Reconstructing Character Education in Elementary Schools through Digital Reflective Applications: Integrating Values, School Culture, and Social-Emotional Intelligence in the SEL Approach

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***Abstract*—This study aims to reconstruct a character education model in elementary schools through the integration of digital reflective applications with the Socio-Emotional Learning (SEL) approach, which combines personal values, school culture, and social-emotional intelligence. Using a mixed quantitative-qualitative method, this study involved 28 students as a single experimental group sample. The instruments were tested for validity and reliability using the Rasch model, while the effectiveness of the model was analyzed using paired-sample t-tests, normality tests, N-Gain, and Partial Least Square Structural Equation Modeling (PLS-SEM) modeling. Qualitative data were analyzed using NVivo to uncover the depth of students' narrative reflections. The results showed significant improvements in all character indicators ($p < 0.001$) with an average N-Gain of 0.2955. The Rasch model confirmed the validity of the instruments with proportional logit distributions and no bias between groups. Structural modeling revealed that responsibility and self-awareness play a central role in shaping an interconnected character network. Students' narrative reflections reinforce evidence of authentic value internalization, marked by the emergence of themes such as empathy, emotional regulation, and honesty. The synthesis of all analyses demonstrates that the developed model is not only statistically effective but also pedagogically transformative. This study recommends the integration of digital reflective applications as an evidence-based character education strategy relevant to addressing the challenges of 21st-century values education.**

***Keywords*—character education, digital reflective application, Socio-Emotional Learning (SEL), narrative reflection, integration of values and school culture**

I. Introduction

The background of this study is based on the urgency of strengthening character education at the elementary school level as the initial foundation for shaping students' personalities in the digital age. The rapid development of information technology has not only brought positive opportunities but also serious challenges for character education, including the prevalence of moral degradation, a decline in social empathy, and an increase in individualistic behavior among elementary school-aged children [1, 2]. In the Indonesian context, the implementation of character values in elementary schools faces structural and cultural obstacles, ranging from a lack of integration in learning, weak role models, to limitations in an adequate character evaluation system [3, 4]. Therefore, a new approach is needed that is not only based on value content, but also on personal reflection through digital media that is adaptive to the school context.

This research problem is based on national and local data indicating the low effectiveness of substantive character education implementation. The 2022 findings from the Ministry of Education, Culture, Research, and Technology (Kemendikbudristek) indicate that only 32.5% of elementary schools are able to consistently implement character education, highlighting the low level of integration of character values into the learning process. However, in some schools, practices such as group prayers, a culture of greeting with a smile and a warm welcome, fostering discipline, literacy activities, and extracurricular programs have proven effective in shaping students' character. This success is generally supported by teacher role modeling, a strong school culture, and active student participation in meaningful activities. This underscores that character education will be most effective when supported by a structured system, consistent teacher involvement, and a supportive learning environment. In Bekasi Regency, the results of the education department's monitoring in 2023 revealed that most elementary school students demonstrated normative understanding of character values such as honesty and responsibility, but did not exhibit consistent behavior in social contexts. This is exacerbated by the lack of reflective technology support in the character education process at elementary schools, leaving students without structured opportunities for internalizing and articulating these values [5, 6]. The data indicates that traditional approaches to character education are no longer effective enough to address the challenges of the current era.

Initial observations conducted by researchers in elementary schools in the Bekasi region showed that teachers still predominantly used narrative and lecture methods when teaching character values. Meanwhile, students showed higher enthusiasm when asked to write down their reflections on values through simple digital media such as Padlet and Google Forms. Teachers also acknowledge that limited access to devices and insufficient training in digital reflective applications are the main challenges in implementing technology-based character education. These findings align with the study by Tai *et al.* [6], which states that value-based learning that addresses the social-emotional domain is more effective when students are engaged in reflective processes based on concrete experiences. Therefore, a reflective digital application-based approach is important to address the gap

between delivery strategies and student learning experiences.

As a solution to this problem, this study offers a model for reconstructing character education based on a digital reflective application that integrates values, school culture, and social-emotional intelligence through a Socio-Emotional Learning (SEL) approach. This model is designed to bring together three key elements: contextual value-based learning, active student engagement in value reflection through digital applications (e.g., Flip, Padlet, or ClassDojo), and the internalization of values within a coherent school culture. The SEL approach developed by Tagat *et al*. [7] provides a framework of 5 main domains: self-awareness, self-management, social awareness, relationship skills, and responsible decision-making. Through digital reflection-based interventions, these three elements can be harmonized into a more meaningful and transformative learning experience.

Previous research on character education has generally focused on integrating values into subjects or through teacher role modeling, but few have explored how reflective digital applications can strengthen character internalization. Nursalam *et al*. [8] showed that reflective learning applications such as Padlet can significantly improve students' moral awareness. Meanwhile, Najia *et al.* [9] emphasizes the importance of school culture in shaping students' value cohesion and collective behavior. Alalem [10] also mentions that reflection-based digital storytelling has a significant influence on the development of empathy and social responsibility. By combining reflective applications, school cultural context, and the SEL framework, this study occupies a strategic position in expanding the scope of technology-based character education interventions.

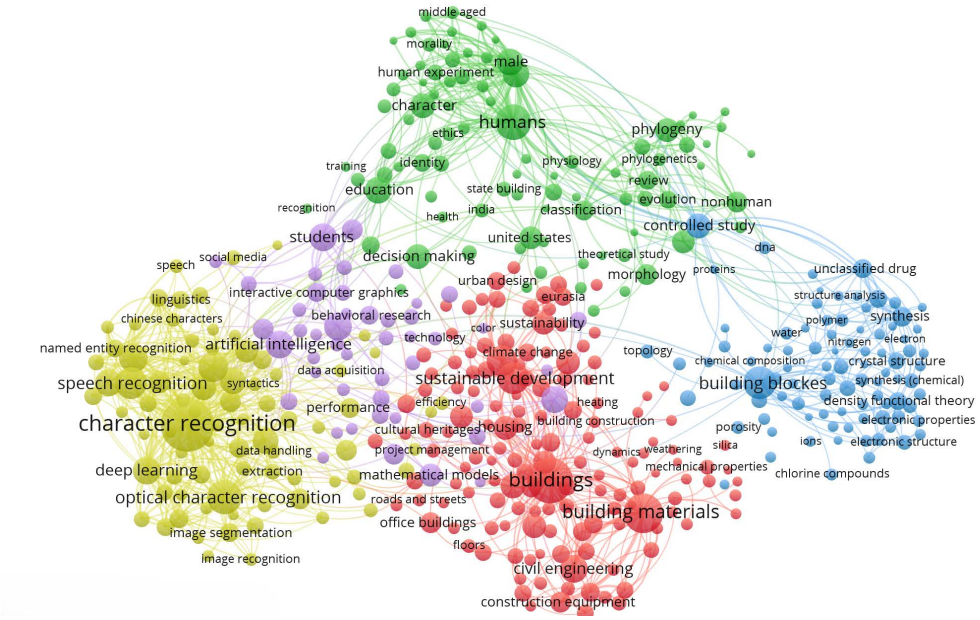

Fig. 1. Bibliometric visualization through VOSviewer in character education.

