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Candidate:

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2022/470017

Belgrade, 2026

Abstract

Sustainable development has become a global concern, and it affects decision making on international and national levels with progress, development and well-being of humans and the planet being seen differently as humans are more aware of constant social inequalities, dangers for the environment and economic uncertainty. As a result, these challenges call for development frameworks that go beyond GDP, economy and growth-oriented metrics towards more holistic approaches and frameworks that incorporate sustainability, equity, and long-term resilience.

The Human Development Index (HDI) was conceptually grounded in Amartya Sen's Capability Approach, which defined development not as much as economic growth, but as the expansion of people's freedoms and capabilities to lead lives of value. HDI has for some time now acted as the main indicator for measuring national development by balancing health, income and educational pillars. Although HDI managed to shift global attention away from only economic growth (GDP), it still has limits in capturing the sustainability and qualitative dimensions of human development. Specifically, educational pillar is measured only through expected years of schooling and mean years of schooling, while there is no account of the extent to which education supports individuals with ethical awareness, knowledge related to sustainability, and skills needed to address wicked problems.

This doctoral dissertation proposes an Enhanced Human Development Index (E-HDI) by incorporating Education for Sustainable Development (ESD) into the education dimension of HDI. The study uses a mixed-method research design: quantitative method - a longitudinal panel regression analysis conducted across 15 nations over the period of 2000 - 2023 to examine the relationship between HDI and selected education-related indicators and broader enabling conditions relevant to ESD, including education expenditure, tertiary enrolment, governance and digital access; qualitative method - A focus group discussion with government employees (policymakers) educators and sustainability experts in Oman offers relevant and contextual insights into the challenges feasibility and policy relevance of incorporating ESD into national development frameworks.

The goal is to have the results which will provide empirical evidence on how sustainability oriented education may contribute to more holistic, balanced and resilient human development which goes beyond current HDI measurements. This thesis primary contribution is proposing E-HDI framework that enhances the conceptual and empirical foundations of human development measurements. ESD is integrated into the education dimension of HDI - shifting the focus from educational attainment to the substantive opportunities education creates for individuals and societies to pursue sustainable and equitable development.

Consequently, the research study offers actionable recommendations for policymakers especially in developing economies and hopes to support transitioning toward more ethical, more inclusive, and sustainable development pathways through sustainability-oriented education.

Abstract in Serbian

Održivi razvoj postao je globalna briga i značajno oblikuje procese donošenja odluka na međunarodnom i nacionalnom nivou, pri čemu se pojmovi napretka, razvoja i blagostanja ljudi i planete sagledavaju na drugačiji način, usled sve veće svesti o trajnim društvenim nejednakostima, ugroženosti životne sredine i ekonomskoj neizvesnosti. Kao rezultat toga, ovi izazovi ukazuju na potrebu za razvojnim okvirima koji prevazilaze BDP, ekonomiju i metrike zasnovane isključivo na rastu, i koji se preusmeravaju ka holističkim pristupima i okvirima koji uključuju održivost, pravičnost i dugoročnu otpornost.

Indeks humanog razvoja (HDI) je konceptualno utemeljen u Pristupu sposobnosti (Capability Approach) Amartje Sena, koji razvoj ne definiše prvenstveno kao ekonomski rast, već kao širenje sloboda i sposobnosti ljudi da vode život koji smatraju vrednim. HDI već duže vreme predstavlja jedan od najnačajnijih pokazatelja za merenje nacionalnog razvoja, objedinjujući zdravstveni, obrazovni i stub koji predstavlja dohodak. Iako je HDI uspeo da preusmeri globalnu pažnju dalje od isključivog fokusa na ekonomski rast (BDP), on i dalje ima ograničenja u obuhvatanju održivih i kvalitativnih dimenzija humanog razvoja. Konkretno, obrazovni stub se meri isključivo kroz očekivane godine školovanja i prosečne godine školovanja, bez eksplicitnog uzimanja u obzir u kojoj meri obrazovanje doprinosi razvoju etičke svesti, znanja povezanih sa održivošću i veština neophodnih za suočavanje sa tzv. „zloćudnim“ (wicked) problemima.

Ova doktorska disertacija predlaže Unapređeni indeks humanog razvoja (E-HDI) kroz integraciju obrazovanja za održivi razvoj (ESD) u obrazovnu dimenziju HDI-ja. Istraživanje koristi kombinovani (mixed-methods) istraživački dizajn. Kvantitativni deo obuhvata longitudinalnu panel regresionu analizu sprovedenu na uzorku od 15 zemalja u periodu od 2000. do 2023. godine, sa ciljem ispitivanja odnosa između HDI-ja i odabranih ESD proxy indikatora, kao što su izdvajanja državnog budžeta za obrazovanje, upis na fakultet, upravljanje i digitalni pristup. Kvalitativni deo istraživanja obuhvata fokus grupnu diskusiju sa zaposlenima u državnoj upravi (donosiocima odluka), nastavnicima i stručnjacima za održivost u Omanu, koja pruža relevantne i kontekstualne uvide u izazove, izvodljivost i političku relevantnost integracije ESD-a u nacionalne razvojne okvire.

Cilj istraživanja je da pruži empirijske dokaze o tome na koji način obrazovanje usmereno ka održivosti doprinosi holističkom, uravnoteženijem i otpornijem modelu humanog razvoja, koji prevazilazi ograničenja postojećih HDI pokazatelja. Glavni naučni doprinos ove doktorske disertacije ogleda se u predlaganju konceptualnog okvira Unapređenog indeksa humanog razvoja (E-HDI) kojim se unapređuju konceptualne i empirijske osnove merenja humanog razvoja. Integracijom obrazovanja za održivi razvoj u obrazovnu dimenziju HDI-ja, fokus se pomera sa formalnih obrazovnih dostignuća na stvarne sposobnosti i mogućnosti koje obrazovanje omogućava pojedincima i društvima u ostvarivanju održivog i pravednog razvoja. Shodno tome,

istraživanje nudi praktično primenljive preporuke za donosioce odluka, naročito u zemljama u razvoju, s ciljem podrške tranziciji ka etičnijim, inkluzivnijim i održivijim razvojnim modelima zasnovanim na obrazovanju usmerenom ka održivosti.

Reflections & Acknowledgements

This thesis presents a framework for a new HDI, and it is my attempt to put into practice, or at least begin sharing, my main professional goal: *to contribute to the development of responsible, values-driven educational and organizational practices that place human well-being, equity, and sustainability at the core of decision-making.*

During this process, I was not alone. Thus, I would like to thank a few extraordinary people:

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List of Abbreviations

SD - Sustainable Development
 ESD - Education for Sustainable Development
 SDGs - Sustainable Development Goals
 HDI - Human Development Index
 E-HDI - Enhanced Human Development Index
 CE - Circular Economy
 TBL - Triple Bottom Line
 EI - Education Index
 TLT - Transformative Learning Theory
 AI - Artificial Intelligence
 FGD - Focus Group Discussion
 UN - United Nations
 UNDP - United Nations Development Programme
 UNESCO - United Nations Educational, Scientific and Cultural Organization
 UIS - UNESCO Institute for Statistics
 WCED - World Commission on Environment and Development
 WGI - Worldwide Governance Indicators
 GDP - Gross Domestic Product
 GNI - Gross National Income
 ESG - Environmental, Social, and Governance
 ICT - Information and Communication Technology
 SME - Small and Medium-sized Enterprise
 NGO - Non-governmental Organisation
 PISA - Programme for International Student Assessment
 TIMSS - Trends in International Mathematics and Science Study
 POLS - Pooled Ordinary Least Squares
 FE - Fixed Effects
 RE - Random Effects
 BE - Between Effects
 FD - First-Difference
 VIF - Variance Inflation Factor
 R^2 - Coefficient of Determination
 Adj. R^2 - Adjusted Coefficient of Determination
 GEE - Government Education Expenditure
 PPE - Pre-primary Enrollment
 SSE - Secondary School Enrollment
 TSE - Tertiary School Enrollment
 PTR - Pupil-Teacher Ratio
 ALR - Adult Literacy Rate
 INT - Internet Penetration (Internet Access)
 URB - Urbanization
 PS - Political Stability
 GEFF - Government Effectiveness
 VA - Voice and Accountability
 UNEMP - Unemployment
 YUNEMP - Youth Unemployment

