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The role of education policy and crowdfunding in supporting the feasibility of primary schools in Indonesia

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Abstract
The feasibility of facilities and infrastructure in primary schools is a crucial indicator for evaluating the quality of education in Indonesia. This study aims to analyze the condition of school facilities and infrastructure, identify patterns of interregional disparities, and evaluate the potential of crowdfunding as an alternative funding mechanism. A quantitative approach employing K-means clustering was used to group primary schools based on their facility and infrastructure conditions. The data used were secondary data from the Ministry of Education, Culture, Research, and Technology's Open Data Portal, including information on educational units, student numbers, teacher qualifications, and classroom conditions. The analysis was conducted in two stages: Exploratory Data Analysis (EDA) and clustering, with evaluation using the silhouette score. The results indicate significant disparities in facilities across provinces, particularly in classroom conditions and teacher qualifications. The clustering results categorize schools into three groups based on facility and infrastructure conditions: low, medium, and high. The findings show that eastern Indonesia has the highest funding needs, suggesting that crowdfunding can serve as a strategic mechanism to support equitable improvement of primary education quality through cross-sector collaboration. This study provides practical contributions for the government, schools, and communities in designing more adaptive and sustainable education funding strategies.

Keywords
School Facilities, Primary Education, K-Means Clustering, Crowdfunding, Facility Disparities.

1 | INTRODUCTION

Education in Indonesia remains a government priority, serving as a strategic effort to prepare the nation's future generation. Quality education is not only an instrument for developing academic abilities but also a means of fostering critical thinking skills and preparing individuals to navigate social dynamics. This aligns with the views of, who emphasize that education shapes individuals who are intellectually, emotionally, and socially mature. At the primary school level, educational quality plays a significant role, as it lays the foundation for the development of cognitive abilities, character, and students' basic understanding across various fields of knowledge (Alannasir, 2020). Subsequent paragraphs, however, are indented. Nevertheless, significant disparities in educational facilities and infrastructure continue to challenge the achievement of equitable primary education across Indonesian regions.

The quality of primary education is influenced by multiple interconnected factors, including the availability of adequate facilities and infrastructure, the competence of teachers, the accessibility of learning resources, and the creation of a supportive learning environment that promotes students' holistic development. While physical infrastructure alone cannot guarantee educational quality, inadequate facilities often hinder teaching and learning processes, reduce student engagement, and exacerbate educational disparities among schools. In Indonesia, limited educational funding continues to represent a major challenge, particularly in rural, remote, and economically disadvantaged regions where schools frequently face shortages of classrooms, libraries, laboratories, sanitation facilities, digital learning equipment, and other essential educational resources. Such deficiencies not only affect students' learning experiences but also limit schools' capacity to implement innovative and inclusive educational practices. Although government support through the State Budget (APBN) and the School Operational Assistance (BOS) program has played an important role in financing basic education, these mechanisms are often insufficient to address the growing and diverse needs of schools across different regions (Sarbini et al., 2025). This situation highlights the urgency for the government and society to introduce alternative funding mechanisms that are more adaptive and responsive to the real needs of educational institutions.

In recent years, crowdfunding has emerged as an alternative funding mechanism increasingly considered within the education sector, particularly in addressing financial limitations faced by schools and educational institutions. Research shows that collaboration between the Sukabumi City Education Office and private stakeholders through crowdfunding has enabled the procurement of school equipment, improvement of educational facilities, and the provision of scholarships for high-achieving but economically disadvantaged students (Egalite et al., 2017). Furthermore, crowdfunding offers a participatory approach that allows communities, businesses, and civil society organizations to contribute directly to educational development initiatives. Scholars emphasize that crowdfunding can enhance public participation and social awareness of the need for adequate education while ensuring transparency and accountability in the use of funds. Through the GESITIN Yuk program, evidence demonstrates that online campaign activities and structured donation initiatives can help reduce disparities in facilities among primary schools, particularly in underserved areas, while fostering a culture of collective responsibility for improving educational quality and access (Ahmad et al., 2023).

Despite its potential, existing crowdfunding initiatives in education often lack an objective and systematic basis for determining funding priorities. Most educational crowdfunding programs allocate resources without comprehensive assessments of school feasibility conditions or empirical identification of schools with the greatest needs. Consequently, funding distribution may be inefficient and less effective in reducing educational inequalities. Previous studies examining school infrastructure disparities have primarily relied on descriptive analyses and evaluation approaches that identify problems but rarely provide data-driven financing solutions (Abdusyakur & Poortman, 2019). At the same time, crowdfunding research has largely focused on entrepreneurship, business development, and micro-enterprise financing, with limited attention to its strategic application in addressing educational infrastructure inequalities. This gap highlights the need for a framework capable of linking objective school conditions with targeted funding mechanisms.