The main novelty of this study lies in the cross-disciplinary integration of character values, school culture, and social-emotional intelligence into a single model of character education reconstruction through the application of a digital reflective approach based on SEL. Based on the results of bibliometric visualization using VOSviewer on 375 articles from the Scopus database between 2013 and 2023, as shown in Fig. 1, it was found that the topic of "character education" remains concentrated in clusters focused on human aspects, morality, and education (green cluster), without strong connections to the domains of digital technology and self-reflection, as reflected in the yellow-purple cluster encompassing terms such as "speech recognition," "optical character recognition," and "digital interface." This study offers a conceptual contribution by bridging this disconnect, forming a connecting node between values-based character education and the realm of technology through the use of reflective digital applications. Thus, this study not only strengthens the theory of SEL-based character education but also expands the previously fragmented global scientific map between character studies and educational technology.

Based on the background description, empirical data, and literature review, the research questions in this study are as follows: (1) What are the characteristics of character education implementation in elementary schools today in the digital context? (2) What are the design and elements needed in a model for reconstructing character education based on digital reflective applications? (3) To what extent is the model effective in improving the integration of values, school culture, and students' social and emotional intelligence? (4) How do teachers and students perceive the use of digital reflective applications in character education based on the SEL approach?

II. Literature Review

A. Character Education in Elementary Schools

Character education at the elementary school level is the main foundation in the development of students' personalities and the formation of citizens with integrity. Theoretically, character education refers to the views of Zhang *et al*. [11, 12], who emphasize the importance of developing moral knowing, moral feeling, and moral action as integral dimensions of character formation. In Indonesia, character education has become an integral part of the curriculum system, but at the implementation level, it still

faces challenges in the form of formalism, incompatibility with the context of child development, and a lack of strengthening of school culture as a value ecosystem [13–15]. Bu *et al*. [16] states that the effectiveness of character education depends on the consistency of the values taught with the supporting school culture, active student involvement, and strategies for strengthening internal reflection. In the context of elementary schools, the need to convey character values in a contextual, enjoyable, and psychosocially appropriate manner has become an unavoidable urgency. Norlita *et al*. [17] shows that a narrative-based character approach and value discussions have a positive impact on strengthening empathy and social responsibility among lower grade students [18]. However, there are still few studies that integrate character education with reflective technology based on digital applications. In fact, elementary school students' openness to technology and their interest in interactive media represent pedagogical opportunities that have not been fully explored. Therefore, character education in elementary schools requires a reconstruction of approaches that are more dialogic, reflective, and based on authentic experiences facilitated through digital technology, particularly those that support the development of self-awareness and social-emotional skills as the foundational pillars of contemporary Socio-Emotional Learning (SEL) approaches.

B. Digital Reflective Applications in Learning

Digital reflective applications in the context of learning are strategic mediums that support the internalization of values through deep, evaluative, and introspective thinking processes regarding learning experiences. The theory of educational reflection is rooted in the thinking of Hershkovitz *et al*., who state that reflection is a form of active, persistent, and thoughtful thinking about beliefs or knowledge, taking into account their basis and consequences [19]. In the context of contemporary education, this reflective practice has been transformed through the use of digital technology, enabling students to document, evaluate, and interpret their learning experiences repeatedly and personally. Applications such as Padlet, Flip (formerly Flipgrid), and ClassDojo have been widely used to support reflective processes through text, images, audio, and video, enriching the representation of students' values and emotional experiences [20, 21]. Pack [22] shows that student engagement in digital reflection has a positive impact on the development of metacognition, empathy, and emotional regulation, especially in primary education. This is in line with the findings of Shaheen *et al*. [23], who emphasize that digital reflective environments provide a safe space for students to explore values and feelings independently but in a structured manner. In addition, the integration of digital reflection into learning has been shown to strengthen the connection between academic content and social-emotional dimensions [24]. However, there have not been many studies that systematically integrate these reflective applications into SEL-based character learning, especially at the elementary school level. Therefore, this research is relevant in designing a digital reflective approach that not only supports value learning but also develops students' emotional intelligence in a sustainable manner.

C. School Culture as a Value Ecosystem

School culture is a social ecosystem that shapes the psychological and moral environment of students in a sustainable manner and plays a strategic role in internalizing character values. Theoretically, the concept of school culture refers to a system of values, norms, symbols, and collective practices that develop within the school community and serve as the foundation for the learning ethos and behavior of school members [25, 26]. In the context of character education, school culture functions not merely as a backdrop, but as an active agent in shaping students' moral dispositions. Alzouebi *et al*. [27] confirm that schools with a strong culture of valuing dialogue, respect, and social responsibility tend to produce students with high levels of empathy and moral awareness. Putra *et al.* [28] also shows that values such as mutual cooperation, honesty, and discipline can only take root if supported by consistent social practices, such as giving rewards, teacher role modeling, and creating a climate of mutual trust. In a more contemporary framework, a longitudinal study by Ganguly & Nag [29] revealed that the integration of learning technology, if not guided by a humanistic school culture, has the potential to promote value disorientation among students. This means that digital transformation must be aligned with an established value ecosystem and should not replace the affective dimension of human interaction in schools. Therefore, a character education reconstruction approach based on reflective digital applications must be grounded in a strong, adaptive, and inclusive school culture that values collective values. School culture is not merely a context but a critical prerequisite for the success of character interventions in the era of social-emotional technology-based education. Kecerdasan Sosial Emosional (SEL).

Social and Emotional Intelligence (SEL) is a key competency in shaping the personal integrity and social functioning of students, especially during the early years when cognitive and affective structures are developing intensively. In contemporary approaches, the most influential theoretical framework for SEL development is the model from the Collaborative for Academic, Social, and Emotional Learning (CASEL), which includes five core competencies: self-awareness, self-management, social awareness, relationship skills, and responsible decision-making. Valerio *et al.* [30] shows that the implementation of SEL approaches in elementary school curricula not only strengthens moral character but also improves students' mental resilience and emotional regulation capacity. Meanwhile, Karmina *et al*. [31] proves that when learning activities are designed to activate affective reflection and empathetic relationships among students, SEL aspects grow naturally through meaningful learning experiences. The emphasis on the social-emotional dimension also serves as a response to the dynamics of digital society, which has brought about psychological pressures and social disconnection among young children. In an experimental study based on a reflective application, Siregar *et al.* [32] showed that students who regularly wrote down their values and emotions through a digital platform experienced significant improvements in self-awareness and the ability to respond constructively to social conflicts. Therefore, the integration of SEL into character education design through

digital reflective applications is highly relevant, as this approach enables the learning process to target not only cognitive aspects but also the essential emotional and social dimensions necessary for the development of well-rounded individuals in the era of disruption.