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CHAPTER 1: INTRODUCTION

1.1 Background and Context

During the twentieth century, rapid industrialization, technological progress, and large-scale economic growth transformed the world in unprecedented ways—and not without consequences. Nature and its cycles were disrupted more than at almost any other time in history. While these changes clearly improved material wealth and living standards, they also increased pressure on ecological systems. The balance began to shift. Industrial production, reliance on fossil fuels, mass consumption patterns, and widespread use of linear “take–make–dispose” models all contributed to accelerating environmental damage, depleting natural resources, reducing biodiversity, and simultaneously deepening social inequalities. In the first half of the century, these consequences were seldom questioned. They were seen as externalities—almost expected or at least tolerated—in the pursuit of economic growth and modernization.

By the second half of the century, however, the situation became harder to overlook. The impacts were no longer distant or abstract—they became visible, measurable, and, in many cases, irreversible. What we now call ‘wicked problems’ (Rittel & Webber, 1973; Head & Alford, 2015)—environmental crises, resource constraints, and persistent inequalities—began to clearly highlight a deeper issue: that existing development paths were unsustainable over the long term. It was during this period that sustainability, as a concept broader than just business continuity or environmental management, started to gain serious attention (Ruggerio, 2021).

Challenges like climate change, inequality, and resource depletion are widely recognized as wicked problems—not just because of their scale, but due to their complexity. They’re systemic, interconnected, and involve multiple actors with competing priorities and values, making them resistant to straightforward or definitive solutions (Rittel & Webber, 1973; Head, 2008). Over time, this understanding led to a shift in collective awareness. Continuing on the same path wasn’t just risky anymore—it became genuinely unsustainable, both for planetary systems and human well-being. From this point, sustainability didn’t emerge as a single concept but rather as a necessary response—a framework that extends beyond “business as usual” and narrow environmental concerns. It began to cover something broader and more intricate: the links between economic development, social equity, and environmental protection. In that way, sustainability isn’t just another dimension—it forms the foundation on which future development must be reconsidered (Ruggerio, 2021).

The evolution of sustainability thinking did not happen in a straight line. It gradually brought a different understanding of how humans relate to nature. For a long time, the dominant view was quite clear—human systems were separate and often placed above natural ones. Nature was something to be used, managed, or adjusted when needed. Over time, though, this way of thinking started to feel limited. A different idea began to take shape—that human systems are not outside of nature, but part of it, embedded within it. This shift was slow - it did not appear suddenly, and

it did not immediately change practice but it did start to influence how production and consumption could be reconsidered. Not all at once, but gradually. One of the outcomes of this change in thinking is what is now referred to as the Circular Economy (CE). This new concept is often described through the idea of mimicking natural cycles. It sounds simple in principle, but it is not simple in reality. Instead of the usual pattern—take, make, dispose—it tries to keep materials in use for as long as possible. That includes reducing, reusing, repairing, repurposing, recycling, and remanufacturing, depending on what is possible in a given context. The intention is quite clear: minimising waste, less pressure on natural systems. The action of achieving results, however, is more complex. Geissdoerfer et al. (2017) point out that the main characteristics of the CE are closely linked to sustainability. There is a shared focus on long-term value, on efficiency within systems, and on responsibility that extends beyond immediate results. These ideas overlap in many ways. Some authors go further in interpreting this connection. Minić and Filipović (2023), for instance, position CE not just as a related concept, but as one of the paradigms within the broader framework of sustainable development (SD).

At around the same time, other frameworks started to emerge, further expanding how sustainability was understood. The Triple Bottom Line (TBL), for instance, introduced what felt like a more structured recognition of the economic, social, and environmental dimensions as interconnected and equally important. Rather than focusing only on profit, TBL challenged organizations—and, more broadly, systems—to consider a more balanced and holistic evaluation of success (Elkington, 2013). It shifted the conversation, not completely, but enough to question purely profit-driven approaches. As sustainability, the CE and TBL gained more attention, the need to better define their relationships and boundaries also became more evident. It was no longer enough to use these concepts interchangeably. Questions started to emerge—how do they relate, where do they overlap, and how can they be applied in practice across different levels, from individual organizations to entire economies? Nikolaou et al. (2021) point to this growing need for clarity, especially across micro, meso, and macro levels of analysis. Together, these developments reflect a broader shift in how sustainability is understood—not as a single idea, but as a multidimensional and systemic response to the limitations of twentieth-century development models. At the same time, they also opened up important debates. In particular, disagreements emerged around how far economic, social, and environmental systems can substitute for one another, leading to the well-known distinction between weak and strong sustainability.

For the big part of the 20th century, the main development paradigms saw progress as economic growth, using gross domestic product (GDP) and other income-based indicators as the main tool for measuring national success and overall development. Whilst these offered convenient and quantifiable proxies for market activities, they offered only some (not sufficient) account of human well-being and social progress. This was the result of the post war consensus that economic growth would benefit employment, increase the standards of living and therefore improve lives. By the late 20th century, however, it was found out through important empirical and theoretical research that strong economy cannot be trusted to guarantee improvements in life quality as well as

equitable benefit distribution (McGillivray & White, 1993; Sen, 1999). These critiques showed that development cannot only mean economic output, but also enhancing people's capabilities to lead lives of purpose and value (Sen, 1999).

This was the time when research started showing that countries with similar income levels exhibited different outcomes in terms of health, education, and social inclusions, while at the same time periods of economic growth showed rising inequality, environmental degradation, and social exclusion (Anand & Sen, 1994; Fukuda-Parr, 2003). This evidence challenged the idea that income was an adequate proxy for development and influenced another thought, or better yet, a question – What does “progress” really mean? It became clear that development could not be reduced to merely the accumulation of material wealth but had to be understood in terms of human well-being, opportunity, and agency.

In the same way, Doughnut Economics (DE), another alternative framework, tries to reframe the purpose of economic activity through a concept of human development placed between basic social needs and planetary boundaries in a “safe and just space” (Raworth, 2017). Kate Raworth's framework challenges the assumption that continuous economic growth is compatible with long-term wellbeing and sustainability. Her work can be seen as complementing Sen's philosophy whereby she emphasizes that human capabilities should expand only within ecological boundaries and development must be limited in order not to undermine environmental systems otherwise it would affect the freedom of future generations. This broader shift towards development models that do not prioritise GDP growth is also reflected in recent comparative work on CE, DE, degrowth, green economy and happiness-based approaches (Minić & Al Hinai, 2025).

The above frameworks and perspectives combined may be taken to show a gap in current human development measurements. HDI does include education and health but it does not show whether systems promote and measure skills needed for ethical, inclusive, equity-driven sustainable development and it does not account for the systemic economic and ecological limitations that shape human freedom. This gap is especially important for emerging economies where fast development might be seen as prioritizing quantitative expansions rather than qualitative transformation.

Therefore, this dissertation tries to respond to that gap by proposing an E-HDI that reshapes the concept of educational dimension of the HDI. Embedding ESD within the education component, the E-HDI attempts to expand the measurement system by introducing education's role in teaching and promoting skills that are in line with SD – ethical actions, responsible leadership, long term well-being.

