

Research Article

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Education That Matters: Investigating the Quality of Secondary Schooling in Support of Sustainable Development Goal 4

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Abstract

Background/purpose. This study explores the implementation of Sustainable Development Goal 4 (SDG 4)—which advocates for inclusive, equitable, and quality education—among high school students, with a specific focus on the interconnection between quality learning, learning environments, content, processes, and outcomes. Drawing on Vygotsky’s Sociocultural Theory, the research emphasizes that meaningful and sustainable learning depends on the dynamic interaction of well-structured content, inclusive pedagogy, and supportive classroom environments.

Materials/methods. A quantitative cross-sectional design was used, involving 2,425 high school students in West Purwokerto, Indonesia. Using a Structural Equation Modeling (SEM-AMOS) approach, the study measured relationships among key quality indicators: content relevance, instructional performance, student engagement, and outcome effectiveness.

Results. The results revealed strong correlations between quality processes and learning environments, as well as between learning environments and learning outcomes. However, weaker associations were found between content and process integration. The findings suggest that the realization of SDG 4 requires a holistic approach, integrating curriculum reform, teacher training, inclusive practices, and infrastructure improvement. By highlighting the interconnectedness of these educational dimensions, the study contributes valuable insights for policymakers, educators, and school leaders aiming to transform secondary education in support of sustainable development.

Conclusion. In conclusion, the implementation of SDG 4 in high schools is not merely a policy goal; it is a moral and practical necessity. Empowering students to contribute significantly to a more just, peaceful, and sustainable world necessitates a steadfast commitment to the principles of inclusive, egalitarian, and excellent education.



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1. Introduction

Sustainable Development Goal 4 (SDG 4) emphasizes the importance of ensuring accessible and equitable quality education, while promoting lifelong learning opportunities for all. Translating this global commitment into tangible effects in education at the classroom level presents a considerable challenge (Rico et al., 2021). Although the SDG 4 framework delineates extensive educational objectives, numerous classrooms continue to grapple with fulfilling the fundamental tenets of quality education: quality learning, quality learning environment, quality content, quality process, and quality outcomes (Molina et al., 2021). A critical challenge is the cultivation of proficient learning. A multitude of students enter the classroom with varied histories, educational deficiencies, and diminished motivation, frequently intensified by socioeconomic inequalities. This complicates the assurance of uniform preparedness and engagement in education. The learning environment in numerous schools is insufficient to provide high-quality education. Outdated facilities, restricted access to technology and manipulatives, excessive class numbers, and insufficient psychological safety impede teaching efficacy and student engagement (Chotibuddin et al., 2025).

There frequently exists a disparity between the curriculum content and the knowledge students require to thrive in a swiftly evolving, technology-oriented environment. The instruction sometimes lacks practical relevance, cultural sensitivity, and alignment with global competencies (Lestari et al., 2024). The educational process encounters obstacles, such as excessive dependence on conventional, teacher-centric instruction, limited application of varied and inclusive teaching methods, and inadequate formative assessment procedures. These challenges hinder active learning and limit students' ability to develop higher-order thinking skills (Afolabi, 2021). Consequently, learning outcomes are inadequate in numerous areas. Significant achievement disparities endure, and children frequently lack the problem-solving, critical thinking, and numerical competencies essential for advanced education, employment, and engagement in sustainable development. According to Ghazali et al. (2024), these enduring issues highlight a substantial disparity between the aspirations of SDG 4 and the actualities of teaching in schools. Addressing these problems necessitates a thorough comprehension of the interactions and contributions of each component—learning, environment, content, process, and outcomes—to the overall quality of education in the classroom.

Despite the increasing focus on quality education as a worldwide imperative, numerous classes still encounter substantial obstacles in achieving their full potential. Students frequently experience low engagement, fear, and insufficient foundational abilities, indicating deficiencies in cultivating proficient learning (Friday, 2024). Moreover, Lafuente-Lechuga et al. (2020) note that educational settings in numerous schools—attributable to overcrowded classes, insufficient resources, or little support—do not furnish the requisite conditions for effective instruction. The inconsistency in curriculum material exacerbates the issue, as teachers occasionally emphasize rote memorization rather than conceptual comprehension, thereby constraining students' capacity to apply information in practical contexts (Said et al., 2024). The educational process often lacks creativity, differentiation, and formative assessment, leading to inadequate instruction that fails to address unique student needs. These inadequacies ultimately affect learning outcomes, resulting in several students exhibiting inadequate performance and restricted problem-solving abilities, both in standardized assessments and real-life situations (Su et al., 2023). It is imperative to tackle these interrelated concerns. In the absence of a comprehensive strategy that unifies quality learning, learning environment, content, process, and outcomes, initiatives to enhance education will remain disjointed and inadequate. This study aims to analyze these significant problem areas and investigate solutions to improve each element inside the classroom.

While SDG 4 emphasizes not only access to education but also quality education for all, existing studies on secondary schooling tend to focus disproportionately on enrollment, equity in

participation, and resource distribution. There is still a limited systematic investigation into how quality content, quality processes, quality learning environments, and quality outcomes are being realized in secondary schools (Chotibuddin et al., 2025; Molina et al., 2021). Specifically, little is known about how curricula integrate relevant, meaningful, and sustainable content; how teaching and learning processes foster critical thinking and problem-solving; how school environments provide inclusivity and safety; and how outcomes align with both academic achievement and the broader competencies required for sustainable development (Ghazali et al., 2024). This lack of comprehensive evidence creates a research gap in understanding whether secondary schooling genuinely supports the transformative aspirations of SDG 4. Addressing this gap is significant because achieving SDG 4 requires moving beyond access and completion rates to ensure that education delivers meaningful learning experiences. By examining the four dimensions of quality—content, processes, learning environment, and outcomes—this study provides a holistic understanding of how secondary schools can contribute to sustainable development. The findings are valuable for policymakers, curriculum developers, and educators as they highlight what aspects of schooling need strengthening to ensure equity, inclusivity, and relevance. Ultimately, this study contributes to ensuring that secondary education not only equips learners with academic knowledge but also empowers them with values, competencies, and skills essential for global citizenship and sustainable futures.