Although previous studies have extensively examined disparities in primary school infrastructure and highlighted the limitations of formal government funding, most have relied on descriptive analyses or conventional evaluation methods without proposing actionable and evidence-based financing solutions. Moreover, existing research has largely treated crowdfunding as a general fundraising mechanism rather than integrating it into a strategic framework for educational development. The novelty of this study lies in its integrated approach, which combines quantitative data mapping through K-Means clustering with the strategic implementation of crowdfunding mechanisms within a collaborative governance framework. By categorizing schools based on objective indicators of facility and infrastructure feasibility, this study provides a more systematic basis for prioritizing funding allocation. While crowdfunding has been widely explored in economic development, entrepreneurship, and MSME contexts, its application as a targeted financing strategy based on empirical school feasibility clusters remains largely unexplored. Consequently, this research addresses an important gap in the literature by offering a data-driven blueprint for mobilizing public and private resources to reduce inequalities in basic education and promote more equitable educational outcomes (Westover, 2025).

Specifically, this study offers three main contributions. First, it develops an empirical school feasibility classification model using K-Means clustering to identify priority groups for educational funding. Second, it proposes a data-driven crowdfunding allocation framework that aligns alternative financing mechanisms with objective indicators of school needs. Third, it extends the collaborative governance literature by demonstrating how governments, communities, and private stakeholders can collectively mobilize resources to address inequalities in primary education. Accordingly, this study aims to analyze the feasibility of primary school facilities and infrastructure, identify patterns of disparity among school clusters, and evaluate the potential of crowdfunding as a complementary funding mechanism for schools with the greatest needs. The findings are expected to provide theoretical insights and practical recommendations for developing more equitable and sustainable educational financing strategies in Indonesia.

2 | LITERATURE REVIEW

2.1 | Policy Implementation

Policy implementation represents one of the most critical stages in the public policy process because the success or failure of a policy is ultimately determined by how effectively it is translated into practice. While policy formulation establishes goals and intended outcomes, implementation determines whether those objectives can be achieved under real-world conditions. According to Mazmanian and Sabatier, effective policy implementation depends on several factors, including the clarity of policy objectives, the adequacy of financial and organizational resources, the commitment and capacity of implementing agencies, and the broader socioeconomic and political environment in which implementation occurs. Similarly, contemporary policy scholars argue that implementation is not a linear administrative activity but rather a dynamic process involving interactions among multiple actors, institutions, and levels of government (Capano & Elias de Oliveira, 2026). As policies move from central authorities to local implementers, variations in institutional capacity and resource availability often create gaps between policy intentions and actual outcomes.

The implementation perspective is particularly relevant in the education sector, where policies frequently require coordination across different administrative levels and stakeholders. Educational policies often involve national governments, local authorities, school administrators, teachers, communities, and private actors, each of whom possesses different interests, capacities, and responsibilities. Consequently, the effectiveness of educational programs depends not only on policy design but also on the ability of implementing institutions to adapt policies to local conditions. In many developing countries, implementation challenges frequently arise from limited financial resources, bureaucratic complexity, weak monitoring mechanisms, and uneven institutional capacity across regions.

These challenges often result in disparities in educational service delivery despite the existence of national policies intended to promote equity and accessibility.

Within the Indonesian context, the implementation of primary education financing policies illustrates these challenges clearly. The government has introduced several funding mechanisms, including the School Operational Assistance (BOS) program and the Special Allocation Fund (DAK Fisik), to support school operations and infrastructure development. These programs have contributed significantly to improving educational access and supporting basic school needs. However, the outcomes of these policies vary considerably across regions due to differences in fiscal capacity, geographical conditions, administrative effectiveness, and local governance quality (Ainscow, 2020). Schools located in remote, underdeveloped, and economically disadvantaged areas often continue to experience shortages of classrooms, learning facilities, sanitation infrastructure, and educational technology despite the availability of formal funding mechanisms. In many cases, bureaucratic procedures and budget allocation regulations limit the flexibility of schools and local governments to address urgent infrastructure needs.

These implementation constraints reveal an important limitation of centralized educational financing systems. While formal funding mechanisms are essential for ensuring baseline educational provision, they may be insufficient to respond quickly and effectively to diverse local challenges. The existence of administrative bottlenecks, competing budget priorities, and fiscal limitations can reduce the responsiveness of public financing programs, particularly in areas with severe infrastructural deficits (Nir, 2020). As a result, schools with the greatest needs do not always receive adequate support at the appropriate time, thereby perpetuating educational inequalities.

Understanding these implementation limitations provides an important theoretical foundation for this study. From a policy implementation perspective, alternative financing mechanisms can be viewed as complementary instruments that help address gaps left by formal government programs. This study argues that when centralized funding systems encounter bureaucratic and fiscal constraints, more adaptive and participatory approaches become necessary. Crowdfunding represents one such approach because it enables communities, private organizations, philanthropic actors, and other stakeholders to mobilize resources directly in response to local educational needs. By complementing existing government programs, crowdfunding has the potential to enhance policy outcomes and support more equitable educational development. Therefore, policy implementation theory not only helps explain the persistence of infrastructure disparities in Indonesian primary schools but also provides a rationale for exploring innovative financing mechanisms capable of strengthening educational policy effectiveness and reducing inequalities in school infrastructure provision.

