system within SMA Negeri 1 Rembang that serves as a data source to avoid similarities in the type and content of KIR reports.

Source: In depth interview on KIR implementation at SMA Negeri 1 Rembang

Table 1.2 Obstacles and Follow-Up Actions in the Implementation of the KIR Program at SMA Negeri 1 Rembang

No.	Obstacle	Follow-Up Action
1.	Resistance from teachers and students who consider the mandatory KIR program a burden.	Establish effective communication with supervising teachers and students to overcome resistance to the mandatory KIR policy.
2.	Time constraints due to the busy schedules of supervising teachers and students.	1. Establish effective communication with all relevant parties to overcome various obstacles that arise in the implementation of the mandatory KIR program. 2. Provide motivation to supervising teachers and students to be more enthusiastic in carrying out the KIR guidance process.
3.	Differences in the academic background of supervising teachers and the type of research chosen by students.	Conduct an IHT on research to upgrade the skills of supervising teachers.
4.	Limited facilities and infrastructure owned by students to support the KIR program.	Facilitate students who have difficulties with supporting facilities and infrastructure for the mandatory KIR program by providing accessible computer labs, printers, and paper.
5.	Students' low research writing skills.	Integrate research methodology materials into Coding and Artificial Intelligence (KKA) subjects starting in grade X.

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6.	SMA Negeri 1 Rembang does not yet have a digital system internally that serves as a data source to avoid similarities in the type and content of KIR reports.	Students' KIR reports, in soft file format, are collected on the library computer and organized into folders according to the year of submission.

Source: In depth interview on KIR implementation at SMA Negeri 1 Rembang

Discussion

This discussion examines research findings at SMA Negeri 1 Rembang within the theoretical framework of strategic management and educational literacy to construct a new understanding of the institutionalization of scientific inquiry in secondary schools.

Institutionalizing a Research Culture Through Structural Intervention

Research findings indicate that SMA Negeri 1 Rembang's success in mobilizing all students to conduct scientific research did not occur organically, but rather through intentional structural design. The formation of a Special Research Research Team (KIR) under the direct supervision of the Vice Principal for Curriculum marked a paradigm shift in literacy management. While KIR was previously often considered an optional student activity, SMA Negeri 1 Rembang brought it into the academic and mandatory curriculum. The formation of a "Special Research Research Team" directly under the supervision of the Vice Principal for Curriculum demonstrates that research literacy is no longer viewed as a peripheral activity (an optional extracurricular activity) but rather as the heart of the school's academic endeavors (a mandatory extracurricular activity). This strategic step aligns with the findings of Zaenuddin et al. (2025) emphasized that the implementation of effective strategic management by the principal can create a conducive school climate and orchestrate the extracurricular potential of all its students. By formalizing the KIR Team structure, the principal has carried out structured, top-down "cultural engineering."

In this case, the principal's leadership functions as a strategic architect, not only providing instruction but also building a system. This confirms Darling-Hammond's (2021) view that principals must transform from mere administrative managers to instructional leaders who actively shape a culture of literacy. By establishing a mentoring ratio (1:36) and involving almost all teachers as mentors, the school creates a "culture of academic collegiality" that encourages massive knowledge transfer. Furthermore, the established mentoring ratio (1:36) also demonstrates the school's efforts to maintain the quality of supervision services. This aligns with Sundari's (2021) conclusion, which found that the success of extracurricular activities is highly dependent on managerial competence in planning, supervising, and evaluating the program on an ongoing basis. Without a clear oversight structure, such mass programs are vulnerable to losing direction and quality.

Standardizing Inquiry: From Policy to Culture

The strength of the implementation strategy at SMA Negeri 1 Rembang lies in the strict procedures (SOPs) applied. The establishment of a research cycle from grades X to XII, with clear milestones (socialization, title submission, guidance, reporting), demonstrates disciplined execution. Wheelen et al. (2023) asserted that successful strategy implementation depends on the leader's ability to guide people to use their abilities through clear procedures. One interesting finding is the use of "KIR Guidance Cards" and the establishment of a rigid research cycle as a quality control tool. This policy emphasizes that "mandatory" does not mean simply eliminating obligations. These strict procedures serve as a forcing function to transform students' habits from passive readers to knowledge producers. The KIR Guidance Cards found in this study are not merely administrative tools, but rather quality assurance instruments that ensure that each student experiences the process of critical thinking, rather than simply copying reports (plagiarism).

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The policy of making KIR a graduation requirement serves as an effective forcing function to change behavior. This strategy confirms the importance of integrating literacy into formal school documents. Maimunah et al. (2023) elaborated in their study that the role of extracurricular activities in student development rests on how these programs are comprehensively integrated into school systems and policies. At SMA Negeri 1 Rembang, this policy was translated into technical SOPs that bind teachers and students. In organizational culture change theory, procedural coercion is often necessary in the initial stages to form habits (habit formation) before they eventually become internalized. This procedure ensures that literacy does not stop at the receptive level (reading) but advances to the productive level (writing and research), in accordance with Kusripinah and Subrata's (2022) comprehensive definition of literacy.