Therefore, based on the research gap of this study, the research objective are: 1) To evaluate the quality of educational content in secondary school curricula and determine its alignment with the knowledge, skills, and values required to achieve SDG 4; 2) To analyze the quality of educational processes, including pedagogy, assessment, and teacher practices, in fostering equitable, inclusive, and effective learning; 3) To investigate the quality of the learning environment in secondary schools, focusing on inclusivity, safety, resources, and support systems that contribute to meaningful learning experiences; 4) To assess the quality of learning outcomes in terms of academic performance, critical thinking, problem-solving skills, and the broader competencies necessary for sustainable development; 5) To identify challenges and opportunities in implementing and sustaining quality education across the four dimensions of SDG 4 in secondary schooling; and 6) To provide practical recommendations for policymakers, educators, and stakeholders to strengthen the contribution of secondary schooling toward achieving SDG 4. While, the research questions for this study are: 1) How does the quality of secondary schooling contribute to the achievement of SDG 4?; 2) How does the linking of quality content to quality process in SDG 4?; 3) How does the linking of quality content to the quality learning in SDG 4?; 4) How does the linking of quality processes to the quality learning in SDG 4?; 5) How does the linking of quality processes to the quality learning of environment in SDG 4?; 6) How does the linking of quality learning of environment to the quality outcomes?

2. Literature Review

2.1. *Vygotsky's theory for quality education*

SDG 4, established by the United Nations, aims to guarantee inclusive and equitable quality education while promoting lifelong learning opportunities for all students. This global objective highlights the importance of learner inclusion, active participation, meaningful outcomes, and the development of skills necessary for sustainability and citizenship. Vygotsky's Sociocultural Theory provides a robust framework for rethinking educational practices in alignment with SDG 4 (Vygotsky, 1999). The research on the Zone of Proximal Development (ZPD), social interaction, and cultural mediation has significantly impacted global education systems, underpinning pedagogical strategies that foster inclusive, engaging, and high-quality learning for diverse learning (Hausfather, 1996).

Vygotsky's focus on differentiation and responsive teaching aligns with the inclusive education objectives of SDG 4, which seeks to eradicate educational disparities and guarantee equal access for marginalized groups. The notion that learning differs based on an individual's developmental stage

and sociocultural context underscores the necessity for equitable and student-centered methodologies. Research by Sekarningrum et al. (2020) illustrates the application of Vygotskian methods in aiding students with disabilities and those from marginalized communities, offering tailored support aligned with their Zone of Proximal Development (ZPD). Vygotsky emphasized the importance of dialogue-rich, collaborative, and supportive environments that facilitate the co-construction of knowledge in learning. These environments correspond with SDG 4, which advocates for safe, inclusive, and effective learning spaces. Studies indicate that practices influenced by Vygotsky, such as peer tutoring, cooperative learning, and discussion-based learning, enhance student engagement, social inclusion, and cognitive development (Budikusuma et al., 2024). These strategies hold significant importance in multilingual or multicultural classrooms, as learning gain advantages from diverse forms of social mediation.

Vygotsky's sociocultural theory offers a substantial and applicable basis for fulfilling the objectives of SDG 4. The focus on social interaction, cultural relevance, learner agency, and inclusive practices aligns with the vision of providing quality, equitable, and meaningful education for all. Education systems globally are working to achieve the objectives of SDG 4, and the incorporation of Vygotskian principles may enhance teaching effectiveness and enrich learning experiences in various contexts.

2.2. The linking of quality content and quality processes

The achievement of SDG 4, which seeks to "ensure inclusive and equitable quality education and promote lifelong learning opportunities for all" (Meylani, 2025), emphasizes the importance of the interplay between quality content and quality processes in facilitating meaningful learning outcomes. The two components, although functionally distinct, are highly interdependent, and their integration is crucial for achieving a transformative education system. Quality content encompasses the curriculum's relevance, depth, coherence, cultural responsiveness, and applicability to real-world contexts. It encompasses both the factual and conceptual knowledge imparted to learning, as well as the essential competencies required to succeed in a globalized, data-driven environment (Victoria et al., 2023).

Conversely, quality processes include teaching methods, classroom interactions, assessment practices, and instructional strategies that promote learning. The processes influence the delivery, interpretation, and internalization of content by students. Research indicates that the effectiveness of curriculum content is significantly affected by the teaching processes employed (Iljazi & Pandiloska, 2024). Complex concepts, including statistical analysis and algebraic reasoning, necessitate process-oriented approaches such as inquiry-based learning, collaborative problem-solving, and formative feedback loops to facilitate deep understanding. The combination of rich content and active, inclusive teaching strategies enhances student engagement with the material and fosters the critical thinking skills highlighted by SDG 4 (Vásquez et al., 2023).

The integration of quality content and processes promotes equity and inclusivity, which are fundamental principles of SDG 4. Quality content that encompasses diverse cultural contexts and real-life issues—such as climate data modeling or financial literacy—becomes accessible to all students when presented through differentiated, learner-centered processes. This combination enhances academic performance and fosters social-emotional learning and civic engagement, which are essential indicators of sustainable development (Firdaus et al., 2024). Empirical research substantiates this correlation. Lukita et al.'s (2020) findings from the PISA assessment indicate that students who engage with well-structured content via collaborative and reflective teaching practices attain greater learning gains compared to those instructed solely through traditional teacher-based methods. Vásquez et al. (2023) highlight that the attainment of quality education under SDG 4 necessitates the alignment of curriculum content with innovative and inclusive pedagogical methods.

The relationship between quality content and quality processes is symbiotic rather than linear. Content defines the focus and objectives of instruction, whereas processes dictate the methods by which those objectives are realized in practice. The dynamic relationship within SDG 4 ensures effective and transformative educational delivery, preparing learning to contribute meaningfully to a sustainable and equitable global society.

2.3. The linking of quality content and quality learning

Numerous studies indicate that high-quality content has a substantial impact on learning outcomes. Agbata et al. (2024) revision of Bloom's Taxonomy highlights the necessity for content that fosters higher-order thinking skills, which are associated with long-term academic achievement. Vygotsky (1999) contends that learning involves meaning construction, necessitating that materials offered to students are developmentally suitable and scaffolded to facilitate progression.

Ulya et al. (2024) conducted a global study revealing that students exposed to well-structured and contextually relevant content demonstrate superior performance in assessments evaluating problem-solving and conceptual understanding. Shulman's (1986) theory of pedagogical content knowledge posits that effective teaching, and consequently effective learning, depends on the alignment of content with learning's needs and interests. According to Fallis (2018), curriculum reform is essential for meeting the objectives of SDG 4. This involves updating the curriculum content and ensuring alignment with pedagogical strategies that promote inclusive and participatory learning environments. Content that integrates themes such as climate change, digital literacy, and sustainable development facilitates learning comprehension and engagement with real-world challenges, aligning with the objectives of SDG 4.