2.2 | Collaborative Governance

Collaborative governance has emerged as an important framework for addressing complex public problems that cannot be effectively resolved through conventional government action alone. Collaboration is only effective when built upon structured dialogue, transparency, mutual trust, and a shared commitment to common goals According to Ansell & Gash, (2018), effective collaboration is built upon inclusive participation, transparent communication, mutual trust, shared understanding, and a commitment to common goals. This approach recognizes that many public challenges require the collective involvement of government and non-government actors whose resources, expertise, and capacities are distributed across multiple sectors. Consequently, collaborative governance shifts the paradigm from traditional state-centric administration toward a network-based model in which public value is co-created through partnerships among government agencies, private organizations, civil society groups, and local communities. Through such collaborative arrangements, stakeholders can mobilize complementary resources, share responsibilities, and develop more innovative and sustainable solutions to public issues.

In Indonesian basic education, collaborative practices have traditionally manifested through school committees (*Komite Sekolah*) and community self-help organizations (*Gotong Royong*) (Carstensen et al., 2021). However, the impact of these local collaborations is often constrained by the socio-economic limitations of the

immediate surrounding community. Schools located in economically disadvantaged regions face a double burden: they receive inadequate formal state funding and lack a wealthy local community base to compensate for those deficits.

To overcome these localized constraints, this study expands the collaborative governance framework by examining how public participation can be digitally scaled through web-based platforms. By integrating digital networks into the governance model, cross-regional resource mobilization becomes possible, enabling individuals from affluent regions to support underprivileged schools across the archipelago (Rufini et al., 2025). This digital expansion redefines the boundaries of collaborative governance, transforming it from a local community effort into a nationwide civic network.

Furthermore, this multi-stakeholder dynamic requires a clear regulatory bridge to ensure institutional compliance. The interaction between government education boards and civil society in digital spaces demands a high degree of transparency. When collaborative governance is digitized, it does not diminish the state's role; rather, it creates a hybrid public sphere where accountability is co-managed by both public officials and citizens.

2.3 | Crowdfunding Theory

Crowdsourcing and crowdfunding, according to Brabham, as well as Surowiecki's concept of "wisdom of the crowd," explain that collective public contributions can be practical when there are clear, transparent, and verifiable participation mechanisms. The review emphasizes that the effectiveness of crowdsourcing depends on the presentation of detailed needs and on the diversity of public perspectives, which support more rational decision-making (Sinxadi, 2020). In the context of basic education, this concept is relevant because crowdfunding enables the community to support schools by documenting needs, crafting strong narratives, and ensuring transparency in the use of funds. Thus, this mechanism can complement government funding, especially for schools that have not yet reached the standard of infrastructure feasibility.

To understand why individuals choose to participate in such digital funding initiatives, Ajzen's *Theory of Planned Behavior* (TPB) suggests that an individual's intention to contribute to a civic cause is driven by their attitude toward the behavior, subjective norms, and perceived behavioral control (Shahzalal & Adnan, 2022). In primary education, crowdfunding platforms enable vulnerable schools to secure funding by documenting their physical infrastructure deficits, crafting transparent campaign narratives, and providing public accountability for every unit of donation received. This mechanism does not aim to replace the state's constitutional obligations, but strategically complements government budgets for schools failing to reach national infrastructure feasibility standards.

2.4 | Previous research

Extensive research on Indonesian elementary school infrastructure confirms persistent deficits across various regions. Demonstrate that many primary schools lack adequate classrooms and sanitation facilities, with significant disparities existing between urban and rural or remote regions (Ngwenya et al., 2018). Regarding formal funding, find that BOS allocations are heavily consumed by routine operational costs, leaving long-term infrastructure development largely underfunded (Anago, 2024).

Furthermore, schools with lower accreditation ratings generally suffer from the worst infrastructure and lowest managerial capacity to plan or maintain physical facilities. Previous studies literature highlight that low-accredited schools often fall into a vicious cycle where poor facilities prevent them from achieving higher accreditation (Parmar & Murari, 2025). This dynamic reduces their likelihood of receiving competitive government infrastructure grants, which typically reward schools with better administrative readiness.

In terms of regional categorization, utilized cluster analysis to profile the deep inequality of water, sanitation, and hygiene facilities across Indonesian provinces (Unggul et al., 2023). Their findings underscore that the eastern regions of Indonesia consistently lag behind Western Java and Sumatra, demanding a targeted resource allocation

strategy. Similarly, point out that big data integration is becoming vital to mapping educational deficits objectively, though its application in financing frameworks is still minimal. Regarding communication and platform mechanics, explored how online crowdfunding platforms manage communication to build donor retention (Xiao & Yue, 2021). Effective digital campaigns rely on structured narratives, visual evidence, and continuous feedback loops to maintain public trust. However, most public infrastructure campaigns on these platforms are sporadic and lack a systemic tie-in with national educational databases.