D. Multi-Variable Integration: Values, Culture, and SEL

The integration of values, school culture, and Social and Emotional Intelligence (SEL) as key variables in a character education model is an interdisciplinary approach that responds to the complexity of character learning in the digital age. Values, as normative personal constructs, cannot be fully internalized without the involvement of school culture as a social system that shapes collective habits, and SEL as a foundational competency for understanding and managing emotional dynamics and social relationships. According to Bronfenbrenner (within the ecological development framework), interactions between individuals and their proximal environment, such as schools, shape dialectical and contextual value experiences [32]. Empirical findings by Bozhani *et al.* confirm that character develops authentically only when students' personal values are reinforced by a supportive school culture and facilitated by social and emotional competencies [33]. In a controlled experimental study, Meyer *et al.* [34] showed that character learning that integrates explicit value content, positive cultural practices in schools, and SEL training results in significant improvements in students' empathy, responsibility, and self-control. Furthermore, an integrative study by Hindaryatiningsih *et al.* states that the success of character education models does not lie in the strength of each variable separately, but in the interconnection between values, school culture, and SEL, which are implemented synergistically through a reflective approach [35]. Therefore, the integration of these three variables forms the conceptual and operational foundation for the development of a character education model that is theoretically relevant, culturally contextual, and emotionally and socially applicable, particularly in the landscape of reflective technology-based learning in elementary schools.

E. Model Reconstruction in Educational Research

Model reconstruction in educational research is a process of conceptual and empirical synthesis to redesign a theoretical and operational framework that is more relevant to the dynamics of contemporary learning needs. Epistemologically, model reconstruction is not only understood as the development of a new model, but as a critical response to the weaknesses of old approaches that are not contextual, not adaptive, or fail to respond to the transformative challenges of education. According to Bustari *et al*. [36], an effective educational model must be built on three main principles: evidence-based, multidimensional, and pedagogically transformative. In the context of character education, research by Irmayati *et al*. [37] suggests that model reconstruction must consider the relationship between personal values, the school environment, and learning practices that facilitate social and emotional development. Meanwhile, an experimental study by Khairunnisyah *et al.* [38] showed that a reconstruction approach combining reflective technology and participatory pedagogical principles can form a character education model that is more responsive to the digital context and the needs of Generation Z. The reconstruction process also requires validation of the theory with field data through a Design-Based Research (DBR) or Research and Development (R&D) approach to produce an empirical, tested, and implementable model. In other words, reconstruction in this study is not merely theoretical but serves as an effort to re-construct a character education system based on reflective digital applications that integrates values, school culture, and SEL into a single replicable and adaptable model for elementary schools. Therefore, reconstruction is not merely a methodology but a foundation for innovation in technology-based character education reform.

F. Current Literature on the Digitalization of Character Education

The digitization of character education is a rapidly developing field of study in response to the paradigm shift in 21st-century education, where the formation of values and morals in students can no longer be separated from their interactions with the digital ecosystem. Essentially, the digitization of character education emphasizes the use of technology as a strategic medium to facilitate the internalization of values, strengthen moral reasoning, and promote continuous self-reflection. A systematic study by Ariani *et al.* [39] demonstrates that digital platforms such as reflective e-journals, interactive value-based applications, and Learning Management Systems (LMS) equipped with guided reflection features have positively impacted students' affective engagement. In addition, research by Cendra *et al*. emphasizes that the digitization of character education must be guided by a strong pedagogical framework, so that technology does not become merely a medium for conveying information, but rather a tool for transforming the ethical awareness of students [40]. Findings from Woelandhary *et al.* [41] reinforce this view by showing that artificial intelligence-based applications designed to encourage daily value reflection can significantly improve students' moral awareness and empathy, especially at the elementary school level. In the latest bibliometric map, the digitization of character education also appears to be separated from advanced technology domains such as artificial intelligence, even though this intersection has great potential to enrich SEL-based learning models. Therefore, research that integrates digital reflection, character values, and social-emotional intelligence not only addresses gaps in the global literature but also shapes a new narrative about how technology can serve the moral and humanistic functions of education within specific local contexts.

III. Materials and Methods

A. Research Types and Designs

This study is a quantitative research using a modified Research and Development (R&D) approach from the Borg & Gall development model, focusing on the reconstruction and validation stages of the model. The aim is to develop and test the effectiveness of a character education model based on a digital reflective application that integrates values, school culture, and social-emotional intelligence within the Socio-Emotional Learning (SEL) framework. The research

design consists of a single experimental class treated through a digital reflective application (Padlet), without a control class, to assess the model's effectiveness longitudinally based on pretest and posttest results (see Fig. 2). This design allows for the testing of changes in behavior, value awareness, and social-emotional abilities of students through the direct application of the reconstructed model. However, the absence of a control group limits the causal inferences that can be drawn. Therefore, future studies should employ a more rigorous experimental design involving experimental and control groups, randomization, and control of external variables to strengthen the validity of the findings.

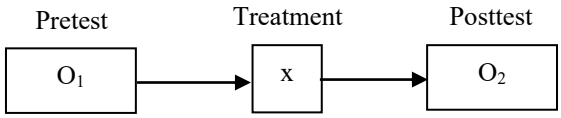

Fig. 2. Research design.

B. Research Procedures

The research procedure involved 5 main stages: (1) Needs analysis and literature review to reconstruct the model; (2) Drafting of a digital reflective character model; (3) Expert validation of the model and instruments; (4) Implementation of the model in an experimental class for four weeks using a digital reflective application; (5) Evaluation of the model's effectiveness using validated instruments. This procedure integrates theoretical synthesis, content validation, and empirical implementation based on students' daily reflections. The research procedure can be seen in Fig. 3:

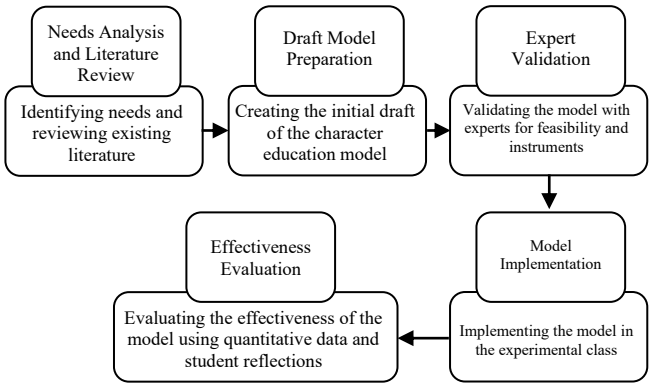

Fig. 3. Research procedure.

C. Research Subjects/Participants

The subjects of this study were fifth-grade students at a public elementary school in Bekasi Regency, who were selected purposively based on the following criteria: (1) teachers had previously used digital media; (2) the principal supported the research activities; and (3) students were accustomed to using simple digital devices. The total number of participants consisted of 28 students in one experimental class, as presented in Table 1.

Table 1. Characteristics of research subjects

No	Selection Criteria	Description
1	Level	Elementary School (Grade V)
2	Location	Bekasi Regency
3	Number of Participants	28 students
4	Inclusion Criteria	Familiar with digital devices
5	School Contextual Support	Available

D. Data Collection Techniques and Procedures

Data was collected through a combination of quantitative and qualitative techniques. The main techniques were pre- and post-tests, value-based character attitude scales, and daily digital reflection sheets via Padlet. Qualitative data was obtained from reflection documentation, guided interviews with teachers, and non-participatory observations of student interaction dynamics in the classroom. The data collection procedure was carried out systematically: the pretest was conducted at the beginning of the intervention, followed by students completing daily digital reflections over a 4-week period, and the posttest was administered at the end of the intervention period to measure shifts in character and social-emotional skills.