1.2 Research Problem

HDI has for some time been used as a main metric of national progress, measuring and reporting on income, health, and education (UNDP, 2010). Although it has moved global focus beyond GDP and only economic development (Sachs et al., 2019), HDI still feels incomplete when it comes to

the sustainability parts of human development (Reisch et al., 2016). Researchers claim HDI does not take into account the ethical dimensions of education, environmental issues, and social equity (GlobeScan & SustainAbility, 2019). Moreover, education dimensions show only access and completion, while the quality of learning content, including sustainability knowledge, critical thinking, and ethical decision-making are not present at all (Borg et al., 2014; UNESCO, 2017).

The gap, which clearly shows the lack of measuring quality and sustainability in education, has important implications in how development is measured as well as in policymaking. Wherever sustainability-oriented learning outcomes are excluded, national progress is assessed primarily through quantitative indicators such as income levels, life expectancy, and years of schooling, while long-term factors related to values, ethics, and societal resilience are not present (Neumayer, 2018).

As global challenges—so-called “wicked problems”—such as climate change, biodiversity loss, and social inequality become more prominent, the main question is:

Can HDI adequately capture the type of education required to prepare individuals and societies for sustainable futures? (Rittel & Webber, 1973; Head & Alford, 2015).

If not, national development strategies may appear successful according to HDI rankings but at the same time, they may lack the educational foundations required to address complex, intergenerational challenges characteristic of wicked problems (Rittel & Webber, 1973; Head & Alford, 2015; Sachs et al., 2019). Beyond the descriptive role, HDI is in fact a powerful policy-signaling mechanism which means that its development indicators affect policy priorities, resource allocation, and reform agendas by implicitly defining what is seen as progress. If sustainability-oriented learning outcomes are excluded from HDI, education policies may be at risk to prioritise quantitative measures over qualitative transformation. This creates a risky feedback loop whereby what is measured is managed, while what is omitted—for example, ethical reasoning, sustainability literacy, and long-term responsibility—may receive limited policy attention, despite its growing relevance for sustainable development outcomes (Neumayer, 2018; GlobeScan & SustainAbility, 2019).

Education is increasingly recognized as a key driver of sustainable development, and this recognition was formalized in Sustainable Development Goal 4, particularly SDG 4 (Quality Education) target 4.7, which emphasizes how ESD is essential for equipping learners with the knowledge and skills needed to promote sustainability, human rights, gender equality, and global citizenship (United Nations, n.d.; UNESCO, 2017). However, despite this global movement, the ESD principles are not reflected in HDI metrics, which shows discrepancy between global development measurement frameworks and international sustainability commitments (Wals & Corcoran, 2006; UNESCO, 2017).

Against this background, the research problem addressed in this dissertation has two dimensions:

1. HDI does not fully capture whether education systems prepare people to respond to sustainability challenges.
2. The absence of sustainability-oriented education indicators limits HDI's usefulness as a tool for guiding long-term development policy.

These two define the central problem examined in this dissertation: Would enhancing the educational pillar in HDI through the integration of ESD indicators contribute to more accurate measurement of sustainable human development and more effective policy outcomes?

1.3 Research Aim

The aim of this research is to examine the relationship between ESD-related indicators and human development in emerging economies and, based on the integrated quantitative and qualitative findings, develop a conceptual and empirically informed E-HDI framework that incorporates ESD within the education dimensions of HDI. The proposed framework seeks to address the limitations of the conventional education dimension by extending it beyond educational attainment to include educational quality, sustainability competencies, values and responsible actions.

To accomplish this, the study combines cross-country panel data analysis with qualitative stakeholder evidence from Oman in order to examine both the statistical relationship between education-related factors and HDI and practical conditions through which ESD may contribute to sustainable human development.

1.4 Research Questions

Building on the research problem explained and outlined in the previous section, the dissertation aims to examine if the HDI as it is currently, adequately reflects the role of education in enabling sustainable human development, and if ESD, added to the education dimension of HDI can enhance its explanatory and policy relevance.

Accordingly, this study is guided by the following research questions:

RQ1: Can there be found and measured a relationship between ESD-related indicators and the HDI across countries?

RQ2: To what extent are education-related and sustainability-relevant indicators associated with HDI outcomes?

RQ3: How is ESD at present reflected in higher education policies and practices in Oman, as perceived by Omani key stakeholders in sustainability and academia?

RQ4: How can ESD be integrated, systematically and holistically, into the education dimension of the HDI in order to improve HDI's capacity to measure sustainable human development?

The first two questions are aimed to be answered through quantitative cross-country analysis (Panel Regression), with the third question explored through a qualitative focus group discussion with stakeholders in Oman. The last question synthesizes insights from both studies to inform the development of an E-HDI framework.

1.5 Research Objectives

In response to the limitations identified in the two previous sections, specifically the section discussing the research problem, this thesis aims to improve the measurement of human development by strengthening the education dimension of the HDI through the integration of ESD. This research is a response to the need for development indicators that indeed show current achievements in health, income, and education, but also reflect societies' capacity to sustain human well-being in the face of complex social, environmental, and economic challenges (UNESCO, 2017; Sachs et al., 2019).

The overall, ultimate objective of this dissertation is to develop a conceptual E-HDI that incorporates ESD-related educational dimensions and indicators within the education pillar of HDI, and thus improves its ability to measure sustainable human development.

To achieve this main objective, this research study focuses on the following specific research objectives:

1. To understand the empirical relationship between ESD indicators and the HDI in different countries, so as to assess if sustainability-oriented education is associated with higher levels of human development.
2. To evaluate to what extent education quality and sustainability-related proxies contribute to HDI outcomes beyond years of schooling and to address the limitations of only quantitative education measures.
3. To explore how ESD is reflected in higher education policies and practices in Oman, especially when it comes to alignment with national strategies and international sustainability agenda.
4. To develop a framework - E-HDI which integrates ESD within the education dimension of HDI as a policy-relevant mechanism for assessing sustainable human development and informing long-term development planning.

Through these objectives, this dissertation is trying to inspire academic debates on development measurement and at the same time provide practical insights for policymakers who wish to align education systems with sustainability goals. Combining quantitative cross-country analysis with qualitative evidence from Oman, the research represents a bridge in the gap between measurement, policy design, and educational practice.

1.6 Research Hypotheses

In order to address the research questions related to the relationship between education, sustainability, and human development, this thesis proposes a few testable hypotheses which stem directly from the research problem and are designed to be examined through quantitative cross-country panel data analysis while the qualitative focus group discussion complements the hypothesis testing through giving contextual and policy-relevant insights in the integration of ESD, particularly in the Omani context.

The hypotheses focus on assessing whether education-related sustainability proxies and enabling contextual factors are significantly associated with human development outcomes as measured by the HDI in 15 different economies.

H1: Countries with higher enrollment in education levels aligned with ESD show higher HDI scores.

This hypothesis aims to check if higher participation in sustainability-oriented systems may be associated with improved human development outcomes. Education is a crucial aspect of human development as wider access to education expands individuals' opportunities to acquire knowledge, develop skills and capabilities and improve their social and economic outcomes (Sen, 1999; UNDP, 2010). Higher enrollment across different levels of education can therefore contribute to human development as larger share of population is reached by formal education and has the opportunity to progress through successive learning, strengthen literacy and competencies, improve employability and participate more effectively in social and economic life. When education incorporates ESD principles, learners may additionally develop critical thinking, responsible decision-making and more awareness of sustainability challenges (UNESCO, 2017). Based on these links between broader educational access, capability development and ESD, a positive association between HDI and enrollment in education is expected. H1 therefore examines the broader contribution of educational access across multiple levels of the education system to human development.

H2: Political stability is positively associated with HDI.