While these studies thoroughly map infrastructure deficiencies, resource management problems, and formal budget constraints, a significant literature gap remains. Existing research focuses almost exclusively on evaluating formal state funding (BOS/DAK) or general online platform communication without examining innovative, digitally-driven public financing models that target objective data clusters. This study addresses this exact gap by integrating education policy implementation, data-driven school clustering, and crowdfunding within a collaborative governance framework to foster sustainable and equitable basic education infrastructure (Marques Queiroga et al., 2024).

3 | METHODS

This study establishes a structured quantitative framework utilizing an unsupervised machine learning paradigm to analyze structural disparities in basic educational infrastructure across Indonesia (Misbahuddin & Basir, 2026). By combining spatial statistical profiling with advanced partitioning algorithms, this empirical approach systematically categorizes regional inequalities to evaluate the targeted viability of alternative financing models. The research design is operationalized through a secondary macro-dataset harvested from the Open Data Portal of the Ministry of Education, Culture, Research, and Technology of the Republic of Indonesia for the 2023/2024 academic year. The empirical analysis is executed sequentially through two primary operational stages: Exploratory Data Analysis (EDA) and K-Means Clustering (Pessanha et al., 2018).

3.1 | Data Source and Variable Operationalization

The empirical foundation of this study relies on secondary macro-data aggregated at the provincial level, capturing nationwide spatial variations across 34 administrative regions. This study employs four key indicators to assess regional educational conditions. The first variable, Educational Units (X_1), refers to the total number of active public and private primary schools within a given region. The second variable, Student Density (X_2), represents the cumulative number of enrolled students and serves as an indicator of regional demand for educational services and institutional capacity. The third variable, Teacher Qualifications (X_3), measures the total number of teachers who possess formal national certification credentials, reflecting the professional quality of the educational workforce. Finally, Classroom Conditions (X_4) are assessed using the ratio of damaged classrooms—ranging from minor to severe levels of deterioration—to fully functional educational facilities, thereby indicating the adequacy and quality of educational infrastructure.

3.2 | Data Preprocessing and Standardization

Prior to executing the clustering mechanism, a rigorous Exploratory Data Analysis (EDA) and preprocessing pipeline were executed within the Python software ecosystem, utilizing the Pandas and Seaborn libraries. This phase was critical to diagnosing the underlying distribution, checking for mathematical anomalies, and handling missing data points or duplicate entries across the provincial observations (Yang et al., 2025).

Furthermore, because absolute numbers of students significantly dwarf percentage-based classroom ratios, executing the algorithm directly would skew distance vectors toward high-magnitude variables (Qasim & Lu, 2026). To establish mathematical equilibrium and eliminate scale bias, the features were transformed using Z-score normalization to a uniform scale with a mean (μ) of 0 and a standard deviation (σ) of 1, modeled as:

$$z = \frac{x - \mu}{\sigma}$$

Where x represents the baseline regional observation value, while μ and σ denote the respective feature-specific mean and standard deviation computed across the entire national dataset.

$$\boldsymbol{X} = \{\boldsymbol{x_1}, \boldsymbol{x_2}, \dots, \boldsymbol{x_n}\}$$

3.3 | Data Analysis and Algorithmic Clustering

The processed and standardized dataset was subsequently subjected to the iterative K-means clustering algorithm to partition the 34 provinces into homogeneous groups based on their institutional and infrastructural capacities (Nater Drvenkar & Unukić, 2025). Given a set of provincial data vectors $X = \{x_1, x_2, \dots, x_n\}$, the algorithm maps observations into κ distinct, non-overlapping clusters $S = \{S_1, S_2, \dots, S_k\}$ by minimizing the Within-Cluster Sum of Squares (WCSS):

$$J = \sum_{j=1}^{k} \sum_{i \in S_j} | \quad |x_i - c_j| \quad |^2$$

To ensure mathematical validity, the optimal number of clusters (k) was determined using the Elbow Method. The structural cohesion and separation boundaries of the resulting groups were further validated via individual silhouette scores (S_i), expressed as:

$$s(i) = \frac{b(i) - a(i)}{\max(a(i), b(i))}$$

Ultimately, this analytical synthesis serves as the empirical foundation to map educational inequalities and justify targeted crowdfunding interventions.

4 | RESULTS AND DISCUSSION

4.1 | Condition of Primary School Facilities and Infrastructure in Indonesia

The condition of primary school facilities and infrastructure reflects the quality of education services at the most basic level. The data analyzed show disparities in facilities across provinces, especially in classrooms. Suitable classrooms are not yet prevalent in many regions, while classrooms with minor to severe damage remain high. This finding aligns with research indicating that the unsuitability of learning spaces directly affects learning effectiveness and comfort (Aga, 2024).