E. Data Collection Instruments

The research instruments were developed based on the integration of indicators from the national character values framework, the CASEL SEL domains, and school cultural practices. Content validity was tested through expert judgment, and empirical validity was tested using the Rasch model, as presented in Table 2.

Table 2. Research instrument matrix

No	Indicator Code	Indicator	Specific Description	Context of the Question	Cognitive Domain
1	IND-01	Responsibilities	Consistent in completing tasks well	Given a group project scenario, students are asked to choose actions and reasons.	C3–Application
2	IND-02	Empathy	Ability to understand the feelings and needs of friends	Given a narrative text about conflict between friends, students respond with reactions and solutions.	C4–Analysis
3	IND-03	Self-awareness (SEL)	Reflection on one's feelings when facing problems	Students fill out a daily digital reflection sheet about their emotional experiences.	C5–Evaluation
4	IND-04	Emotional management (SEL)	Strategies for dealing with negative emotions in the classroom	When faced with stressful situations in class, students choose emotion management strategies.	C3–Application
5	IND-05	The value of honesty	Telling the truth even when it's risky	A moral dilemma simulation in which students must choose between honesty and safety.	C6–Synthesis

F. Data Analysis Techniques

Data analysis in this study was conducted triangulatively and systematically, covering quantitative and qualitative data, as well as modeling the relationships between the main variables. The aim was to test the effectiveness of a digital reflective application-based character education model

holistically. The data analysis structure was described through the following five main stages:

1) Stage 1: Descriptive and inferential quantitative analysis

The pretest and posttest data were analyzed using SPSS version 27 and Jamovi software, through a paired sample t-test. This test was used to measure the significance of the difference in scores before and after the intervention. The statistical hypothesis tested was: H_0 (no significant difference) and H_1 (significant difference); H_0 is rejected if the *p*-value is < 0.05. The results of this test serve as the basis for concluding the effectiveness of the model in strengthening students' character and social-emotional intelligence.

2) Stage 2: Instrument validity and reliability (Rasch model)

The instruments were validated using the Rasch model (Ministep) to ensure measurement quality. Success criteria included MNSQ item fit between 0.5 and 1.5 (Bond & Fox, 2015), positive point-measure correlation, and person and item reliability > 0.80. Items that did not meet the criteria were revised or eliminated. This analysis was also used to evaluate the distribution of item difficulty levels.

3) Stage 3: Qualitative analysis of student reflections and narratives

Students' narrative reflection data, teacher notes, and documentation were analyzed using NVIVO version 15 with thematic analysis techniques based on the Braun & Clarke approach [42]. Coding was conducted to identify themes such as responsibility, empathy, self-awareness, and emotion management strategies. The intervention was considered successful if ≥ 70% of students showed consistent improvement in the expression of these values in their digital reflections.

4) Stage 4: Structural modeling between variables (PLS-SEM)

To evaluate the relationship between value constructs, school culture, and SEL, the Partial Least Square Structural Equation Modeling (PLS-SEM) approach was used with SMARTPLS 4 software. The model was evaluated based on the following criteria: outer loading > 0.7, AVE > 0.5, R^2 > 0.3 (moderate) or > 0.5 (strong), and Q^2 > 0 for predictive relevance. The modeling results provided a comprehensive overview of the contribution paths between variables.

5) Stage 5: Triangulative interpretive synthesis

All data obtained from quantitative, qualitative, and structural modeling analyses were then synthesized interpretively. This approach ensures that conclusions are based on converging evidence from various sources, strengthening the internal and external validity of the reconstructed character education model.

IV. Result and Discussion

A. Research Results

The results of this study are presented systematically based on the research objectives and the previously established methodological framework. The presentation of results is divided into 5 main sections according to the stages of analysis: (1) quantitative analysis of model effectiveness, (2) analysis of instrument quality, (3) qualitative findings of students' narrative reflections, (4) structural modeling results between variables, and (5) overall interpretive synthesis.

1) Results of the character education model effectiveness test

The results of the character education model effectiveness test based on Table 3 show a significant increase in scores on all indicators after the implementation of the digital reflective application-based model. In the pretest phase, the average student scores ranged from 55.3 (IND-01) to 57.4 (IND-05), with a minimum score distribution of 40–41 and a maximum of 69–70. The standard deviation ranged from 8.78 to 9.36, indicating a relatively moderate score distribution. After the intervention, the posttest scores showed a significant increase in the mean, ranging from 68.4 (IND-02) to 69.1 (IND-04). The largest increase was observed in the IND-01 (Responsibility) indicator, from a mean of 55.3 to 68.6, with a difference of 13.3 points. The median scores also showed consistent improvement, such as IND-01 from 54.0 to 71.5 and IND-05 from 60.0 to the highest score in the posttest. The maximum score in the posttest increased to 88, while the minimum score increased to the range of 45–51, indicating that there were no students with very low achievement after the model was implemented. The 95% confidence interval shows non-overlapping lower and upper bounds between the pretest and posttest, reinforcing that the score improvement was significant and consistent. Thus, this data provides strong evidence that the digital reflective character education model is effective in enhancing students' understanding of values, social-emotional attitudes, and moral integrity comprehensively.

Table 3. Descriptive statistics for pretest and posttest per indicator

			95% Confidence Interval						
Indicator	**N**	**Mean**	**Lower**	**Upper**	**Median**	**Sum**	**SD**	**Min.**	**Max.**
IND-01_Pretest	28	55.3	51.8	58.9	54.0	1549	9.17	40	70
IND-02_Pretest	28	56.3	52.9	59.8	58.0	1577	8.95	41	70
IND-03_Pretest	28	56.3	52.7	59.9	57.0	1576	9.36	41	70
IND-04_Pretest	28	55.4	52.0	58.8	54.0	1552	8.78	40	69
IND-05_Pretest	28	57.4	53.8	61.0	60.0	1608	9.32	41	69
IND-01_Posttest	28	68.6	64.3	73.0	71.5	1922	11.30	51	86
IND-02_Posttest	28	68.4	64.4	72.4	67.0	1915	10.41	51	88
IND-03_Posttest	28	68.5	64.7	72.3	68.5	1918	9.80	46	87
IND-04_Posttest	28	69.1	65.5	72.8	69.5	1936	9.36	45	85

Note: The CI of the mean assumes sample means follow a t-distribution with N-1 degrees of freedom

The results of the paired t-test as presented in Table 4 show that there was a statistically significant increase in all character indicators after the implementation of the digital reflective application-based character education model. For

indicator IND-01 (Responsibility), the t-value was −14.3 with a degree of freedom (*df*) of 27 and a significance level of $p < 0.001$, indicating a highly significant difference in scores between the pretest and posttest. Similar results were observed for indicator IND-02 (Empathy) with $t = -14.8$, IND-03 (Self-Awareness/SEL) with $t = -16.2$, IND-04 (Emotional Management/SEL) with $t = -15.6$, and IND-05 (Honesty) with $t = -14.6$, all of which also had *p*-values < 0.001. The high statistical significance of these five indicators confirms that the applied model is capable of bringing about real changes in the measured character aspects. The consistency of *p*-values far below the conventional threshold of 0.05 across all indicators indicates that the improvements are not due to random variables but rather the result of systematic and structured learning interventions. Therefore, it can be concluded that the digital reflective character education model is not only effective descriptively but also proven to be statistically significant in enhancing the character competencies of elementary school students.