Abidin and Herman (2023) highlight the importance of curriculum inclusiveness and relevance in addressing disparities and enhancing equity in learning outcomes. Although there is agreement on the significance of aligning content with learning objectives, there is a scarcity of research investigating how this relationship operates specifically within education in developing contexts. Furthermore, there is a necessity for additional empirical research that directly links curriculum quality to SDG 4 learning indicators, particularly in low-resource environments where educational outcome disparities are most pronounced. Research consistently demonstrates that high-quality content is essential for effective learning. In the absence of meaningful, inclusive, and structured curriculum content, educational processes are unable to achieve the deep, transferable learning outcomes mandated by SDG 4 (Li & Tsai, 2022). The relationship between quality content and learning must be a central focus of research and policy as global education systems work towards the objectives of the 2030 Agenda.

2.4. The linking of quality processes and quality learning

Research indicates a strong correlation between high-quality teaching and learning processes and enhanced learning outcomes. Agbata et al.'s (2024) research identified several classroom practices, including formative assessment, clear learning intentions, and feedback, as significantly enhancing student achievement. Hidayati et al. (2020) findings from PISA assessments indicate that interactive and student-centered instructional practices correlate with enhanced performance and increased engagement.

Vygotsky's (1999) sociocultural theory offers a theoretical basis for this connection, positing that learning is mediated socially and improved through guided interactions within the learner's zone of proximal development. This framework highlights the significance of dialogic teaching and structured support, both essential components of a quality educational process. Quality education, as outlined in SDG 4, should be both inclusive and equitable. Research indicates that instructional methods tailored to accommodate diverse learner needs, including differentiated instruction and universal

learning design (UDL), enhance educational equity (Fallis, 2018). Inclusive processes facilitate access and engagement in learning for all students, thereby diminishing disparities in outcomes.

Culturally responsive pedagogy and active participation models facilitate the meaningful involvement of marginalized learning in the educational process (Endelworth, 2020). These practices improve learning outcomes by fostering psychologically safe and cognitively stimulating environments. The relationship between process and learning is well-established; however, there are deficiencies in localized research, especially in low- and middle-income countries. Research often overlooks the impact of systemic constraints, including overcrowded classrooms, inadequate teacher training, and limited resources, on the implementation of quality processes. The necessity for additional data regarding the impact of educational processes on non-cognitive learning outcomes, such as resilience, collaboration, and ethical reasoning, is critical concerning SDG 4.

2.5. The linking of quality processes and quality learning environment

The quality of educational processes and the quality of the learning environment are two interrelated elements central to this vision. They establish the conditions necessary for effective, inclusive, and equitable learning to take place. Educational research emphasizes a significant interrelationship between process and environment. The methods employed by educators can significantly influence the quality of the learning environment, either positively or negatively. Participatory teaching methods promote a collaborative environment, whereas didactic and rigid approaches can lead to disengagement and inequity (Setyaningrum et al., 2021).

Effective processes enhance the learning environment by encouraging student voice and autonomy, promoting mutual respect and cooperation, fostering supportive teacher-student relationships, and creating opportunities for peer learning and inclusion. A supportive environment improves the efficacy of pedagogical processes. Students are more inclined to engage thoroughly with challenging material when they perceive respect, inclusion, and emotional safety (Vásquez et al., 2023). Inclusive processes like UDL modify instruction to accommodate diverse learner needs, thereby enhancing both process quality and environmental responsiveness (Akpalu et al., 2025).

The SDG 4 agenda highlights the importance of quality, equity, and inclusion, which are significantly influenced by effective processes and supportive learning environments. Akinsemolu and Onyeaka (2025) emphasize that enhancing educational outcomes requires more than just curriculum reform; it necessitates a reevaluation of teacher-student interactions and the organization and management of classroom environments. In contexts with limited resources, enhancing processes and environments is especially important. Professional development for teachers may be necessary to implement inclusive pedagogies, while schools should cultivate environments that value gender, language, and cultural diversity. Although there is substantial theoretical backing for the relationship between process and environment, empirical research investigating their joint effects, particularly in the Global South, remains scarce (Yuan et al., 2022). Moreover, although numerous studies assess processes or environments in isolation, there is a scarcity of research investigating the direct impact of changes in instructional processes on environmental factors, including classroom climate, equity, and inclusion.

2.6. The linking of a quality learning environment and quality outcomes

Empirical studies consistently demonstrate that the quality of learning environments directly impacts student outcomes. Nguyen et al. (2024) indicate that classroom climate and relationships significantly influence student achievement. Safe, supportive, and engaging environments promote intellectual risk-taking, inquiry, and perseverance in learning behaviors that correlate with enhanced academic performance and lifelong learning. Emotional safety and a sense of belonging are essential for marginalized and vulnerable learning (Fajar et al., 2021). Students who perceive themselves as

valued and included are more inclined to cultivate confidence, intrinsic motivation, and resilience, factors that enhance learning outcomes.

Moreover, inclusive learning environments that embrace diversity and mitigate barriers to participation are essential for achieving equitable outcomes. Leal (2021) highlights that supportive school environments for students from diverse backgrounds lead to reduced achievement gaps and enhanced overall success. Numerous educational theories demonstrate a significant connection between environment and outcomes. Constructivist theory posits that students learn most effectively in environments that facilitating active knowledge construction through meaningful interactions (Vygotsky, 1999). In these environments, outcomes improve as learning are prompted to engage in critical thinking, collaboration, and the application of knowledge to real-world situations. The Self-Determination Theory posits that environments that satisfy learning needs for autonomy, competence, and relatedness are more likely to enhance motivation, essential for attaining high-quality outcomes (Liu et al., 2022).

Despite a general agreement on the significance of learning environments, persistent challenges persist in consistently measuring environmental quality across various contexts, particularly in low-resource settings. Moreover, a significant portion of current research is focused on developed nations, resulting in a lack of insight into how particular environmental factors influence outcomes across various cultural and socio-economic settings. Moreover, non-cognitive outcomes, including values, resilience, and environmental awareness, while highlighted in SDG 4, are frequently inadequately evaluated within conventional education systems. This results in a discrepancy between policy objectives and the practical assessment of outcome quality.

2.7. The hypothesis of the study

Based on the preceding literature review, the study's hypotheses were formulated and are outlined below.

H1: Quality of processes and content is related

H2: Quality of content and learning lives are intertwined.

H3: There is a connection between the quality of processes and learning.