Imbalances are also seen in the qualifications of teaching staff. The proportion of teachers and principals with less than a bachelor's degree remains relatively high in many provinces, indicating that improvements in educators' capacity have not been evenly distributed. This condition aligns with a study that found that learning quality improves when teachers have high competence and qualifications. A similar pattern emerges among educational personnel, some of whom still have a secondary education, resulting in suboptimal administrative management (Caena & Redecker, 2019).

Interprovincial variations reveal an uneven map of infrastructure suitability. West Java emerges as the province with relatively better conditions, characterized by more suitable classrooms, higher levels of teacher qualification, and more adequate educational personnel. This situation aligns with findings that regions with strong fiscal capacity tend to have more adequate educational facilities (RICCIUTI et al., 2019). Meanwhile, other regions with a predominance of damaged classrooms and low-qualified teaching staff show weaker eligibility. A national study on school facilities also reveals disparities in basic facilities, such as sanitation, underscoring that the burden of adequacy falls not only on classrooms but also on uneven supporting infrastructure.

In conclusion, the state of elementary school infrastructure in Indonesia remains uneven across physical infrastructure, human resources, and administrative support. These three components form the foundation of educational suitability and provide an important basis for conducting mapping using clustering analysis.

4.2 | Characteristics of Clustering Results

K-means clustering was used to assess the feasibility of elementary schools based on variables including the number of schools, the number of students, teacher qualifications, educational staff, and classroom conditions. The number of clusters was determined using the Elbow method, which indicated an elbow at k=3; thus, three clusters were selected as the most stable clustering structure. The silhouette score at k=3 of 0.687 further supported this choice, indicating good cluster separation (Fig. 1). This data-based modeling is important for understanding the variation in educational facilities and infrastructure, which significantly affects student learning outcomes. These findings align with research showing that the quality of school facilities and infrastructure strongly influences learning outcomes at the elementary level (Istakri et al., 2024).

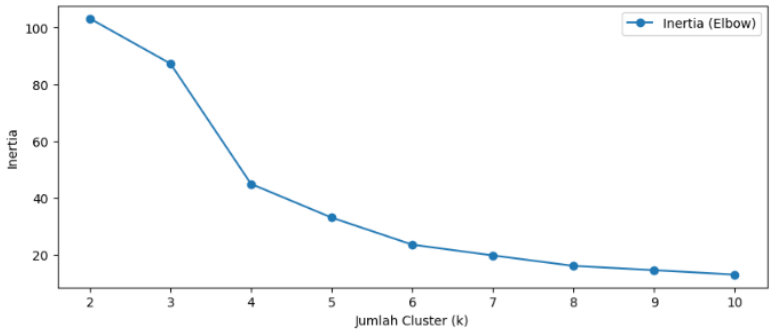

Fig. 1. Elbow Method Score Results

Model validation was performed using silhouette tests to ensure cluster separation quality. Although k=2 yielded the highest value, the two-group structure did not fully capture the diversity of infrastructure conditions. The model with three clusters showed apparent differences among schools with minimal, adequate, and very adequate facilities. This understanding is important because school facilities are strong indicators of learning quality in elementary schools, particularly the availability of learning spaces and the completeness of supporting facilities (Hassanain et al., 2022).

Table 1. Silhouette Score Results

Jumlah Cluster	Silhouette Score
K=2	0.749
K=3	0.687
K=4	0.439
K=5	0.327
K=6	0.334
K=7	0.305
K=8	0.300
K=9	0.271
K=10	0.236

The results of the grouping show three characteristics of basic education feasibility. The first group describes areas with poor infrastructure, characterized by a small number of classrooms and many with minor to severe damage (Table 1). This situation reflects the limitations of basic education services, as many schools lack the minimum facilities necessary for effective learning. Studies on the availability of basic educational facilities indicate that this gap persists across regions and affects the quality of school services.

The second group is at a medium level of feasibility. Schools in this group already have most basic facilities, but still face moderate-scale infrastructure damage. This "sufficiently adequate but not yet stable" condition describes schools in a transitional stage, where facility maintenance is often neglected due to budget constraints. Research on the quality of classroom facilities found that schools in this condition require priority rehabilitation support to maintain the quality of the learning process (Mohamed et al., 2022).

The third group shows the most ideal conditions. Classrooms are well maintained, physical damage is low, and the number of qualified educators is higher than in the other two clusters. Schools in this group have the infrastructure capacity to support an optimal learning environment, enabling the implementation of more innovative and consistent learning strategies. A study in Nabire Regency shows that adequate infrastructure provision directly improves the quality of learning and the stability of elementary school services (Jenny Pally et al., 2025).