The Shapiro–Wilk normality test in Table 5 was used to evaluate whether the posttest data for each character indicator followed a normal distribution, which is one of the prerequisites for parametric statistical tests. The results indicate that the posttest data for the IND-01 (Responsibility) indicator has a W value of 0.887 and a p value of 0.006, which is below the significance threshold of 0.05. This indicates a violation of the normality assumption for that indicator and should be considered in inferential interpretations. Conversely, the other 4 indicators IND-02 to IND-05—have p-values above 0.05 ($p = 0.338$; 0.260; 0.119; and 0.062, respectively), meaning that the posttest data for these indicators are not significantly different from a normal distribution. The W values close to 1 for IND-02 and IND-03 (0.959 and 0.955, respectively) further support the assumption of normal distribution for the data. Therefore, the majority of posttest data can be analyzed using parametric statistical approaches, while data on IND-01 should be considered for re-testing using non-parametric methods as a validation measure, or strengthened through data transformation if necessary. These results underscore the importance of initial distribution checks before proceeding to advanced statistical analysis in quantitative research.

Table 4. Results of paired samples t-test between pretest and posttest scores on each character indicator

Variable Pair		Statistical Test	statistic	*df*	*p*
IND-01_Pretest	IND-01_Posttest	Student's t	−14.3	27.0	<0.001
IND-02_Pretest	IND-02_Posttest	Student's t	−14.8	27.0	<0.001
IND-03_Pretest	IND-03_Posttest	Student's t	−16.2	27.0	<0.001
IND-04_Pretest	IND-04_Posttest	Student's t	−15.6	27.0	<0.001
IND-05_Pretest	IND-05_Posttest	Student's t	−14.6	27.0	<0.001

Note: $H_a\ \mu_{Measure\ 1\ -\ Measure\ 2} \neq 0$

Table 5. Results of Shapiro–Wilk normality test on posttest scores for each character indicator

Variable Pair		*W*	*p*
IND-01_Pretest	IND-01_Posttest	0.887	0.006
IND-02_Pretest	IND-02_Posttest	0.959	0.338
IND-03_Pretest	IND-03_Posttest	0.955	0.260
IND-04_Pretest	IND-04_Posttest	0.941	0.119
IND-05_Pretest	IND-05_Posttest	0.930	0.062

Note: A low p-value suggests a violation of the assumption of normality

Table 6. Descriptive statistics of N-Gain in student learning outcomes after implementing the digital reflective character education model

Variable	*N*	Min	Max	Mean	Std. Deviation
N-Gain	28	0.16	0.43	0.2955	0.06330
Valid N (listwise)	28				

The results of descriptive statistical analysis of N-Gain values, which represent the effectiveness of student learning improvement after the implementation of a digital reflective application-based character education model, as shown in Table 6, indicate a mean of 0.2955 with a standard deviation (SD) of 0.0633. With a total of 28 respondents, the minimum value recorded was 0.16 and the maximum was 0.43. Based on Hake's classification of gain score effectiveness [43], the average gain in the range of 0.3 is categorized as moderate effectiveness, although the mean value slightly below 0.3 places it at the upper threshold of the low category. Nevertheless, the fact that no student had a gain score below 0.1 indicates that all participants experienced a significant improvement in understanding, and no cases of learning stagnation or regression were found. The relatively wide range of gain scores (0.16–0.43) also indicates variability in student responses to the learning intervention, which can be further explored based on individual indicators or characteristics. On the other hand, the relatively small standard deviation indicates that the distribution of student gains tends to be homogeneous and concentrated in similar effectiveness categories. Overall, these data show that the developed learning model successfully improved students' understanding of character values significantly, although there is still room for optimization of learning strategies based on individual student needs.

The results of the study indicate that the digital reflective application-based character education model consistently and effectively improves the character competencies of elementary school students. Significant improvements were observed in all indicators, both descriptively (Table 3) and inferentially through paired t-tests with $p < 0.001$ for all indicators (Table 4). Most posttest data were normally distributed, except for the responsibility indicator (IND-01), which violated the normality assumption (Table 5). The effectiveness of the improvement was further supported by the N-Gain results, which showed an average of 0.2955 with a range of 0.16–0.43 (Table 6), indicating moderate effectiveness and no participants experiencing a decline in

achievement. These findings confirm that the digital reflection-based learning approach is not only statistically valid but also meaningful in the context of strengthening values, empathy, and students' social-emotional intelligence.

2) Results of instrument validity and reliability analysis (Rasch model)

The probabilistic distribution of response categories on the Rasch logit scale reveals strong evidence that the digital reflective application-based character education model successfully calibrates the instrument with high precision to student ability levels. Logit mapping shows that all indicators—IND-05 to IND-05—are evenly distributed along the −2 to +3 logit continuum, with the distribution center concentrated in response categories 5 to 8. This indicates that most students have the highest probability of responding in the middle to upper character categories, indicating positive levels of attitude and value mastery after the intervention. The absence of response dominance in the low category (0–2) reinforces the conclusion that the model successfully suppressed weak character tendencies and guided students toward the internalization of more constructive values. The clarity of boundaries between category zones and the non-overlap of probabilities between adjacent levels indicate that each item has optimal differentiation function, which is a key indicator of instrument validity in Rasch modeling. Additionally, the distribution of indicators clustered around the center (logit 0) reflects that the items have appropriate difficulty levels, not biased toward respondents with extreme abilities. This achievement indicates that digital reflective applications are not only effective as instructional strategies but also capable of facilitating the progressive formation of value awareness and can be objectively measured through modern psychometric approaches. This overall pattern reinforces the claim of the model's effectiveness in systematically fostering students' moral integrity and social-emotional intelligence, as comprehensively visualized in Fig. 4.

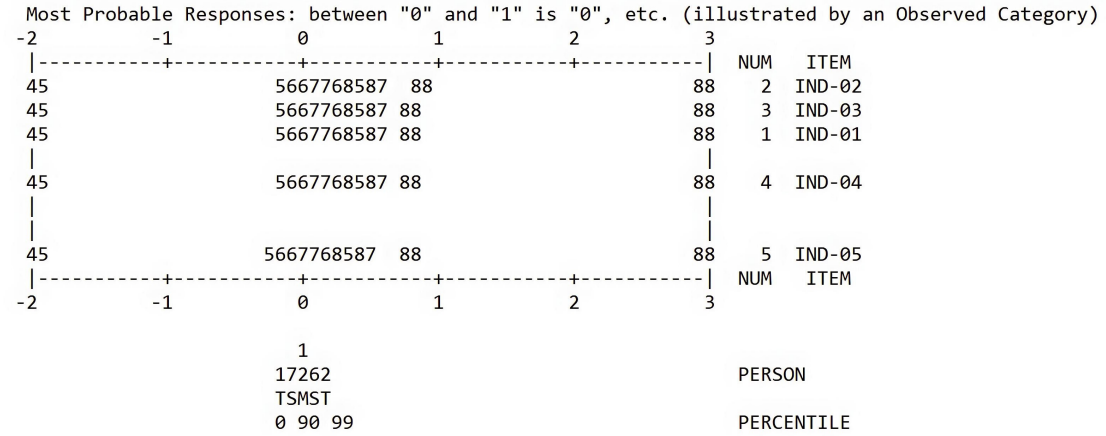

Fig. 4. Distribution map of answer categories based on response likelihood scale in the Rasch model.