H4: Quality of processes is associated with the quality of the learning environment.

H5: There is a connection between the quality of content and the learning environment.

H6: There is a relationship between the quality of learning and the learning environment.

H7: There is a connection between the quality of the learning environment and outcomes.

3. Methodology

3.1. Research design

This study employed a cross-sectional design, characteristic of quantitative research, to collect and analyse data (Ishtiaq, 2019). This strategy was employed as it provides a more comprehensive understanding of the situation. Employing a quantitative methodology, such as a cross-sectional survey, for data collection and analysis is essential for achieving reliable results (Byrne, 2019). This evaluation encompassed the quality of learning, process, learning environment, content, and outcome. A substantial number of variables can be extracted from a single element. The aspects considered include quality of learning, encompassing knowledge, skills, and experiences; quality of content, relating to innovation, standards, and history; quality of processes, concerning performance, service ability, and durability; quality of learning environment, comprising student engagement, curriculum & pedagogy, and assessment for student learning; and quality of outcome impressing

product variables, learning indicators, and teaching model. The questionnaire was developed to gather data on these aspects.

An interaction model was developed to examine the interplay among the four identified factors and their relationship with quality outcomes. The structural equation model analysis of Moment Structure (SEM-AMOS) is crucial for relevant investigations, enabling researchers to analyse the interactions among multiple variables in a constant-variable context (Kline, 2017). The competency evaluation encompasses five primary aspects: quality of learning, content, processes, learning environment, and outcomes.

3.2. Data collection procedures

The data collection process was designed to capture multiple perspectives on the quality of secondary education in relation to SDG 4 (Kline, 2017). The procedures began with the selection of participants, consisting of secondary school students, teachers, and policymakers from the targeted region. Schools were purposively chosen to ensure diversity in terms of academic performance, resources, and socio-economic contexts. Prior to data collection, informed consent was obtained from all participants, and ethical approval was secured to ensure confidentiality and voluntary participation.

Quantitative data were gathered through structured surveys administered to students and teachers. The surveys measured perceptions of quality education across four dimensions: content, processes, learning environment, and learning outcomes. Each item was developed using validated indicators aligned with SDG 4, and responses were collected using a Likert scale format. The surveys were distributed in both paper-based and online formats to maximize accessibility and response rates.

To ensure data accuracy, all responses were checked for completeness and consistency (Byrne, 2019). Quantitative data were coded and entered into statistical software for hypothesis testing, while qualitative data were thematically analyzed to capture emerging patterns and contextual insights. This multi-method approach provided a comprehensive understanding of how quality education in secondary schools supports the achievement of SDG 4.

3.3. Instruments utilized

To investigate the quality of secondary education in relation to Sustainable Development Goal 4 (SDG 4), multiple instruments were employed to capture both quantitative and qualitative data. These instruments were designed around the four dimensions of educational quality: content, processes, learning environment, and outcomes. Survey Questionnaires. Structured questionnaires were administered to both students and teachers. The instrument contained Likert-scale items that assessed perceptions of curriculum relevance, teaching and assessment practices, inclusivity of the learning environment, and the achievement of learning outcomes. The questionnaire was adapted from existing validated tools in education quality research and tailored to reflect SDG 4 indicators. Document Analysis Framework. To complement primary data, an analytical framework was used for reviewing curriculum documents, lesson plans, and assessment records. This instrument allowed researchers to assess the alignment between formal educational content and the competencies outlined in SDG 4.

3.4. Analytical techniques

The SEM-AMOS is an instrument for analysing correlations among various variables. The association may stem from correlation or effect rather than direct causation (Byrne, 2019). Kline (2017) refers to this model as the "whole model" because it integrates both measurement models: factor analysis and confirmatory factor analysis. Diverse types of structures can be assessed utilising

suitable methodologies. Given the challenges in achieving high model accuracy due to potential error-inducing variables, this methodology is preferable (Romeo & Elleine, 2022).

This study evaluated the discriminant validity of the components utilising AMOS 24.0 software. The article often featured model fit metrics including the Tucker-Lewis index (TLI), root mean square error of approximation (RMSEA), and the Comparative Fit Index (CFI). Strajhar et al. (2019) assert that a CFI and TLI value of 0.90 or above signifies a satisfactory model fit. Byrne (2019) states that an RMSEA score below 0.08 is a criterion for admission.

3.5. Research model

Additionally, the literature review served as the basis for the conceptual framework. The study's independent variable was the idea of quality of learning, content, processes, and learning environment. The duration and quality of outcomes were the primary subjects of this study. As shown in Figure 1, the model has two direct impacts on the quality outcomes of connections: learning, content, processes, and learning environment.

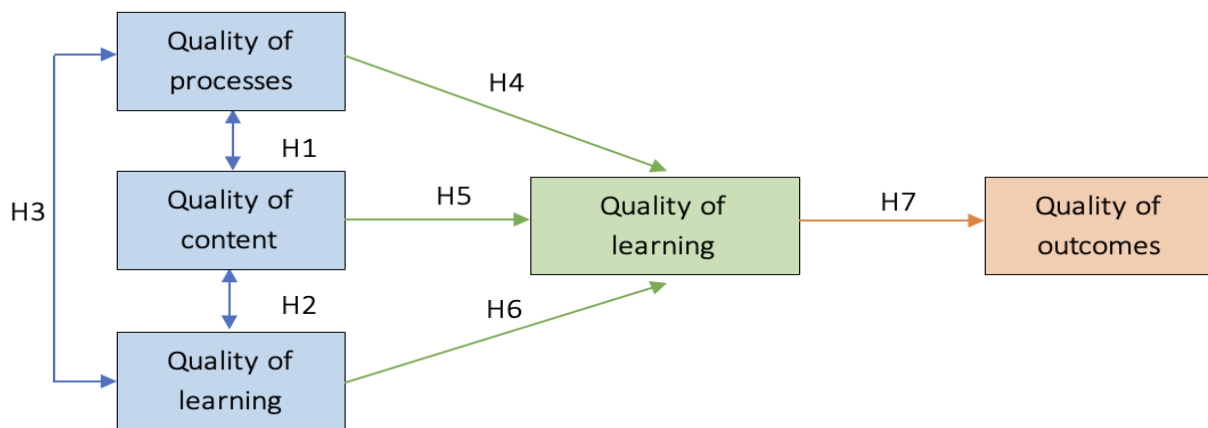


Figure 1. Conceptual framework

3.6. Measurement of variables

The survey form has five sections. Initially, to establish the enduring quality of processes, we considered performance, service ability, and durability dimensions (Hendrayani, 2023). The initial model comprised six components derived from previous research. Secondly, as per Zulfarina et al. (2023), eight questions were extracted from the quality of learning, divided into three segments: knowledge, skills, and experiences. Seven elements were employed to evaluate the quality of content, based on literature regarding innovation, standards, and history (Manni, 2023). Subsequently, the quality of the six items of the learning environment was assessed into three aspects: student engagement, curriculum & pedagogy, and assessment for student learning (Rico et al., 2021). Ultimately, the quality of outcome is comprised of seven questions that consist of product variables, learning indicators, and teaching model (Vásquez et al., 2023). A five-point Likert Scale, where one signifies extreme dissatisfaction and five denotes strong agreement, was employed to evaluate these issues.