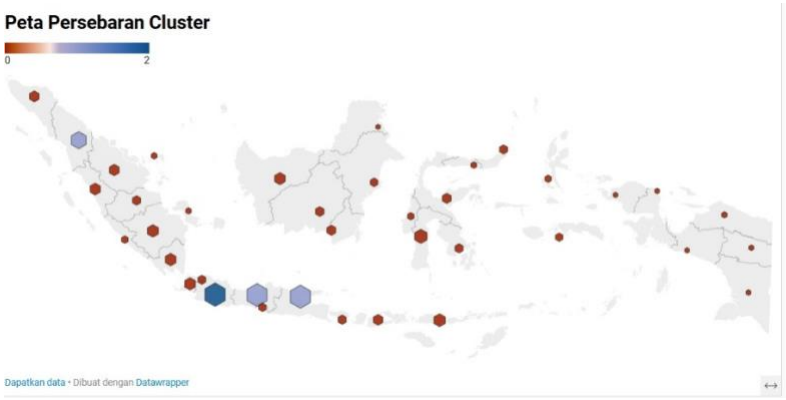

Fig. 2. Map of Cluster Distribution in Each Province

The clustering findings showing schools with low and medium eligibility become even stronger when compared to the national context. A study of 34 provinces found that disparities in educational infrastructure and funding are more pronounced in the eastern region than in most western provinces (Nikolai et al., 2022). Similar disparities are observed between schools in urban and rural areas, with rural facilities and access to learning consistently falling short of standards set by large-city educational services (Fig. 2). Official data from the Ministry of Education and Culture further reinforce these findings, showing that most elementary schools in Indonesia still do not adequately meet basic infrastructure needs despite receiving regular operational funding allocations. This situation indicates that the regular funding scheme has not fully addressed the need for improvement in disadvantaged areas, making schools in low- and middle-income clusters the most eligible candidates for support through alternative mechanisms, such as crowdfunding, to accelerate infrastructure delivery and improve educational service quality.

4.3 | Crowdfunding as an Alternative for Basic Education Funding

Based on the clustering analysis results, the first group is dominated by eastern provinces with relatively low levels of education. These results indicate that the government should prioritize allocating additional funds to these regions. Although times have changed rapidly, basic education in Indonesia remains a significant challenge, particularly in rural and remote areas. This deficiency can be attributed to several key issues, such as the imbalance between the number of students and the availability of quality schools, the scarcity of facilities and funds, the high cost of education, the imbalance between the number of teachers and the relatively large number of subjects, and the ineffectiveness of the education system (Bold et al., 2017).

Funding for children's education comes from various sources, including the government, foundations, parents, and other stakeholders. In this context, the crowdfunding scheme has the potential to provide substantial

aid because it involves multiple sectors and can attract an unlimited number of donors. Crowdfunding is a means of collecting money online from people without any personal contact (Macht & Chapman, 2019). Digital transformation has created unexpected opportunities to develop a more appropriate infrastructure through this scheme.

Crowdfunding is classified into four types: donation-based, reward-based, loan-based, and equity-based. In previous policies, crowdfunding was widely used as an economic driver through MSME financing. The Financial Services Authority (OJK) has supported this solution by accelerating and expanding access to capital markets through Securities Crowdfunding (SCF) products (Sudarwanto et al., 2025). In 2021, OJK reported that SCF had raised Rp. 41.19 billion, while from the beginning of 2022 to June 3, 2022, the funds reached Rp. 507.2 billion, representing a rapid economic growth of 22.75% year to date. Crowdfunding emerged as a response to difficulties in accessing funding. The current digitalization of the financial system is rapidly supporting the successful development of infrastructure. Fintech solutions, as a new source of funding, can serve as an indicator of the expansion of unlimited sources of funds.

Indonesia, an archipelagic country with vast territory and the fourth-largest population in the world, requires substantial budget allocations across various public policy sectors. The Ministry of Finance's Directorate General of Budget reported that the implementation of last year's state budget encountered various challenges during the economic recovery from the pandemic. The qualifications for the 2026 Draft State Budget are concerning because the education budget allocated to MBG is 28.99% higher than the allocation for teacher welfare (Hunt et al., 2026). This certainly raises public concerns about the quality and quantity of education in Indonesia. Although the MBG program is a government flagship program, the BOS funds should not be cut. In addition, other studies show that more than 50% of elementary school principals in rural areas lack a basic understanding of financial management, resulting in poorly organized financial reporting.

In this complex issue, the use of crowdfunding should not be viewed merely as an alternative, but rather as a strategic opportunity for the public and private sectors to participate in strengthening the foundations of basic education and equalizing the quality of education throughout Indonesia. Fundamental rights, such as education, must be fulfilled with an attitude and commitment to move forward together, a commitment to nation-building, and a commitment to supporting equitable development, all of which are essential to preparing the nation to compete and excel relative to other nations (Kehinde, 2023).

These donations will benefit the provision of high-quality facilities, such as schools with libraries, a pleasant environment, qualified teachers or educators in their respective fields, and adequate classroom conditions to ensure comfort. Therefore, the government must ensure consistency in conducting evaluations to regularly assess the effectiveness and impact of educational quality in Indonesia. In addition, all parties involved are accountable for ensuring that collected donations are distributed appropriately and improving the quality of education in Indonesia.