The second hypothesis examines the relationship between political stability and human development, recognising that stable political environments may support effective policy implementation and investment in education and social sectors. Political stability may support human development by creating the institutional continuity needed for public services, long-term investment and effective implementation of educational and social policies. Stable political environments may be better positioned to maintain educational funding, sustain reform programmes, protect institutional capacity and reduce disruptions that can weaken access to and public services. Previous research has also identified positive relationship between governance quality and human development outcomes suggesting that institutional conditions influence how

effectively national resources are translated into improvements in education, health and living standards (Stryzhak et al., 2022). Political stability may therefore contribute to human development by supporting the institutional continuity required for sustained educational and social policy implementation.

H3: Education expenditure, as a percentage of GDP, is positively associated with HDI.

This hypothesis offers the assumption that public investment in education may contribute to improved HDI outcomes. Public expenditure on education represents an important mechanism through which governments can expand educational access and improve the conditions in which learning takes place. Greater investment may support educational infrastructure, teacher recruitment and development, learning resources, student support services and the implementation of educational reforms. All this may contribute to stronger educational outcomes and wider human capability development (World Bank, 2018; UNDP, 2010). From human development perspective, investment in education can also improve individuals' opportunities for employment, participation and long-term social and economic well-being. Therefore, higher government expenditure on education is expected to be positively associated with HDI.

Enabling Infrastructure and Access Hypotheses:

H4: Internet usage/availability is marginally associated with HDI

In this hypothesis, the role of digital connectivity may be a factor in enabling education access, knowledge diffusion, and broader human development. Greater internet access can support learning beyond classroom, widen access to educational resources, facilitate knowledge exchange and strengthen participation in increasingly digital societies. It may also reduce global geographical barriers to information and support the development of digital competencies which are becoming increasingly relevant for employment, lifelong learning and participation in contemporary social life. Research has also identified a positive relationship between technological connectivity and human development, with network accessibility, including internet and broadband access, contributing positively to HDI and its underlying dimensions (Modarress-Fathi et al., 2022; Bala, 2024). However, mere access does not guarantee meaningful educational or developmental outcomes as these also depend on digital skills, infrastructure quality and the effective use of technology. For this reason, internet usage is expected to demonstrate a positive, but perhaps modest, association with HDI.

H5: Tertiary education enrollment demonstrates a positive association with HDI

Tertiary education plays an important role in human development by developing advanced knowledge and skills, strengthening employability and increasing individuals' capacity to participate in higher-value economic and professional activities. This hypothesis isolates tertiary education from the broader enrolment relationship examined in H1 in order to assess whether participation at this advanced level has a distinct association with HDI. Evidence suggests that tertiary education contributes not only to economic growth but also to broader human development

outcomes, including stronger institutions, health, civic participation and professional capacity (Oketch et al., 2014). More recent research has also demonstrated a positive contribution of higher education to sustainable economic development through human capital formation and knowledge development (Li & Kang, 2025). In the context of ESD, tertiary institutions are additionally positioned to develop sustainability-related competencies and prepare graduates to respond to complex societal and environmental challenges. Therefore, higher tertiary education enrolment is expected to be positively associated with HDI.

All the hypotheses are a guide for the quantitative component and are tested through panel regression across a sample of selected countries. This quantitative method examines how education indicators and governance conditions relate to human development outcomes.

The qualitative focus group discussion conducted with key stakeholders in Oman does not test these hypotheses; it is only a complementary method whose role is to provide contextual insight into how ESD is understood, implemented and aligned with policy and institutional settings. The qualitative findings serve to interpret the quantitative results, explore possible explanatory pathways, and inform the development of the E-HDI framework.

1.7 Research Scope

The scope of the research includes a few dimensions - geographical, temporal, thematic, and methodological all of which ensure clarity regarding the boundaries and focus of the examination.

1.7.1 Geographical Scope

The quantitative component of the study employs a cross-country panel dataset comprising 15 selected countries: Oman, Georgia, Costa Rica, Serbia, Brazil, Ukraine, Sri Lanka, Vietnam, Jordan, Egypt, the Philippines, India, Kenya, Rwanda, and Pakistan. The sample covers countries from the Middle East, Europe and Eurasia, Latin America, South and Southeast Asia, and Africa, thereby capturing a range of human development, educational and institutional contexts. The countries were selected to provide geographical diversity while maintaining relevance to the study's focus on emerging economies and the availability of sufficiently comparable longitudinal data for the variables included in the panel analysis. This diversity allows the study to examine whether relationships between education-related indicators and HDI are observable across different national settings rather than within a single region or development context. This comparative approach aims to examine relationship patterns between ESD-related indicators and the HDI across different national settings.

Within this broader comparative framework, the Sultanate of Oman is selected as a focal case for the qualitative component of the study. This small country in the Middle East is able to provide a policy-relevant context because of its constant education reforms and explicit commitment to sustainable development through Oman Vision 2040, which focuses on pillars like knowledge-based economy, human capital formation, and environmental responsibility. This qualitative focus

allows for in-depth exploration of how ESD is understood and operationalized inside a specific national context, and it is not limiting the broader applicability of the study's findings.

1.7.2 Temporal Scope

The quantitative analysis is using longitudinal panel data covering a 24 year period, from 2000 to 2023, which allows the examination of trends and relationships between education-related indicators and HDI over time. This period was chosen to provide a sufficiently long time horizon to examine changes in education-related, governance, digital and human development indicators and to identify relationships that may not be visible in a single-year or cross-sectional analysis. The longitudinal structure also allows the study to account for changes in national development conditions over time and strengthens the comparison of patterns across countries. The qualitative component reflects the contemporary policy and implementation context in Oman. The FGD was conducted in 2026 and examined current stakeholder perspectives on ESD, educational practice, governance, and institutional implementation and sustainability priorities. The qualitative phase therefore complements the historical panel analysis by providing recent contextual evidence that supports the interpretation of the quantitative findings and the development of the proposed E-HDI framework.

1.7.3 Thematic Scope

When it comes to thematical scope, this dissertation focuses on the education dimension of human development, with main emphasis on the integration of sustainability-oriented learning outcomes into development measurement frameworks. Although it fully acknowledges the interconnected economic, social, and environmental dimensions of sustainable development, the research deliberately concentrates on education as a core mechanism for expanding capabilities, ethics, and long-term development capacity.

Within education, the qualitative inquiry focuses primarily on higher education, as its strategic role is in shaping future professionals, policymakers, and leaders in society, and it also has high importance for national development strategies in emerging economies.

1.7.4 Methodological Scope

This thesis methodology uses a mixed method - it combines quantitative panel regression analysis with qualitative focus group discussion. The quantitative component tests the proposed hypotheses through internationally available datasets and proxy indicators related to education quality, sustainability, governance, investment, and connectivity. Proxy indicators are employed because direct ones, directly related to ESD - sustainability competencies, ethics, and systems thinking—are not consistently available, comparable, or measurable in all the countries over time. Thus, internationally comparable/proxy variables are used

In the qualitative part, the study is based on a focus group discussion - stakeholders in Oman were selected - policymakers, educators, and sustainability practitioners. The discussion method is used

to explain and better understand the quantitative results and to support the development of the E-HDI. The aim is not to generalize the qualitative findings but for them to provide deeper insight and practical relevance for policy.

1.7.5 Study Boundaries/Delimitations

This study does not aim to create a completely new sustainability index or to replace existing development measures. Instead, it focuses on proposing how current HDI can be enhanced by strengthening its education component through the inclusion of ESD.

The issues related to environment and economic sustainability are considered only when they are related directly to education and human development (social sustainability aspect). It is not an attempt of this study to measure all aspects of sustainability in a broad, comprehensive way.

1.8 Structure of the Thesis

This dissertation has 6 chapters in its structure and each one addresses a specific aspect of the research problem and aims to contribute to the development all of the E-HDI framework.