According to Romeo and Elleine (2022), the questionnaire items were organised to attain a composite reliability value and a Cronbach's alpha coefficient exceeding 0.7. The five-point scale was selected due to its enhancement of reliability and provision of more objective feedback (Byrne, 2019). Prior theories and empirical studies regarding study objectives, frameworks, and hypothesis formulation did not robustly endorse demographic factors as predictor variables; hence, they were employed as control variables instead. Table 1 presents the survey results used to examine research questions related to students in general.

Table 1. The research variables

Constructs	Sub-constructs	Sample Items
Quality of content	Innovation	I get to choose the items that teachers utilize in the classroom.
	Standards	I may alter the course content to match the needs of my friends by assigning additional assignments, resources, and activities for remediation or enrichment.
	History	I have put mechanisms in place to monitor the amount of new information we have.
Quality of learning	Knowledge	If a concept is too complex for me to grasp, my teacher can easily locate supplementary resources to clarify it.
	Skills	Several fields that call for the integration of different sets of abilities.
	Experiences	I give a range of materials and techniques to cater to my students' interests and demands.
Quality of processes	Performance	Examining the outcomes following the modification of the simulation settings.
	Service ability	After making changes to the simulation parameters, we can see the effects.
	Durability	Troubleshooting problems that call for a series of steps to complete.
Quality of learning environment	Student engagement	I find solace in conversing with people who hold views different from my own.
	Curriculum & pedagogy	The majority of the time, the data that the technology provides would be impossible to access without it.
	Assessment for student learning	Making individualised evaluations of your progress via the learning process is simple.
Quality of outcomes	Product variables	I am well-versed in the subject and have the skills necessary to guide my professors with data.
	Learning indicators	I would like to think that my views contribute to fresh perspectives on our cultural values and traditions.
	Teaching model	The reports and perspectives needed can be easily generated through the school's data system.

3.7. Data and sample

The study involved students from the secondary high school in West Purwokerto, Central Java, Indonesia. The respondents were included in the sample of 2,425 students. Two thousand five hundred paper surveys were distributed to secondary school students and faculty members over one month, utilizing a purposive sampling strategy. Eligibility requires completion of a minimum of one year of study, possession of relevant information regarding the studied phenomena, and the capability to oversee training programs for students. Due to confidentiality considerations, a list of registered personnel could not be provided; therefore, this study employed an alternative method for personnel selection. The constraint precluded the adoption of a random selection approach. Following the distribution of printed questionnaires to interested students, the principal school gathered and transmitted the survey data to the study group.

Table 2 presents the profiles of the respondents. The predominant participants in the poll were male (51.18%), two-year study (42.35%), and three-year study (10.39%). For a study to be considered sufficient, the survey questionnaire should contain over ten formative indicators, and the items of the measurement model must have an outer loading beyond the conventional threshold of 0.70. A minimum of 200 responses is mandated under this general regulation. We successfully tested our hypothesis due to an appropriately sized sample.

Table 2. The profiles of respondents

Profiles	Sub-profile	Frequency	Percentage
Age	14 years old and below	724	29.86
	15-16 years old	1425	58.76
	16 years old and above	276	11.38
Gender	Male	1241	51.18
	Female	1184	48.82
Grade	7	1146	47.26
	8	1027	42.35
	9	252	10.39

4. Results

Utilising the SEM-AMOS 24.0 application, the survey findings were examined. A measurement model analysis validated the reliability and validity of the study instruments (Byrne, 2019), which was considered during the data processing procedure. Secondly, the direct correlation between personal and social sustainability and professional sustainability was further examined by structural model analysis. The formulation of hypotheses grew increasingly challenging as the t-value reached a significant threshold of 1.95. The exploratory power of the study model was assessed using the χ^2 value, categorised into three levels: strong (0.26), moderate (0.13), and weak (0.02). A standardised root-mean-square residual (SRMR) value ranging from 0.08 to 0.10 was deemed indicative of a satisfactory fit between the model and the data, as per Kline's (2017), the fourth criterion. The impact of size was assessed using a χ^2 value, which was 0.35 for large, 0.15 for medium, and 0.02 for microscopic, based on three primary factors. By evaluating the blindfolding value (Q2) with a threshold exceeding zero, the construct achieved the requisite prediction accuracy. One of SEM-AMOS's notable capabilities is its ability to concurrently conduct formative and relative analyses of data from the measurement model. Additional advantages encompass an appealing user interface,

the capability to analyse data from minuscule samples, and the lack of necessity for normally distributed data (Shaheen et al., 2017).

4.1. Testing the reliability of a construct and a discriminant

A reflective measurement model is utilised to evaluate the advantages of convergent and discriminant validity and reliability analyses. A significant degree of expected variation in an indicator signifies that it possesses convergent validity. A convergent validity assessment for the reflecting measurement model can be performed using composite reliability, factor loading, and Average Variance Extracted (AVE). Table 3 illustrates that the loading rate, Average Variance Extracted (AVE), and Composite Reliability (CR) values were employed to assess the reflective measurement model. A loading value over 0.70 was noted for the item-concept association. The AVE was recorded at a value exceeding 0.50. All constructs met the criterion for convergent validity, as the composite reliability score was above 0.70. The reflective measurement model is presented in Table 3.