4.4 | Opportunities for Collaboration between the Government and the Public and Private Sectors

Crowdfunding offers a valuable opportunity for the government to collaborate tangibly, enabling the public and private sectors to contribute to meeting the needs of elementary schools in Indonesia. The persistent year-to-year disparities in Indonesia mean that some students study under uncomfortable conditions due to inadequate facilities and infrastructure.

The involvement of various parties is crucial to closing this gap. Crowdfunding can facilitate cooperation with donors willing to contribute to children's development by providing adequate learning facilities. Crowdfunding, a process that relies on trust between parties and significantly affects the transparency and accountability of education funds, is among the policy solutions the government is considering to raise additional funds for the education sector (Hoque et al., 2023).

This collaboration facilitates the development of crowdfunding integration to support the education budget. The Ministry of Education remains obligated to provide full funding for education. However, in this case, the

government plays a role in validating needs, facilitating collaboration media, regulating funding transparency, and conducting crowdfunding campaigns or socializing to the public.

The digital era can make everything easier, including fundraising without any geographical boundaries. This indicates that the activity can be conducted efficiently through online communities, applications, websites, and social media platforms. One example is Wakaf Kita.net, an initiative that raises community funds to donate waqf assets, such as money or other items. This mechanism is proposed as a financing effort that is included in it. Based on its use, this waqf is divided into two, namely: 1). productive waqf; given directly in accordance with its purpose, and 2) Direct waqf; waqf in the form of basic goods for benefits that can be felt directly, such as school buildings for teaching and learning activities. This has been implemented and utilized by the ATS Tsaqofah Foundation as a medium for managing endowment funds from the general public. This phenomenon provides evidence that crowdfunding has significant potential as an alternative means of supplementing the costs of required education.

Other platforms used include Kitabisa.com, which covers projects ready for funding, such as bridge construction, clean-water facilities, floating-hospital construction, and repairs to damaged schools. Based on the funds raised, a total of Rp. 788,427,939 was successfully allocated, representing 32.25% of the fundraising target.

The involvement of the private sector in this case also enhances cooperation with the government. From the private sector's perspective, crowdfunding is an easier way to participate than submitting formal CSR programs. Companies can provide donations in the form of money, goods, or school facilities directly to schools with low eligibility levels, based on well-organized data.

Opportunities for collaboration between the government and the public and private sectors will proliferate for several reasons, such as the development of digital technology for fund mobilization, the availability of statistical tools that facilitate more targeted data management, a high level of transparency, and an intersectoral approach that can fill budget gaps without reducing the state's responsibilities. This collaboration is not merely a formality but a means of advancing our commitment to the equitable distribution of quality basic education in Indonesia.

To maximize the effectiveness of this collaborative model, a robust governance framework is required to ensure that crowdfunding initiatives are implemented transparently, accountably, and equitably. The government should establish clear mechanisms for project selection, fund allocation, monitoring, and evaluation based on verified educational data. Integrating crowdfunding platforms with national education information systems would enable stakeholders to identify priority areas more accurately, reduce the risk of overlapping interventions, and ensure that resources are directed toward schools with the greatest needs.

Moreover, the sustainability of collaboration between the government, the public, and the private sector depends on the development of mutual trust and shared responsibility. Regular disclosure of funding outcomes, independent auditing processes, and accessible reporting systems are essential to maintaining public confidence and encouraging long-term participation. In this context, digital technologies can facilitate real-time monitoring of projects and provide donors with transparent information regarding the utilization and impact of their contributions.

Ultimately, crowdfunding should be viewed as a complementary financing mechanism rather than a substitute for the government's constitutional obligation to provide equitable access to quality education. By combining public resources with community participation and private-sector engagement, crowdfunding can strengthen social solidarity and expand opportunities for improving educational infrastructure in underserved areas. Through effective governance and data-driven decision-making, this collaborative approach has the potential to contribute significantly to reducing educational disparities and advancing inclusive and sustainable basic education development in Indonesia.

4.5 | The Direction of Education Budget Policy Through Crowdfunding Schemes

Education budget policy plays an important role here because it informs strategic decisions by the government and educational institutions aimed at expanding learning opportunities and improving the quality of national education. This includes curriculum development, improving teaching methods, increasing educator competence, providing facilities and infrastructure, and implementing a continuous monitoring and evaluation system. In general, education financing is categorized into two major categories: education grants and education loans, which can be provided by government, non-governmental, and public-private entities. For example, private non-bank financing in the form of grant loans and community financing through ZISWaf grants, distributed through institutions such as the Djarum Foundation, Tanoto Foundation, Sampoerna Foundation, Baznas, Lazismu, and other foundations.

Given the many limitations and uneven distribution of the budget, the government needs to analyze budget policies and evaluate alternative solutions, such as crowdfunding, to ensure a clear policy direction. For example, the government can ensure and begin to strengthen cooperation by establishing a multi-stakeholder ministry (PPP Education) that covers the following three areas: First, co-governance refers to the shared understanding among participating stakeholders regarding decision-making processes, including the distribution of roles, responsibilities, and authority. Second, value co-creation emphasizes the active involvement of all parties in generating both economic and social value through collective action and mutual engagement. Third, pooling of resources involves the integration of financial, intellectual, and material assets contributed by various stakeholders to advance common goals and support shared interests.