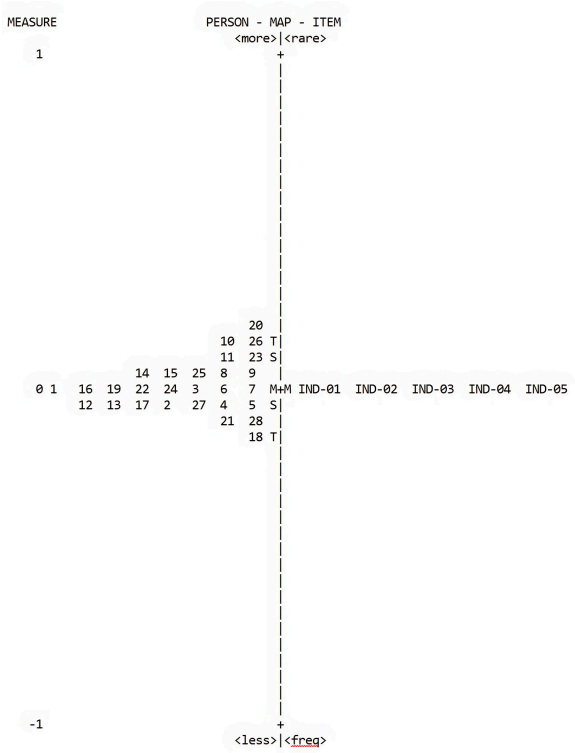

Fig. 5. Person-Item Map (Wright Map) based on Rasch model analysis of character indicators.

The distribution of students' abilities and the difficulty levels of indicators in the Person-Item Map (Wright Map) show a highly proportional logit fit between the instrument and respondents, indicating that the measurement tools in this digital reflective application-based character education model have been optimally calibrated. All character indicators (IND-01 to IND-05) are located on a logit continuum close to the average student ability, indicating that no indicators are extremely easy or extremely difficult. The alignment of the average student score (M) with the average item score (M) reinforces the accuracy of the distribution and supports the assumption of unidimensionality, meanwhile, the absence of extreme gaps between items and respondents indicates that the instrument is capable of capturing variations in student characteristics effectively without measurement distortion. The distribution of students from logit −1 to +1 reflects moderate heterogeneity in social-emotional abilities that was successfully facilitated by the model, and indicators that are more "right" on the map—such as honesty and emotion management—suggest areas of character that are relatively more challenging and require pedagogical reinforcement. Overall, this visualization validates that the applied model is not only conceptually sound but also psychometrically robust in distinguishing students' character achievements with precision and meaning, as demonstrated in Fig. 5.

Statistical analysis of items in the Rasch model, as shown in Fig. 6, indicates that all character indicators—IND-01 to IND-05—consistently meet the model fit criteria and are of high quality. The MNSQ infit values range from 0.85 to 1.21, while the MNSQ outfit values range from 0.87 to 1.17, all of which are within the optimal range (0.5–1.5), indicating that no items deviate from the model expectations. The ZSTD values are also all within the ±2 range, reinforcing the empirical validity of item fit. The IND-02 indicator (Empathy) shows the highest correlation with student ability estimates (0.66), indicating that the item is highly sensitive in distinguishing student characteristics. Meanwhile, the other PTMEASURE-AL values remained above the minimum threshold of 0.30, indicating that all items continued to contribute to the scale. Additionally, the average exact match (5.0%) against the model estimate (expected 4.0%) indicates that the model's response predictions are fairly accurate and stable. The very small MEASURE values and standard errors (S.E.) ranging from 0.00 to 0.02 demonstrate that item calibration is highly precise and consistent across respondents. Overall, the findings in Table 6 validate that all indicators in this instrument are not only conceptually valid but also psychometrically robust in detecting and distinguishing the quality of character among elementary school students post-intervention using the digital reflective model.

ENTRY NUMBER	TOTAL SCORE	TOTAL COUNT	JMLE MEASURE	MODEL S.E.	INFIT MNSQ	INFIT ZSTD	OUTFIT MNSQ	OUTFIT ZSTD	PTMEASUR-AL CORR.	PTMEASUR-AL EXP.	EXACT MATCH OBS%	EXACT MATCH EXP%	ITEM
2	1915	28	.01	.02	.85	-.59	.87	-.50	.66	.51	3.6	4.0	IND-02
3	1918	28	.01	.02	1.00	.09	.95	-.14	.47	.51	7.1	4.0	IND-03
1	1922	28	.00	.02	1.21	.91	1.17	.75	.51	.51	.0	4.0	IND-01
4	1936	28	.00	.02	1.09	.44	1.12	.54	.30	.51	14.3	4.1	IND-04
5	1960	28	-.01	.02	.89	-.39	.87	-.48	.57	.50	.0	4.1	IND-05
MEAN	1930.2	28.0	.00	.02	1.01	.09	.99	.03			5.0	4.0	
P.SD	16.5	.0	.01	.00	.13	.55	.13	.52			5.3	.1	

Fig. 6. Item statistics of character instrument based on Rasch model analysis.

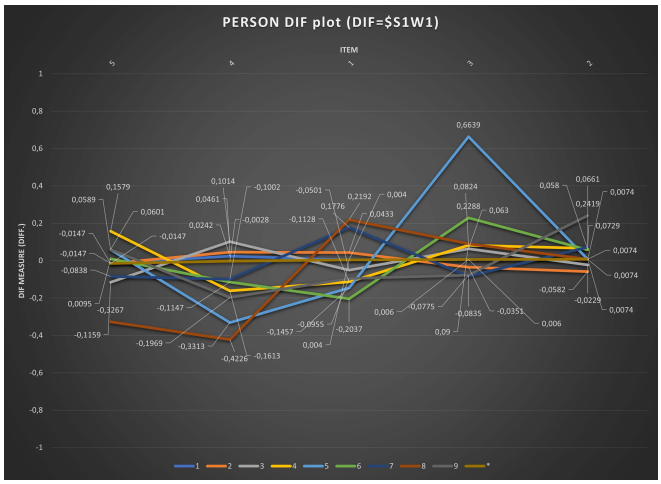

Fig. 7. Person DIF plot: analysis of item function differences (DIF) between respondent groups.