Table 3. The measurement model evaluation

Constructs	Outer loading	Cronbach Alpha	CR	AVE
Quality Content				
HS	0.692	0.831	0.721	0.724
ST	0.701			
IN	0.331			
Quality Learning				
EXP	0.614	0.731	0.844	0.721
SK	0.721			
KNO	0.622			
Quality Processes				
DR	0.741	0.824	0.821	0.721
SA	0.493			
PF	0.764			
Quality Learning Environment				
SE	0.843	0.726	0.791	0.841
CP	0.734			
ASL	0.692			
Quality Outcomes				
TM	0.921	0.791	0.835	0.746
LI	0.492			
PV	0.552			

Note. HS: history; ST: standards; IN: innovation; EXP: experiences; SK: skills; KNO: knowledge; DR: durability; SA: service ability; PF: performance; SE: student engagement; CP: curriculum & pedagogy; ASL: assessment for student learning; TM: teaching model; LI: learning indicators; PV: product variables.

The results of the discriminant validity test, as assessed by SEM-AMOS, are presented in Table 4. All components demonstrated discriminant validity, evidenced by construct values being less than 0.85.

Table 4. The Discriminant Validity

Constructs	Quality processes	Quality content	Quality learning	Quality learning environment	Quality outcomes
Quality processes					
Quality content	0.734				
Quality learning	0.738	0.782			
Quality learning environment	0.686	0.742	0.683		
Quality outcomes	0.798	0.742	0.672	0.752	

4.2. Structural modeling

The findings of the structural model indicated the direct effects of the study's variables. The SRMR was recorded at less than 0.042, which is below the thresholds of 0.10 and 0.08, suggesting that the model demonstrates a strong fit to the data. The results from the strength test (R²) indicated that the model was effective; notably, the objective component accounted for a statistically significant 0.72% of the quality content variables. The analysis of quality content indicated that the model explained 0.75% of the variance in innovation over an extended period. Furthermore, while a quality learning environment represented only 0.68 percent of the variation in long-term curriculum & pedagogy, the variable in quality processes, performance accounted for 0.83 percent of the variation in independence drive, indicating a significant impact. Finally, regarding the consistency of quality outcomes, learning indicators contributed to 82% of the effect, and the model accounted for 91% of the variance in the teaching model.

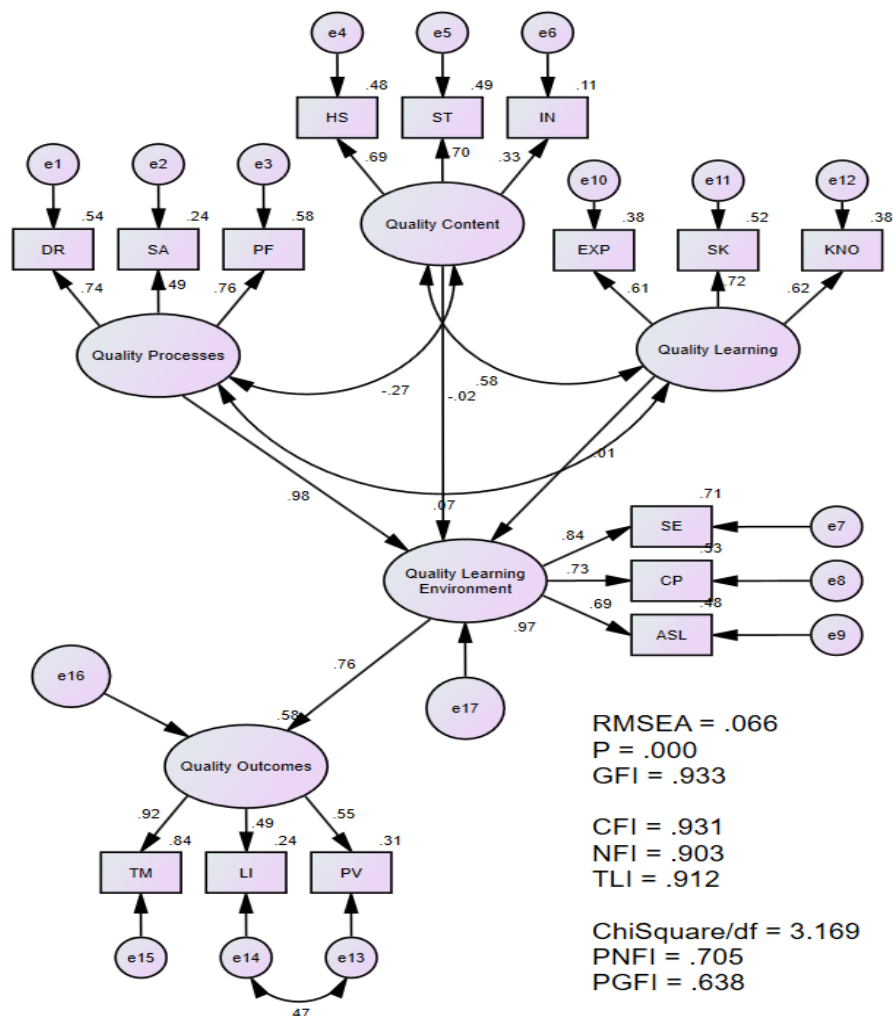


Figure 2. Model structure of the study

Furthermore, quality processes did not influence quality content accounts, evidenced by a χ^2 value of -0.271 (which is below 0.02). $\chi^2 = -0.271$, which is greater than 0.02 but less than 0.15 (Abraham et al., 2019), suggests that there is no statistically significant correlation between quality processes and quality content. A weak association between quality learning and quality learning environment was observed, indicated by a χ^2 value of 0.011 , which exceeds 0.02 yet remains below 0.15 . The χ^2 value of 0.00 , being less than 0.02 , indicates that quality learning had a minimal effect on the quality learning environment over an extended period. The value of 0.011 , which remains below 0.35 , suggests that quality learning exerted a modest influence on the quality learning environment. The final impact result's 0.982 χ^2 value indicates a significant quality process over the quality learning environment term. Figure 2 illustrates the structural model capable of generating predictions.

4.3. Hypothesis result

Table 5 displays the results from the direct model hypothesis testing. The data revealed a negligible association between quality procedures and content relationships ($\beta = -0.274$; $t = 4.426$), leading to the acceptance of H1. The findings of H2 demonstrated a positive and statistically significant correlation between quality content and quality learning ($\beta = 0.584$; $t = 1.225$). Hypothesis 3 is supported by the limited correlation between quality processes and quality learning ($\beta = 0.071$; $t = 1.426$). The robust and significant correlation results between quality processes and quality learning environment ($\beta = 0.984$; $t = 2.327$) substantiate hypothesis 4. The quality of material and the quality of the learning environment demonstrated a negative correlation ($\beta = -0.021$; $t = 2.452$) for

hypothesis 5. The findings of H6 revealed a tenuous correlation between quality learning and the quality learning environment ($\beta = 0.013$; $t = 2.257$). The correlation between a quality learning environment and quality outcomes was significant for H7 ($\beta = 0.762$; $t = 2.527$).