In addition, the government must strengthen its policies by establishing transparency standards and periodic evaluations. The creation of a crowdfunding platform is specifically for education budgets that have been approved and are directly supervised by the Financial Services Authority (OJK). This crowdfunding control is analogous primarily to e-budgeting. This facilitates the government's analysis of education data and the submission of robust reports. Digital data collection, or e-budgeting, can expand analytical capabilities through OLAP, interactive dashboards, trend visualization, and role-based reporting, while ensuring security and audit trails for all activities.

To ensure that education funds are allocated to their intended purposes, the government must be transparent about data and information on the extent of basic education in Indonesia, without manipulation. The application of big data in the education system enhances evaluation outcomes through in-depth, more predictive analyses. Crowdfunding must be based on valid data to avoid creating fundamental gaps and overlapping government budgets.

The final step to ensure the success of this crowdfunding initiative is to ensure that the public understands how the system works, namely, through campaigns or education. This can be achieved easily through social media, which is considered more effective for disseminating relevant information. The campaign design must be as attractive as possible to gain public trust and achieve success.

However, the successful implementation of education crowdfunding requires a comprehensive regulatory framework that clearly defines institutional responsibilities, funding mechanisms, accountability standards, and stakeholder participation. In this regard, the government should establish clear guidelines regarding project eligibility, fundraising limits, reporting procedures, and monitoring systems to minimize the risks of fund misallocation, fraud, and duplication of financing (Lagazio & Querci, 2018). The integration of crowdfunding platforms with national education databases and existing e-budgeting systems would enable policymakers to identify priority areas more accurately, allocate resources more efficiently, and ensure that external funding complements rather than substitutes public expenditure commitments.

Furthermore, the adoption of crowdfunding schemes should be viewed as a complementary financing mechanism rather than an alternative to the government's constitutional responsibility to provide equitable access to quality education. Crowdfunding has the potential to strengthen community participation, promote social

solidarity, and mobilize additional resources for underserved regions and vulnerable populations. Nevertheless, without strong governance, transparent data management, and inclusive participation, crowdfunding initiatives may inadvertently reinforce existing educational inequalities by concentrating resources in areas with greater digital access and fundraising capacity. Therefore, a balanced policy approach that combines public funding, private sector engagement, and community participation is essential to ensure that education crowdfunding contributes to sustainable, inclusive, and equitable educational development in Indonesia.

5 | CONCLUSION

Based on the empirical findings and computational analysis, this study concludes that primary school facilities and infrastructure in Indonesia exhibit critical disparities, with a substantial portion of institutions remaining below national feasibility standards. The execution of the K-means clustering algorithm successfully unmasked deep spatial imbalances, highlighting a severe divide between the highly vulnerable educational ecosystems in the eastern provinces and the relatively well-equipped regions in western Indonesia. These structural deficits underscore the inherent limitations of top-down fiscal mechanisms such as the School Operational Assistance (BOS) and Special Allocation Funds (DAK Fisik) which currently struggle to keep pace with localized infrastructure degradation, thereby indirectly exacerbating educational attrition and dropping-out rates due to suboptimal learning environments.

To mitigate these structural funding gaps, this research establishes a strong conceptual and data-backed justification for integrating alternative, bottom-up financing frameworks, specifically web-based educational crowdfunding. Operating within a collaborative governance paradigm, this digital mechanism offers a viable blueprint to mobilize cross-sectoral resources from the general public, philanthropic organizations, and private sectors to target high-priority clusters objectively. However, despite its high strategic potential to foster educational equity and bypass localized economic constraints, the practical deployment of structured crowdfunding within the national public education framework remains largely unutilized and constrained by administrative rigidities.

Consequently, several strategic pathways are recommended for future research and policy development to operationalize these findings. Future academic inquiries should move toward empirical field-testing and direct-action research at a localized site within the high-priority critical cluster to observe the real-world dynamics, regulatory compliance, and public adoption of a pilot crowdfunding campaign. Additionally, subsequent studies should conduct rigorous comparative budgetary simulations that model the institutional interactions, fiscal transparency, and long-term sustainability of hybrid public-private financing frameworks relative to traditional state-centric educational allocations.

Disclosure Statement

The authors confirm that they have no conflicts of interest that could influence the research, writing, or publication of this article.

Data Availability Statement

The data used in this study came from secondary data obtained through the Ministry of Education, Culture, Research, and Technology's Open Data Portal, specifically related to the condition of elementary school facilities and infrastructure in Indonesia. The dataset includes information on educational units, the number of students, the qualifications of teaching and educational staff, and the condition of classrooms. All data is public and freely accessible through the Ministry of Education, Culture, Research, and Technology's official platform.

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