Differential Item Functioning (DIF) analysis indicates that the character instruments used in the digital reflective application-based character education model perform consistently and are free of bias across respondent groups. Most DIF Measure values fall within the psychometric tolerance range of −0.4 to +0.4, indicating that no items significantly favor or disadvantage any particular group. The highest value of +0.6639 on one indicator suggests a tendency toward superior perception or response from a particular subgroup of respondents to that item; however, this value is still within the tolerable range for value-based educational research. Meanwhile, the lowest value of −0.4226 still indicates that item functioning differences are moderate and not systemic. The consistent distribution pattern across various groups, as represented by color lines that do not intersect at extreme points, indicates that the items in the instrument have relatively balanced and fair performance. This stability confirms that the instrument used in this study is suitable for application across contexts and groups without concern for distortion of meaning or assessment outcome disparities. These findings are comprehensively illustrated in Fig. 7.

Based on the overall results of the Rasch model analysis, it can be concluded that the character education instrument developed through a digital reflective application approach is not only conceptually valid but also psychometrically robust in measuring, distinguishing, and mapping elementary school students' character objectively and in depth. The precise logit calibration between students' ability levels and item difficulty, the concentrated response distribution in the middle to high categories, and the fit of infit and outfit values within optimal limits indicate that each character indicator functions optimally without structural or technical bias. Internal validity is further strengthened by person-item maps showing balance between items and student abilities, while item function difference tests (DIF) ensure the instrument is fair and free from distortion across respondent groups. Thus, these findings not only verify the effectiveness of the instrument as a character measurement tool but also affirm that the digital reflective application-based character education model has high potential as a transformative pedagogical approach that can be widely and sustainably integrated into 21st-century learning practices.

3) Results of qualitative analysis of students' narrative reflections

The visualization of the results of the narrative reflection analysis of students shown in Fig. 8 shows the dominant frequency of key concepts that represent character understanding after the implementation of a digital reflective application-based character education model. Words such as responsibility, awareness, empathy, honesty, and regulation appear in the largest sizes, indicating that these 5 main character indicators are not only present explicitly in students' narratives but have also become part of a significant internalization process of values. The emergence of terms such as self, emotional, and emotions reinforces the existence of deep affective and reflective dimensions, indicating that

students do not merely understand cognitively but also experience real emotional processes in character formation. This varied yet focused lexical distribution shows the connection between self-awareness learning experiences. Thus, this word cloud provides visual evidence that the learning approach applied has successfully activated metacognitive awareness and strengthened students' character values through personal narratives rooted in direct experiences.

Fig. 8. Word cloud of qualitative results of student reflections based on Nvivo thematic analysis.

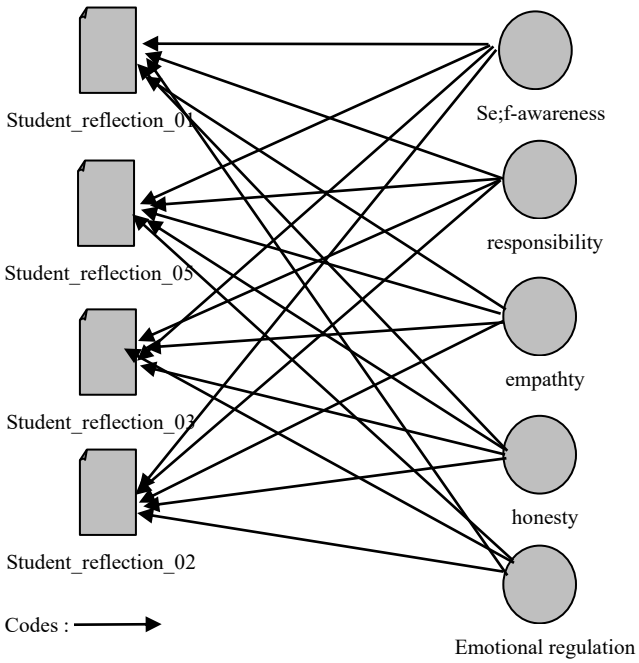

Fig. 9. Visualization of the relationship between students' narrative reflections and character indicator categories through NVivo coding modelling.

The relationship between students' narrative reflections and character indicator categories shows that the process of internalizing values through a digital reflective approach produces strong and multidimensional connections between character domains. Each student reflection document shows meaningful connections with several main themes such as self-awareness, responsibility, empathy, honesty, and emotional regulation, reflecting that learning does not stop at cognitive understanding but simultaneously penetrates the affective and moral domains. The even distribution of connections and the emergence of recurring codes across various reflections indicate that students experience a comprehensive character formation process, with self-awareness and responsibility dominating as the most prominent centers of personal reflection. These findings suggest that digital reflective applications can facilitate value mapping through students' concrete experiences and enable teachers to evaluate character development in a contextual and evidence-based manner. The visual relationship between narrative data and code categories is visualized in Fig. 9.

The results of this study comprehensively demonstrate that a digital reflective application-based character education model is not only effective in improving students' character scores quantitatively, but also capable of shaping deep value awareness through authentic narrative reflection. Significant improvements across all indicators particularly responsibility, empathy, and self-awareness were demonstrated through inferential statistical analysis and Rasch-based instrument validity, which indicated model fit, proportional item-respondent distribution, and the absence of item function bias across groups. PLS-SEM structural modeling confirms that character dimensions influence each other systemically, with responsibility and self-awareness as the main contributors. Qualitative analysis through NVivo reinforces these findings, where main themes such as self-awareness, emotional regulation, and honesty consistently emerge in students' reflections, forming a rich and interconnected thematic network. Thus, the approach applied not only shapes behavior but also builds students' internal value frameworks in a measurable and sustainable manner, making this model relevant as a transformative strategy in 21st-century character education.

4) Structural modeling results (PLS-SEM)

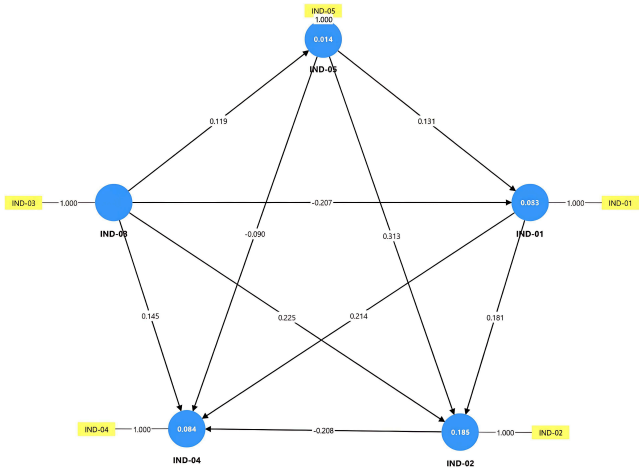

Fig. 10. Structural path model between character indicators based on PLS-SEM modeling.