Table 5. The hypothesis results

Hypothesis	β -values	t-values	p-values	Result
H1: Quality of processes and content are related.	-0.274	* 4.426	0.000	Not Accepted
H2: Quality of content and learning lives are intertwined.	0.584	* 1.225	0.000	Accepted
H3: There is a connection between quality of processes and learning.	0.071	* 1.426	0.000	Accepted
H4: Quality of processes is associated with quality of learning environment.	0.984	* 2.327	0.000	Accepted
H5: There is a connection between quality of content and learning environment.	-0.021	* 2.452	0.000	Not Accepted
H6: There is a relationship between quality of learning and learning environment	0.013	* 2.257	0.000	Accepted
H7: There is a connection between quality of learning environment and outcomes	0.762	* 2.527	0.000	Accepted

The hypothesis testing reveals a mixed pattern of relationships among the four dimensions of quality education within the framework of SDG 4. The results indicate that the quality of processes and content (H1), as well as the quality of content and the learning environment (H5), *were not supported*, suggesting that these factors may not be strongly interrelated in the studied context. However, significant positive relationships were found for most other hypotheses. Specifically, the findings confirm that the quality of content and learning (H2), the quality of processes and learning (H3), and the quality of processes and learning environment (H4) are interconnected. Similarly, there is evidence of significant relationships between learning and the learning environment (H6), and between the learning environment and outcomes (H7). Overall, these results highlight the critical role of learning processes, learning environments, and outcomes in shaping the quality of secondary education, while the direct role of content in relation to processes and environments appears less influential.

5. Discussion

This study highlights the essential relationship between quality content and effective learning in the attainment of Sustainable Development Goal 4 (SDG 4), which advocates for "inclusive and equitable quality education and lifelong learning opportunities for all" (Agbata et al., 2024). Although these components are frequently seen as separate entities in educational policy and practice, the findings highlight their interconnected nature in promoting meaningful, equitable, and sustainable learning experiences. Quality content denotes curriculum, materials, and instructional tools that are pertinent, inclusive, precise, and connected with the requirements of learning and overarching societal objectives. It encompasses not only academic knowledge but also competencies and values, including critical thinking, problem-solving, communication, environmental consciousness, and global citizenship. These correspond with SDG 4, which seeks to incorporate education for sustainable development and global citizenship at all educational tiers (Molina et al., 2021).

Meanwhile, the quality of learning denotes the profundity, pertinence, and durability of the educational experience. It encompasses both knowledge acquisition and the cultivation of higher-order cognitive skills, emotional intelligence, and social responsibility. The kind of content significantly impacts the type of learning that transpires. Content that fosters memorisation and rote activities results in superficial learning, whereas content that promotes analysis, synthesis, and inquiry facilitates deeper, more transformative educational experiences. Friday (2024), The research substantiates the notion that effective learning arises when students are motivated to investigate significant concepts, pose enquiries, address real-world challenges, and contemplate their learning journey. This corresponds with constructivist learning theories, which suggest that learning actively builds knowledge through significant interactions with content (Ghazali et al., 2024).

The connection between content and learning is mutually reinforcing. Although high-quality content is essential for significant learning, how students interact with and assimilate information might influence the necessary adaptations or restructuring of that content. Efficient learning functions as a feedback mechanism for assessing the pertinence, lucidity, and influence of content.

If students find it difficult to connect with or utilise a specific subject, it may suggest a necessity for more inclusive, culturally relevant, or multidisciplinary resources. Conversely, Victoria et al. (2023), when curriculum corresponds with students' lived experiences and future ambitions, learning becomes both more effective and more empowering. This connection is essential to the broader objectives of SDG 4, encompassing equity, lifelong learning, and sustainable development. A high-quality curriculum that incorporates sustainability concepts, ethics, and civic responsibility enables learning to excel academically while simultaneously participating in the world as responsible and educated citizens. The interaction between quality processes and quality learning is a fundamental element in attaining SDG 4, which highlights both access to education and the quality and equity of educational outcomes (Akpalu et al., 2025). This study's findings confirm that quality learning is not achieved in isolation; it is profoundly influenced and improved by the quality of educational processes involved in teaching, assessment, classroom interaction, and school management.

The evidence unequivocally demonstrates a robust positive association between effective teaching practices and the attainment of quality learning. Classrooms that incorporate interactive pedagogy, formative assessment, prompt feedback, and individualised instruction empower students to assume responsibility for their learning, improve their metacognitive abilities, and utilise information in practical situations. Moreover, Rico et al. (2021) quality learning—characterized by depth, relevance, transferability, and equity—flourishes in settings where pedagogical approaches are adaptive and responsive. Teachers who consistently evaluate students' progress and modify lessons accordingly facilitate the cognitive and emotional engagement essential for significant learning (Akpalu et al., 2025). This method is particularly consistent with constructivist and sociocultural learning theories, which highlight learner autonomy, collaboration, and contextual significance.

The study reveals that educational procedures promoting critical thinking, self-regulation, problem-solving, and teamwork enhance both immediate academic results and the development of lifelong learning skills. This corresponds with the overarching objective of SDG 4 to equip individuals not solely for examinations, but for lifetime adaptation, civic engagement, and sustainability (Molina et al., 2021). Quality processes that promote learner reflection, idea connectivity, and engagement with varied views cultivate enduring learning that transcends formal education. These competencies are crucial for tackling intricate global issues and fostering a sustainable future (Meylani, 2025). This study underscores the substantial and reciprocal relationship between the quality of educational processes and the learning environment, which is crucial for the effective achievement of SDG 4. This goal emphasises not only universal access to education but also the provision of equitable and

inclusive quality learning opportunities. The results indicate that strong and inclusive educational practices are essential for creating supportive learning environments, and the reverse is also true.