Chapter 1 introduces the context by outlining the history and evolution of sustainability and human development thinking, with the focus on HDI, identifies the research problem, and defines objectives and scope of the study.

Chapter 2 reviews the available relevant literature on sustainability, human development, education quality and ESD. It examines existing concepts, approaches and indicators critically and finds gaps in the contemporary research in terms of HDI dimension metrics.

Chapter 3 presents research methodology (mixed-method approach used), gives details on data sources, variables selection, econometric techniques, as well as qualitative research design used in this study. It also explains limitations in sourcing data.

Chapter 4 reports and discusses the results/findings of quantitative panel data analysis— it examines the relationship between HDI and sustainability related education indicators across the selected countries. This is followed by a qualitative focus group discussion with policymakers, educators, and sustainability experts in Oman, which provides contextual depths and policy relevant interpretation of the quantitative results. All these findings, especially the qualitative ones from the case study of Oman, introduce the E-HDI framework, integrating insights from both quantitative and qualitative analyses.

Chapter 5 interprets the main findings of the study with regard to research aim, problem and objectives, hypotheses, theoretical framework and existing literature.

Chapter 6 concludes this dissertation through summarizing the key findings; it then outlines theoretical and policy contributions of this study, discusses limitations and finally offers recommendations for further research and policy development.

CHAPTER 2: LITERATURE REVIEW

2.1 Background and Theoretical Foundation

A comprehensive understanding of the relationship between human development and sustainability requires going beyond traditional development paradigms and examining the theoretical frameworks that explain how societies develop, manage resources, and conceptualize progress. As sustainability emerged as a central concern in development discourse, researchers increasingly challenged the assumption that economic growth alone could sustain long-term human well-being without imposing environmental and social consequences. These discussions gave rise to different schools of thought on sustainability and development, particularly concerning the relationship between economic, social, and environmental systems and the extent to which these systems can substitute for one another.

The concept of weak sustainability is founded on the principles of neoclassical economic theory, which posits that different forms of capital, including natural, human and manufactured capital are mutually substitutable. From this perspective, environmental degradation is considered acceptable if declines in natural capital are adequately compensated by improvements in the other forms of capital, such as technological progress, human development, the accumulation of skills, and economic growth (Solow, 1993; Pearce & Atkinson, 1993). It may therefore be argued that weak sustainability places efficiency, innovation and economic adaptability at the center of its approach thereby influencing mainstream policy frameworks and development indicators that focus on human well-being rather than ecological constraints. In contrast, the concept of strong sustainability challenges of the assumption of substitutability, arguing that many ecological assets provide essential functions that cannot be sustained by human-made capital. According to proponents of strong sustainability, exceeding ecological limits jeopardizes the foundations of long-term human well-being, while any short-term economic and social gains are considered insufficient to justify the associated risks (Daly, 1996; Neumayer, 2003). According to this perspective, respecting planetary boundaries is essential to prevent irreversible environmental change, ensure intergenerational justice, and guarantee that development occurs within the Earth's biophysical limits rather than relying on future technological progress to offset environmental degradation. While weak sustainability is closely aligned with growth-oriented development models and composite indicators that prioritize short-term objectives and outcomes, strong sustainability advocates a precautionary approach centered on the protection of critical natural systems, resilience, and long-term ecological capacity (Neumayer, 2003; Ekins et al., 2003). The distinction between strong and weak sustainability reaches beyond environmental concerns, encompassing broader issues of social equity, institutional responsibility, ethical decision-making, and the need for development frameworks that evaluate not only present achievements but also the capacity to sustain development in the future.

Recent years have witnessed a growing number of studies investigating disconnection between human development and sustainability. In addition, integrating sustainability indicators into the HDI to strengthen its consistency with the Sustainable Development Goals (SDGs) has become a central research objective in efforts to address interconnected global challenges and improve prospects for the future generations. A pioneering contribution by Fuentes-Nieva and Pereira (2010) established a theoretical basis for examining the disconnect between human development and sustainability. Their work identified several instances in which sustainability indicators were incompatible with the components of human development. Furthermore, their conceptualization of “sustainable human development” underscored the need for the development of novel measurement frameworks capable of representing these relationships more effectively. In the context of integrating educational quality into the components of human development, Grisolia et al. (2022) refined the educational dimension of the HDI by incorporating the Programme for International Student Assessment (PISA) as an additional indicator of education index, emphasizing that the increasing demand for technical competencies in the future labour market necessitates a greater focus on the quality of education rather than solely on duration of schooling. In another study, Gorobets (2011) proposed an alternative approach to measuring human development by incorporating natural, physical and biological indicators in the HDI formula. Üstün and Ürey (2024) examined the Trends in International Mathematics and Science Study (TIMSS), a periodical assessment of the quality of mathematical and scientific education, in the context of sustainability. Their findings demonstrated that the “Environmental Awareness Scale” included in TIMSS, which measures students’ awareness of environmental issues, represents an important step toward strengthening ESD. Furthermore, mathematics and statistics have been recognized as powerful tools for advancing sustainability education, provided that the teachers possess the necessary capacity to effectively integrate and communicate sustainability-related concepts and learning materials (Vásquez et al., 2023).

A comprehensive report highlighting the importance of integrating environmental topics into educational systems, particularly as a resource for educational policymakers, was presented by Isac, Sandoval-Hernández, and Saas (2025). It is also important to note that several international organizations and assessment programs, including International Association for the Evaluation of Educational Achievement, Trends in International Mathematics and Science Study (TIMSS), Programme for International Student Assessment (PISA), and Sustainability Literacy Test, have increasingly incorporated sustainability-related objectives into their assessment frameworks to evaluate both the education quality and the extent to which education systems support sustainable development. Furthermore, Stryzhak et al. (2022) examined the quality of institutional environment by analyzing the World Governance Indicators (WGI) and identified a positive association between the HDI and the WGI. Similarly, a comprehensive study by Cling and Delecourt (2022) demonstrated that cross-country difference in the Sustainable Development Goals (SDG) indicators are largely explained by variations in economic development, as measured by gross national income (GNI) per capita. Despite the universal nature of the SDGs, they

highlighted several concerns regarding the cross-country evaluation of SDG performance arising from differences in regional settings and local priorities. These concerns are consistent with the findings of Kanbur, Patel and Stiglitz (2018).

Furthermore, Kumar et al. (2025) examined the relationship between the HDI, CO₂ emissions, income inequality, and the Economic Complexity Index, demonstrating the important role of policymakers in balancing economic development to address the environmental challenges associated with economic growth and income inequality. In a case study conducted in China, Li and Kang (2025) emphasized the substantial contribution of higher education to regional sustainable development. Specifically, they reported a positive correlation between the number of higher education graduates and growth in GDP per capita. In addition, enhancing access to higher education was identified as a key driver of economic growth.

The status of ESD in the Arab region has been examined across several dimensions. For instance, a United Arab Emirates-based study by Al-Naqbi and Alshannag (2018) revealed a strong positive attitude among students toward ESD and environmental issues. In a case study of primary education in Egypt, Elkholy (2024) examined education for sustainability from two perspectives, namely the alignment of the curriculum and teachers' familiarity with the elements required for implementation of education for sustainability. Based on content analysis and interviews, the author identified sustainability-related content; however, the integration of ESD remains limited and requires overcoming prevailing cultural attitudes and perceptions regarding education. At the higher education level, universities in high-income Arab countries have been shown to play a fundamental role in achieving the SDGs through practical teaching and learning processes. In particular, Abdalla et al. (2024) identified several key contributions of the Arab higher education sector in the Gulf Cooperation Council region, including the provision of sustainability-related academic courses and programs to enhance understanding of sustainability issues, the allocation of sufficient funding to support relevant projects, and the establishment of strong partnerships between Arab Universities and local communities, industries, NGOs, and governments.