However, evaluating these procedures is also crucial. Nur et al. (2022) note that systematic talent and interest development management requires early identification of student potential to ensure programs are targeted and aligned with students' cognitive levels. The finding of "low student writing skills" at SMA Negeri 1 Rembang indicates the need for procedural evaluation at an early stage (grade X), perhaps by increasing the amount of scaffolding before students engage in independent writing.

Literacy Escalation: From "Receptive" to "Productive"

Program development through methodology training and the integration of research materials into informatics/KKA subjects demonstrates the school's efforts to bridge the competency gap between curriculum demands and students' initial abilities. This strategy directly addresses the need to master 21st-century skills (6Cs), particularly Critical Thinking and Creativity (Anggraeni et al., 2021: 38). By requiring research, students are encouraged to not only consume information (receptive literacy) but also produce knowledge (productive literacy).

The development of a research competition program marks a paradigm shift in literacy at this school. While Rohma and Hakim's (2025) study highlighted the success of extracurricular management merely in the realm of developing general interests and talents, SMA Negeri 1 Rembang has gone further toward massive productive literacy. As Arifudin (2022) emphasized, optimizing extracurricular activities is a crucial instrument in fostering students' fundamental character, where reasoning activities foster discipline and objectivity. This mandatory KIR program is essentially a massive implementation of Project-Based Learning that institutionalizes this reasoning process. The finding that this program is supported by a library that functions as a knowledge repository demonstrates efforts to build a sustainable School Literacy Ecosystem. This role aligns with the findings of Mustari et al. (2023) who emphasized that the introduction of optimal research-based extracurricular activities can accustom students to exploring problem-solving by utilizing resources in the surrounding environment. The digitization of student work becomes a valuable knowledge asset for the regeneration of young researchers at the school. At SMA Negeri 1 Rembang, the availability of student work archives is a first step toward knowledge management, despite still facing challenges in the plagiarism detection system. Students' success in entering research competitions is empirical evidence that mass-producing research doesn't have to sacrifice quality; in fact, a large number of participants creates a wider talent pool for attracting talented young researchers, as Wicaksono (2022) noted regarding the positive impact of KIR on logical thinking.

Navigating Challenges: Resistance and Academic Integrity in the AI Era

Although the strategy has been implemented, this study reveals complex realities in governance. The governance challenges identified, such as teacher resistance and time constraints, are common in change management. Mujahidin et al. (2023) noted that managing extracurricular activities requires principals to implement measurable actuating functions to overcome schedule synchronization and administrative burdens. The perception that KIR is a "burden" suggests the need for more persuasive communication strategies and a more attractive incentive system for supervising teachers. Teacher resistance due to workload and student complaints is a common occurrence in

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organizational change, as Sedarmayanti (2020) reminds us that implementing strategies requires sacrifice and discipline.

However, the biggest challenges identified were threats to academic integrity, particularly the unethical use of Artificial Intelligence (AI) and inter-generational plagiarism due to the lack of an integrated database system. These findings provide new insights that have not been widely discussed in previous research (such as Mahfudh & Imron, 2020 or Rahman, 2024). In the digital era, school literacy strategies can no longer focus solely on providing textbooks but must include strategies to mitigate the validity of work amidst easy access to technology. Principals need to develop governance (Zaenuddin et al., 2025) that emphasizes not only the final report product but also the validation of the inquiry process itself (e.g., through oral exams or progress presentations) to ensure that literacy competencies are truly formed within students, not fabricated by AI. Regarding the competency of research teachers, Hartina and Siahaan (2024) emphasize that the availability of qualified mentors is a key determinant of program success. Similarly, Farid et al. (2025) suggest the need for consistent internal coaching. Therefore, future teacher training must include material on AI detection and digital academic integrity to meet the challenges of the times.

CONCLUSION

This study concludes that the principal of SMA Negeri 1 Rembang's strategy in implementing the Compulsory Youth Scientific Work (KIR) program successfully institutionalized a culture of scientific inquiry and strengthened the school's literacy ecosystem. This success did not occur by chance, but rather resulted from a planned, strategic management orchestration across four dimensions: (1) Structure: Establishing a dedicated team that ensures authority and coordination across levels; (2) Procedure: Establishing strict SOPs and integrating KIR as a graduation requirement, which serves as a positive coercive force; (3) Program: Strengthening teacher and student capacity through training and optimizing the role of the library; and (4) Governance: Mitigating obstacles through persuasive communication and parental involvement. This study recommends the development of a digital plagiarism detection system and ethical guidelines for the use of AI as strategic next steps to maintain academic integrity in the future school literacy ecosystem. The research findings at SMAN 1 Rembang can be used as a pilot project for other schools in implementing the "Mandatory KIR" with some adjustments depend on the schools' situation.

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