The research confirms that quality learning directly affects the characteristics of the learning environment. Pedagogical techniques that emphasise cooperation, respect for student perspectives, and diversity inherently foster a classroom environment where students experience emotional and intellectual safety. Likewise, Ghazali et al. (2024) formative assessments and constructive feedback systems alleviate anxiety and foster confidence, so enhancing a pleasant psychological environment. Furthermore, student-centered methodologies such as inquiry-based learning, collaborative work, and reflective conversations foster contact and peer support, thereby enriching the social aspect of the classroom. These activities enhance students' academic abilities while cultivating qualities such as empathy, cooperation, and respect, essential for realising the comprehensive objectives of quality education as outlined in SDG 4. Effective practices are essential for establishing inclusive learning environments, particularly for marginalised populations (Leal, 2021). When instructional approaches are modified to accommodate varied needs—via differentiated instruction, multilingual support, or universal learning design—students with impairments, language challenges, or socioeconomic disadvantages can more effectively engage and succeed (Lestari et al., 2024). This corresponds with the goal of SDG 4 to "leave no one behind" and guarantee that all learning, irrespective of their circumstances, can access a quality educational experience.

In contrast, Akinsemolu and Onyeaka (2025) a well-organised learning environment can facilitate and improve the execution of effective processes. Well-equipped, safe, and emotionally supportive classrooms enable teachers to implement more interactive and student-centered pedagogies. Physical resources, such as technology and educational materials, classroom architecture, and the culture of school administration, all influence the facilitation or limitation of high-quality teaching processes (Iljazi & Pandiloska, 2024; Nguyen et al., 2024). The interplay between processes and the environment is defined by a feedback loop: enhancements in the learning environment foster more inventive and effective educational processes, while improvements in these processes further enhance the environment. For example, when students encounter a nurturing and respectful environment, they are more inclined to engage actively, pose enquiries, and contribute, so reinforcing a culture of learning and reciprocal respect.

Meanwhile, Li and Tsai (2022) state that dynamic engagement is essential for maintaining quality education over time. It promotes not only academic success but also the holistic development of the child—socially, emotionally, and ethically—thereby advancing the broader objectives of SDG 4 related to lifelong learning and sustainable development. Subsequently, Chotibuddin et al. (2025), the quest for quality education, as delineated in SDG 4, underscores both fair access to school and the significance of successful learning outcomes. The quality of the learning environment is a crucial component affecting these results. This discourse examines how a supportive learning environment acts as a fundamental catalyst for enhanced educational results, encompassing both academic and non-academic dimensions, in accordance with the objectives of SDG 4.

The results demonstrate a distinct correlation between the quality of the learning environment and the quality of learning outcomes. In educational institutions where students perceive physical safety, emotional support, and respect, engagement levels are markedly elevated. This results in enhanced attendance, diminished dropout rates, and superior academic performance—fundamental indicators for SDG 4.1, which aims for "effective learning outcomes." Furthermore, learning consequences extend beyond just test results (Su et al., 2023). Students in supportive circumstances build enhanced social-emotional competencies, including cooperation, empathy, self-regulation, and resilience. These "soft" outcomes are increasingly seen as vital for lifelong learning and for equipping learning to contribute significantly to sustainable societies. Subsequently, environments that foster inclusion—where gender equity, disability accommodation, and cultural diversity are actively

endorsed—contribute to closing achievement disparities and ensuring equitable outcomes. This aligns with SDG 4.5, which aims to eradicate educational inequities.

6. Conclusion

The quest for quality education, as delineated SDG 4, is essential for enabling all learning to get the information, skills, values, and attitudes requisite for leading productive and satisfying lives. This study highlights that for high school students, attaining quality education necessitates not only access but also a focus on the curriculum, instructional methods, the learning environment, and the resultant outcomes. Research indicates that students who engage with pertinent and inclusive curriculum content, delivered through learner-centred and participatory approaches, and supported by a secure, inclusive, and resource-rich learning environment, are more likely to attain significant and enduring learning outcomes. These achievements extend beyond academic achievement to encompass critical thinking, creativity, teamwork, and a robust sense of social responsibility. The study emphasises that quality education is a multifaceted and interrelated process. Improving student learning outcomes necessitates collaborative efforts among educators, school administrators, legislators, and communities. Investment in educator training, educational infrastructure, curriculum enhancement, and ongoing evaluation methodologies must fit with the overarching objectives of SDG 4. In conclusion, implementing SDG 4 in high schools is not merely a policy goal; it is a moral and practical necessity. Empowering students to contribute significantly to a more just, peaceful, and sustainable world necessitates a steadfast commitment to inclusive, egalitarian, and excellent education.

7. Limitations

This study has several limitations that should be acknowledged. First, the participants were limited to secondary school students, teachers, and a small group of policymakers, which may not fully represent the perspectives of other important stakeholders such as parents, community leaders, or non-governmental organizations involved in education. The relatively narrow participant scope restricts the comprehensiveness of the findings. Second, the research was conducted within a specific geographical region and a limited number of schools, meaning that the results may not be generalizable to other contexts with different policies, resources, or socio-economic conditions. Third, much of the data relied on self-reported perceptions from students and teachers, which may be influenced by social desirability bias or limited awareness of broader indicators of educational quality. In addition, although the study focused on four critical dimensions of quality education—content, processes, learning environment, and outcomes—it did not fully address other influential aspects such as governance structures, financial investment, or cultural diversity. Finally, the research was conducted within a relatively short timeframe, which limited the possibility of examining long-term changes in student learning outcomes or institutional practices that contribute to achieving SDG 4.

8. Suggestion

The study highlights the importance of relevant and meaningful content for student engagement and learning. Educational policymakers should revise secondary school curricula to ensure alignment with global competencies, sustainability themes, and local cultural contexts. This includes integrating topics like climate change, financial literacy, and digital citizenship to support SDG 4. To improve instructional quality and support diverse learners, continuous professional development should focus on active learning strategies, formative assessment, differentiated instruction, and inclusive practices. Training should also address how to translate quality content into engaging classroom activities, particularly in resource-constrained settings. A safe, inclusive, and resource-rich learning environment is strongly linked to better learning outcomes. Investments should be made to reduce class sizes, upgrade facilities, provide adequate learning materials, and ensure psychological safety in

classrooms. Prioritizing the needs of marginalized groups—including students with disabilities and those from low-income backgrounds—is essential to fulfilling the equity targets of SDG 4. Ultimately, traditional testing often fails to capture the broader learning goals of SDG 4. Schools should implement assessment systems that evaluate cognitive, social-emotional, and ethical development. This includes using project-based evaluations, reflective tasks, and collaborative assessments that align with the curriculum and promote lifelong learning skills.

Declarations

Author Contributions. W.N.: Literature review, conceptualization, and writing the manuscript. S.W.: methodology, data analysis. E.S.: review-editing and writing, original manuscript preparation. I.H.: review-editing and writing.

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Data Availability Statement. All evidence supporting this study's findings comes from previously published and publicly available sources, which have been appropriately cited in the References section.

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