Research has sought to bridge this gap by integrating sustainability into HDI framework as part of its measurement system or by proposing additional dimensions that complement the HDI. For instance, Grisolia, Lucia, and Torchio (2022) proposed incorporating reading, mathematics, and science achievement data from assessments such as PISA into Education Index (EI) of the HDI. This modification enriches the measurement by capturing the actual quality and effectiveness of learning rather than relying solely on years of schooling. The modified education index is denoted as EI*, while the revised HDI is referred to as HDI*. Torchio et al. (2024) proposed linking the HDI with greenhouse gas emissions and particulate matter (PM_{2.5}) by introducing an Environmental Cost Index, a metric that complements the HDI and enables a more comprehensive assessment of human development. Their case study conducted in Italy demonstrated that a high

207 HDI score does not necessarily correspond to higher levels of well-being; in other words, economic growth does not automatically translate into greater life satisfaction or happiness.

113 Education, one of the core pillars of the HDI, has been criticized for its limited consideration of sustainability-related competencies. Although education constitutes a fundamental component of the HDI, its current measurement, which is based primarily on mean years of schooling and expected years of schooling, has been criticized for lacking a qualitative dimension, particularly with respect to sustainability-related competencies. Critics argue that the education pillar of the HDI is predominantly input-based, emphasizing educational attainment and enrollment-related measures while failing to account for the quality, transformative potential, and relevance of learning. This approach may not adequately capture the extent to which education fosters competencies such as ethical reasoning, systems thinking, and ecological awareness, all of which are essential for sustainable development.

61 Among the early critical contributions, Sagar and Najam (1998), writing in *Ecological Economics*, argued that the HDI “assesses how well reports have lived up to their conceptual mandate.” Here, he refers to the discrepancy between the original conceptual objectives of the HDI and its practical implementation, ultimately arguing that the education component of the HDI fails to reflect its broader developmental and sustainability-related objectives. According to Sagar and Najam (1998), the indicators are too narrow, as they do not adequately address equality, freedom, quality, or sustainability.

Grisolia et al. (2022) extended this line of criticism by adopting a more proactive approach aimed at redefining HDI. ESD, reflected in SDG 4 (Quality Education), particularly SDG4.7 and endorsed by UNESCO, emphasizes transformative learning that promotes responsible citizenship and leadership, critical thinking, ethical decision-making and ecological consciousness. Torchio, Lucia, and Grisolia (2024) argued that incorporating ESD into the Education Index (EI) could enhance the capacity of the HDI to promote quality education globally, and consequently, long-term sustainable human development. Rather than treating ESD as a supplementary or external objective, integrating it into the educational sub-index HDI would recalibrate the index to reflect the quality and purpose of learning, rather than merely its duration or levels of educational attainment.

187 Additionally, Transformative Learning Theory (TLT), originally proposed by Jack Mezirow, provides an important theoretical foundation for understanding how education, particularly at the adult and tertiary levels, can make a meaningful contribution to human development through values-based and deeper learning. The TLT was originally developed in the context of adult women returning to education through community college programs. In this context, it focused on the processes through which adults revise their perspectives through personal experience, dialogues and critical reflection (Mezirow, 1991).

249 In *Transformative Learning: Theory to Practice*, Mezirow (1997) outlined a ten-phase process that begins with a disorienting dilemma, progresses through a process of reorientation, and ultimately results in a transformed perspective. Although TLT originated in the field of adult education, it has proven beneficial when applied to lifelong learning and tertiary education, particularly (Eschenbacher & Fleming, 2020). In the present study, TLT provides the theoretical foundation for the first hypothesis, H1, which posits that education, particularly tertiary education, when aligned with ESD principles, contributes significantly to the HDI. In contrast to the traditional educational measures within the HDI, which focus primarily on years of schooling, TLT emphasizes the qualitative dimension of education by focusing on the transformation of learners, thereby supporting the proposition that certain forms of education are more effective in shaping long-term human development. Through the integration of transformative learning, the present analysis moves beyond purely quantitative measures of education toward recognizing education as a driver of sustainable, ethical, and inclusive development.

2.2 Key Variables in Literature

73 The conceptual foundation for understanding human development independently of GDP is rooted in the Capability Approach, developed by Amartya Sen, who conceptualizes development as the expansion of people's freedoms to lead lives they have reason to value (Sen, 1999). From this perspective, development is understood not in terms of economic growth, income, or institutional expansion, but in terms of the genuine opportunities available to individuals to achieve well-being, exercise control over decisions affecting their lives, and participate meaningfully in society.

78 Amartya Sen's Capability Approach emerged as a response to narrow, growth-oriented models of development that equated progress with rising income levels. Sen argued that income and resources are merely means rather than ends, and that their value lies in the extent to which they enable individuals to convert them into valuable "functionings", such as being educated, maintaining good health, participating responsibly in civic life, and choosing to live with dignity (Sen, 1985; Sen, 1999). This distinction is of fundamental importance, as individuals and societies differ substantially in their ability to transform resources into genuine freedoms. Possessing resources does not necessarily imply having the freedom to use them, since social systems, institutions, culture, and power structures may constrain the real opportunities available to individuals.

52 The HDI emerged as a response to prevailing development paradigms and represented a significant shift in global development thinking, particularly within policy- and decision-making circles. Introduced by the United Nations Development Programme in 1990, the HDI was designed to move beyond the narrow view of development based solely on GDP or gross national income (GNI), adopting instead a more holistic approach that incorporates health, education, and income as its core dimensions (UNDP, 1990; Anand & Sen, 1994). By combining life expectancy at birth, expected years of schooling, mean years of schooling, and gross national income per capita, the HDI reframed development as a multidimensional concept centered on human well-being rather

than solely on material wealth. This shift in perspective contributed to what has been described as “human-centered turn” in development economics and policy (McGillivray, 1991; McGillivray & White, 1993; Fukuda-Parr, 2003). In doing so, the HDI sought to capture both the means and the ends of development, making a conceptual departure from growth-centric models. Consequently, it contributed to the institutionalization of human development as a dominant development paradigm (McGillivray, 1991; Fukuda-Parr, 2003).

The HDI was directly influenced by Sen’s Capability Approach. By incorporating the dimensions of health, education, and income, it acknowledged the multidimensional nature of human well-being (UNDP, 1990). Nevertheless, despite its conceptual foundation in Sen’s philosophy, the operationalization of the HDI remains predominantly quantitative. For instance, education is assessed in terms of expected years of schooling rather than the skills and qualitative capacities it develops, including critical thinking, ethical reasoning, and social responsibility. Thus, the HDI captures educational access and attainment but only partially reflects the expansion of human capabilities that Sen considered to be the essence of development (Sen, 2009).

Consequently, Sen’s Capability Approach has become a crucial ethical and analytical framework for re-examining the role of education within development frameworks. According to Sen, education is valuable not because it exists as an institutional system, but because it expands individuals’ capabilities by enabling them to exercise the real freedom to choose, to act, and to contribute to society. This approach is consistent with the principles of ESD, as reflected in SDG 4.7 which emphasises systems thinking, ethical judgement, intergenerational responsibility, and informed participation in addressing social and environmental challenges (UNESCO, 2017).

While Sen explains development in terms of freedom, contemporary economic critiques continue to argue that existing measures of development remain insufficient. Others argue that money is not a neutral instrument, but an institution shaped by legal, political, and social arrangements that influences how resources and economic opportunities are distributed across society (Desan, 2014). From the perspective of Sen’s capability approach, this implies that financial systems can either expand or constrain human freedoms, depending on how they are designed and governed. Consequently, development indicators that overlook these systemic influences risk misrepresenting genuine human progress.