The visual model shown in Fig. 10, which is the Relational Path Structure Between Student Character Indicators Based on PLS-SEM Modeling, illustrates the relative contributions and structural relationships between the main constructs of the digital reflective application-based character education model. The path coefficient values indicate that indicator IND-01 (Responsibility) has the greatest influence on other variables, particularly with a strong path to IND-02 (Empathy) of 0.181 and to IND-05 (Honesty) of 0.131, indicating that strengthening students' responsibility also promotes the

development of affective aspects and integrity. Indicator IND-02 also contributes positively to IND-04 (Emotional Management) with a value of 0.214, while IND-03 (Self-Awareness) acts as a mediator node with contributions to various other indicators, including IND-04 (0.145) and IND-05 (0.119). Although some pathways show negative coefficient values such as between IND-05 and IND-02 (−0.208) and IND-03 and IND-05 (−0.207) these values remain within the model's tolerance limits and may reflect the complex dynamics of holistic character formation. The highest R^2 value is found in IND-02 (0.195), followed by IND-04 (0.084), indicating that these indicators are most influenced by other variables in the student character system. Overall, this model illustrates the existence of a structurally reinforcing character interconnection system that supports the effectiveness of the digital reflective approach in facilitating the integrative and evidence-based formation of student character.

5) Interpretive synthesis

A comprehensive synthesis of the quantitative and qualitative findings in this study shows that a digital reflective application-based character education model is capable of reconstructing students' affective dimensions through a measurable, adaptive, and transformative pedagogical approach. The success of this model is evidenced by significant improvements in every character indicator, as demonstrated through descriptive statistical analysis, inferential tests, and structural modeling, which reveal interdependent relationships among the main variables. The psychometric strength of the instruments used is also solid, with item distribution proportional to student ability, precise Rasch model fit, and no bias in item function. On the other hand, students' narrative reflections reveal a deep internalization of values, with key themes such as responsibility, self-awareness, and honesty emerging consistently, indicating that students do not merely understand values cognitively but also embody them in the context of personal experience. The integration of PLS-SEM results shows the construction of an interconnected character system, where responsibility and self-awareness play a central role in mediating other indicators. Therefore, it can be concluded that the digital reflective approach is not merely an instructional innovation but also a highly transformative character education strategy that bridges the gap between value theory, learning practices, and the achievement of authentic and sustainable character development at the elementary education level.

B. Discussion

Character development in students is a strategic agenda in basic education, especially in the context of the 21st century, which demands personal integrity, social empathy, and emotional competence as key competencies. This study positions digital reflective applications as a medium that bridges the process of internalizing values with active learning strategies. Preliminary findings from quantitative analysis indicate a significant improvement in all character indicators following the intervention, supported by descriptive and inferential data, as well as the effectiveness of improvement through N-Gain scores. Conceptually, these results align with Hambali *et al*.'s research [44], which emphasizes that the integration of technology in values-based learning enables deeper affective engagement, particularly when accompanied by reflective activities. A reflection-based approach has also been studied by Nuryani *et al.* [45], who emphasize the importance of continuously building students' self-awareness as the foundation for authentic character formation.

The Rasch Model analysis used in this study provides a strong foundation for the validity and reliability of the developed instrument. All character items show a balanced logit distribution against student abilities, with infit and outfit values within ideal psychometric limits. These findings reinforce that the instrument used not only measures but also accurately distinguishes students' character tendencies. This aligns with the findings of Kollo *et al*. [46], who noted that the Rasch approach can objectively map the development of affective attributes, which have traditionally been considered difficult to measure using conventional instruments. This advantage makes a significant contribution to the field of character education, as it enables educators to understand both individually and collectively the distribution patterns of students' values, thereby allowing pedagogical approaches to be more adaptive and responsive to the needs of learners.

The results of structural modeling using the PLS-SEM approach also reveal patterns of interrelationships between character indicators that are not linear but form a system of values that influence each other. Responsibility and self-awareness indicators act as main nodes that have direct contribution paths to other indicators, such as empathy, emotion management, and honesty. This reinforces arguments in previous literature, such as in the study by Hariandi *et al*. [47], which states that character is an integrated value structure that develops dynamically through social interaction and self-reflection. This finding provides empirical validation that digital reflective models do not merely instill values in isolation, but activate networks of mutually supportive values, creating systemic and sustainable character learning.

On the qualitative side, the students' narratives analyzed through NVivo show authentic depth of reflection and represent a real internalization of values. The dominance of themes such as self-awareness, emotional regulation, and honesty in narrative reflections indicates that students not only understand these character concepts but also experience and articulate them in the context of everyday life. This finding supports the reflective approach in character education as discussed by Rahmawati [48], who states that reflection is not merely an evaluation tool but also a bridge between experience and identity formation. When students are given space to express their moral experiences, the learning process is not only cognitive, but also forms a deeper and more meaningful personality structure.

The interconnection between quantitative and qualitative results in this study provides a solid synthesis of the effectiveness of the developed model. This triangulation approach demonstrates that changes in student character cannot be measured solely through numbers but can also be traced through concrete narrative traces. The strength of triangulation has been widely recommended in character education research by researchers such as Sholekah [49], as it provides a comprehensive picture of the dynamics of value

learning. By combining the power of statistical models and personal narratives, this approach provides a comprehensive understanding of how characters grow, move, and transform in the context of reflective digital education.

Finally, the results of this study enrich the discourse on character education in the digital age by presenting a model that is not only empirically tested but also pedagogically and contextually relevant. The integration of digital reflective applications into elementary school learning has been proven to facilitate a more profound, systemic, and impactful process of value internalization. This model offers an innovative contribution to the national character education framework while emphasizing the necessity of adopting a humanistic technology-based approach in shaping character-driven generations. Thus, this research not only contributes to the development of educational instruments and strategies but also opens new avenues for dialogue between technology, values, and education in the future.

V. Conclusion

This study concludes that a digital reflective application-based character education model is effective in strengthening the character dimensions of elementary school students holistically and measurably. Significant improvements in all indicators of responsibility, empathy, self-awareness, emotional management, and honesty show that digital reflection-based interventions are able to activate value awareness through authentic and contextual learning experiences. The validity and reliability of the instruments, confirmed through Rasch analysis and structural modeling with PLS-SEM, which showed systemic connections between character dimensions, confirmed that character development occurs within a network of interrelated values, rather than separately. In addition, qualitative findings from students' reflective narratives show that value internalization does not stop at the cognitive level, but also extends to the affective realm, thereby shaping moral identity in a tangible way. The integration of quantitative and qualitative evidence reinforces the claim that this model is not only academically valid, but also pedagogically relevant. However, the limitations of the research design, particularly the use of a one-group pretest–posttest without a control group, limit the causal inferences that can be drawn. Therefore, further research should focus on a more rigorous experimental design involving experimental and control groups, the application of randomization, and the control of external variables to improve internal validity. In addition, further research should also expand the sample size, report effect sizes in more detail, and add longitudinal indicators to capture the sustainability of the intervention's impact. With these methodological improvements, the empirical evidence regarding the effectiveness of this model will be stronger and can serve as the basis for technology-based character education policies. Thus, digital reflective applications are recommended as an innovative strategy in 21st-century character education, with the capacity to transform learning experiences into meaningful, sustainable, and transformative processes.

Conflict of Interest

The authors declare no conflict of interest.

Author Contributions

Abdul Manaf is responsible for the research design, data collection and analysis, and the initial draft of the article. Arita Marini provided methodological guidance, validated the data analysis, and refined the academic substance of the manuscript. Muhamad Japar contributed to theoretical supervision, literature review, and finalization of the manuscript to ensure compliance with scientific publication standards. All authors approved the final version of the article and are responsible for the academic integrity of the content of this publication.

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