The research framework adopted in this study reflects the multidimensional nature of human development and the broader institutional conditions within which education contributes to sustainable development. The selected variables are grouped into five conceptual categories: the human development outcome, education-related conditions, governance and institutional enabling conditions, a digital enabling condition, and socio-economic controls. This grouping is informed by the literature on human development, education policy, governance, digital inclusion, and ESD.

HDI is retained as the human development outcome because it captures achievements across three central dimensions of development: health, education, and income (UNDP, 2020). Its inclusion is

11 consistent with the Capability Approach, which conceptualises development as the expansion of human opportunities and freedoms rather than economic growth alone. At the same time, the HDI has been criticised for limitations in capturing aspects of human development that extend beyond its existing dimensions, including qualitative aspects of education (Sagar & Najam, 1998). These limitations are particularly relevant to this study because the education component of the HDI primarily captures years of schooling rather than the knowledge, values, and competencies associated with ESD.

76 The education-related variables represent different characteristics of education systems through which ESD may be supported and delivered. These include participation across pre-primary, secondary, and tertiary education, adult literacy, government expenditure on education, and the pupil-teacher ratio. Together, they reflect access, educational resources, literacy, and learning conditions. They are not treated as direct measures of ESD, since internationally comparable longitudinal indicators of ESD implementation and sustainability competencies remain limited. Rather, they represent educational conditions within which competencies such as critical thinking, ethical reasoning, systems thinking, and responsible participation may be developed (Mezirow, 1997; UNESCO, 2020). The inclusion of the pupil-teacher ratio further acknowledges the importance of learning conditions, although input-based indicators alone cannot fully capture educational quality or learning outcomes (Hanushek & Woessmann, 2007).

61 Education systems also operate within broader institutional environments. Political stability, government effectiveness, and voice and accountability are therefore considered governance and institutional enabling conditions. Their inclusion reflects the importance of institutional stability, policy implementation capacity, and participatory governance in supporting sustained educational reform and wider human development (Kaufmann et al., 2009). Huynh and Jacho-Chávez (2009) similarly highlight the relationship between political stability, institutional quality, and development outcomes.

2 Internet access is included as a digital enabling condition because access to digital infrastructure can expand opportunities for learning, knowledge exchange, and participation in increasingly digital education systems. However, connectivity alone does not guarantee meaningful educational or developmental outcomes. Research on digital inclusion emphasises that access must be accompanied by digital literacy, affordability, inclusive design, and the capacity to use technology effectively (Ahuja, 2023; Eyieyien et al., 2024; Raihan, 2025; Kane, 2025).

Finally, unemployment and urbanisation are included as socio-economic controls to account for wider labour-market and structural conditions that may influence human development independently of the principal explanatory variables. Their inclusion helps distinguish the relationships associated with education, governance, and digital access from broader socio-economic influences across the selected countries.

The variables were selected on the basis of their theoretical relevance to the study and the availability of sufficiently comparable longitudinal data across the 15 countries. Variables already incorporated directly into the construction of the HDI, such as life expectancy, were not included as explanatory variables in order to avoid circularity. Table 1 summarises the conceptual grouping of the variables used in the study.

Table 1. Conceptual Grouping of Variables in the Study

Variable group	Variable abbreviations	Conceptual relevance to the study
Human development outcome	HDI	Represents multidimensional human development and provides the outcome against which education-related and enabling conditions are examined.
Education-related conditions	GEE, PPE, SSE, TSE, ALR, PTR	Represent educational participation, resources, literacy, and learning conditions through which ESD may potentially be delivered.
Governance / institutional enabling conditions	PS, GEFF, VA	Represent institutional stability, implementation capacity, and participatory governance relevant to sustainability-oriented educational policy and implementation.
Digital enabling condition	INT	Represents access to digital knowledge, learning resources, and connectivity that may enable ESD.
Socio-economic controls	UNEMP, URB	Represent wider labour-market and structural conditions that may influence human development independently of the principal explanatory variables.

Source: Author's conceptualisation based on the literature reviewed

2.3 Hypotheses Development

Soon after its introduction, the HDI became one of the most influential composite indices used in global development governance. It shaped international comparisons, informed policy discussions, and served as a valuable tool for highlighting disparities in well-being across countries (Klugman

et al., 2011). More importantly, it established education and health as legitimate intrinsic dimensions of human development rather than merely instrumental inputs to economic productivity. However, despite the significant contribution of these dimensions to the success of the HDI, their limitations became increasingly apparent as global challenges grew more complex and prominent.

As the twenty-first century unfolded, it became increasingly evident that the development and exponential growth promoted during the previous century were accompanied by significant sustainability challenges. Climate change, ecosystem degradation, water scarcity, demographic shifts, and profound inequalities emerged as systemic risks to human well-being (WCED, 1987; Rockström et al., 2009; Sachs et al., 2019). These challenges threatened not only development itself but also the conditions necessary for sustaining human development over time. As a result, the distinction between development and sustainability became increasingly difficult to maintain, giving rise to the concept of sustainable development, which was first formally introduced by the World Commission on Environment and Development.

Emphasizing the need to reconcile social progress with ecological limits, the Brundtland Commission defined sustainable development as "development that meets present needs without compromising the ability of future generations to meet their own needs," a definition that continues to serve as the principal reference point in the field (WCED, 1987). However, although the concept of sustainable development gained widespread acceptance, its practical implementation has proved considerably more challenging.

Most development indicators, including the HDI, primarily measure current achievements but face limitations in capturing long term resilience and sustainability capacity (Neumayer, 2018). As a logical global response, education assumed a central role in facilitating the transition toward sustainable development. It came to be recognized as a key mechanism for ensuring that societies acquire the skills necessary to address complex contemporary challenges that cannot be resolved through technological or economic solutions alone (Tilbury, 2011; Sterling, 2011). As sustainability concerns became increasingly prominent, with the term *polycrisis* entering mainstream discourse over the past decade, global policy agendas began to place greater emphasis on education as one of the principal drivers of sustainable development. This shift in perspective was reflected in the 2030 Agenda for Sustainable Development, particularly in SDG Target 4.7, which explicitly links education to sustainability, global citizenship, ethical responsibility, and social inclusivity (UNESCO, 2017; UNESCO, 2019).

Building on the insights derived from the literature and guided by the TLT, this study seeks to address the limitations identified above, particularly the inability of traditional HDI measures to adequately capture the qualitative dimensions of education, especially the competencies required for sustainable development, as well as their limited consideration of the roles of governance and institutional and ecological factors in shaping long-term human development (Sagar & Najam, 1998; Fuentes-Nieva & Pereira, 2010; Torchio et al., 2024). Accordingly, the theoretical and

empirical arguments reviewed in this section provide the basis for the research hypotheses presented in Section 1.6.

The hypotheses provide the basis for the panel regression analysis conducted in this study and inform the subsequent qualitative investigation of ESD within the Omani context.

2.4 Systematic Mapping of the Literature: Positioning the Present Research within Existing Knowledge Using VOSviewer

While the preceding sections critically reviewed the theoretical foundations, empirical evidence, and hypotheses underpinning this dissertation, the present section adopts a complementary perspective by systematically mapping the existing body of literature. Unlike the narrative review presented in Sections 2.1–2.3, which provides an in-depth conceptual discussion of the key themes relevant to this study, the systematic mapping aims to identify the broader structure of research within the field and to position the present dissertation within that landscape. Its purpose is not to replace the narrative review, but rather to strengthen it through a transparent and reproducible examination of the existing scientific literature.

Systematic mapping has become an increasingly recognised approach for synthesising large bodies of research, particularly within interdisciplinary fields where concepts have evolved across different academic traditions (Petersen et al., 2008; Donthu et al., 2021). Unlike traditional narrative reviews, systematic mapping applies a transparent and reproducible search strategy to identify, classify and organise the existing body of knowledge. Rather than critically evaluating individual studies in detail, it provides an overview of the volume, distribution and thematic organisation of the literature, enabling researchers to identify dominant research streams, emerging themes and areas that remain comparatively underexplored (Župic & Čater, 2015; Donthu et al., 2021). Consequently, it serves as an appropriate complement to the narrative review by objectively positioning the present research within the broader scientific landscape.

Unlike a full systematic literature review, which typically seeks to synthesise findings from a narrowly defined body of evidence in order to answer a specific research question, the objective of the present systematic mapping is exploratory. It seeks to understand how the concepts of sustainability, human development, education and developing economies have been studied collectively, and to determine the extent to which ESD has been integrated within research on human development.

2.4.1 Search Strategy

The systematic mapping was conducted using the Scopus database, selected because of its extensive coverage of peer-reviewed international literature across the fields of sustainability, education, economics, public policy and social sciences. A structured search strategy based on Boolean operators was employed to ensure transparency and reproducibility.

The mapping was undertaken in two stages. First, a broad search was performed using combinations of keywords related to sustainability, human development and developing countries. This search generated a comprehensive dataset representing the wider research landscape. Subsequently, progressively narrower searches were conducted to examine the extent to which the principal concepts underpinning the present dissertation—HDI, Education for Sustainable Development, ESD, and developing or emerging economies—have been investigated simultaneously within the existing literature.

Searches were performed within article titles, abstracts and author keywords. Only peer-reviewed journal publications indexed in Scopus were considered for inclusion. Following the application of the eligibility criteria and screening process, the broad search yielded 336 publications, which was subsequently refined to 296 publications used as the basis of the bibliometric mapping conducted using VOSviewer (version 1.6.20). The bibliometric analysis included keyword co-occurrence analysis, enabling the identification of dominant research themes, conceptual relationships and the overall structure of the field.

2.4.2 Mapping the Research Landscape

To position the present study within the broader scientific landscape, a series of structured searches was conducted in the Scopus database using combinations of keywords representing the principal concepts underpinning this dissertation. The searches were designed to progressively refine the literature from broad, well-established research domains to the specific intersection addressed by the present study. This approach enabled not only an assessment of the volume of existing research but also an evaluation of the extent to which ESD, human development and the context of developing countries have been examined together within the published literature.

Table 2. Methodological framework of the systematic mapping

Step	Description
Objective	To identify and map the existing literature at the intersection of Education for Sustainable Development, Human Development, and developing countries, and to position the present research within the broader scientific landscape.
Database	Scopus
Search field	TITLE-ABS-KEY (Title, Abstract and Keywords)
Search period	February 2026
Document types	Journal Articles and Review Articles
Source type	Journals
Language	English
Publication stage	Final
Screening approach	Progressive refinement through successive Boolean searches to identify both the broader research landscape and the specific intersection of the study variables.

Step	Description
Bibliometric software	VOSviewer version 1.6.20
Analysis type	Keyword co-occurrence analysis
Unit of analysis	Author Keywords
Counting method	Full counting
Minimum keyword occurrence	Four
Final bibliometric dataset	296 publications
Network characteristics	37 items, 6 clusters, 155 links, total link strength = 229

Source: Author's compilation.

Table 2. summarises the methodological framework adopted for the systematic mapping. Scopus was selected as the primary database due to its broad multidisciplinary coverage and extensive indexing of peer-reviewed literature relevant to sustainability, education and human development. The search was conducted within article titles, abstracts and keywords (TITLE-ABS-KEY) using progressively refined Boolean search strategies. Only English-language journal articles and review papers published in their final form were retained to ensure the quality and consistency of the bibliometric dataset. The resulting dataset was analysed using VOSviewer (version 1.6.20), employing a co-occurrence analysis of author keywords with the full counting method and a minimum occurrence threshold of four.

Following the methodological framework presented in Table 2, a structured search strategy was implemented using progressively refined Boolean searches in the Scopus database. The stages of the search process and the number of publications retrieved at each stage are presented in Table 3. which summarises the search strategy and demonstrates the progressive narrowing of the literature as the principal concepts are combined.

Table 3. Progressive narrowing of the literature through systematic database searches

Stage	Purpose of the search	Search strategy (TITLE-ABS-KEY)	Documents retrieved	Observation
1	Establish the literature on Education for Sustainable Development	"Education for Sustainable Development"	5,764	Demonstrates that ESD constitutes a well-established and growing field of research.
2	Establish the literature connecting human development and education	"Human Development" AND education	6,951	Indicates an extensive body of literature examining education in relation to human development.
3	Examine the explicit intersection between Human Development and ESD	"Human Development" AND "Education for Sustainable Development"	38	Reveals that relatively few studies explicitly integrate these two concepts.
4	Examine the intersection within the context of developing countries	"Human Development" AND "Education for Sustainable Development" AND "developing countries"	0	No publications were retrieved using this exact combination of search terms. This suggests that the literature remains conceptually fragmented rather than indicating the complete absence of related research.
5	Construct a broad literature dataset for bibliometric mapping	"Human Development Index" OR "Human Development" OR HDI AND "Education for Sustainable Development" OR sustainability education OR ESD AND "developing countries" OR "developing economies" OR "emerging economies" (subsequently refined to English-language journal articles and reviews in final publication stage)	296	Dataset used for systematic mapping and bibliometric analysis using VOSviewer presented in the following section.

Source: Author's systematic search in Scopus.

The results reveal a clear pattern in the existing body of literature. ESD represents a substantial and well-established field of research, with 5,764 publications retrieved using the exact search phrase. Similarly, the relationship between human development and education has received

considerable scholarly attention, yielding 6,951 publications. These findings indicate that both research domains have developed independently and continue to attract significant academic interest.

A markedly different picture emerges when these concepts are examined together. Combining the exact phrases "Human Development" and "Education for Sustainable Development" reduced the number of retrieved publications to only 38, suggesting that relatively few studies explicitly integrate these two perspectives within a single research framework.

The literature narrows further when the geographical context of developing countries is incorporated. No publications were retrieved using the exact combination of "Human Development", "Education for Sustainable Development", and "developing countries" within the title, abstract and keywords indexed by Scopus. This finding should not be interpreted as evidence that no related studies exist. Rather, it indicates that the explicit integration of these concepts remains limited within the indexed literature and that relevant studies frequently employ different terminology, conceptual frameworks or disciplinary perspectives. Consequently, the existing knowledge base appears conceptually fragmented rather than fully integrated.

To examine the broader intellectual landscape surrounding these themes, a broader bibliometric dataset was subsequently constructed using a comprehensive Boolean search strategy. To ensure the quality and consistency of the dataset, the search was limited to English-language journal articles and review papers in the final publication stage. Following the application of these inclusion criteria, the final dataset comprised 296 publications, which were exported from Scopus and analysed using VOSviewer (version 1.6.20). This broader dataset was intentionally selected for bibliometric mapping because it provides sufficient coverage to identify the dominant research themes, conceptual relationships and emerging research directions while remaining directly relevant to the objectives of the present study.

Interpretation

The progressive refinement of the search strategy reveals a clear pattern within the existing literature. While ESD human development, and education each constitute well-established fields of research independently, considerably fewer studies explicitly integrate these concepts within a single research framework. Furthermore, when the geographical context of developing countries is incorporated, the number of retrieved publications decreases substantially, indicating that the intersection of these research domains remains comparatively underexplored.

This finding should not be interpreted as evidence that research on human development, sustainability, or education is limited. Rather, it suggests that these topics have largely evolved as parallel streams of inquiry, with relatively limited conceptual integration. Consequently, although substantial evidence exists regarding the contribution of education to human development and the increasing importance of ESD in achieving the SDGs, comparatively few studies have investigated

how ESD may contribute to enhancing human development within developing and emerging economies.

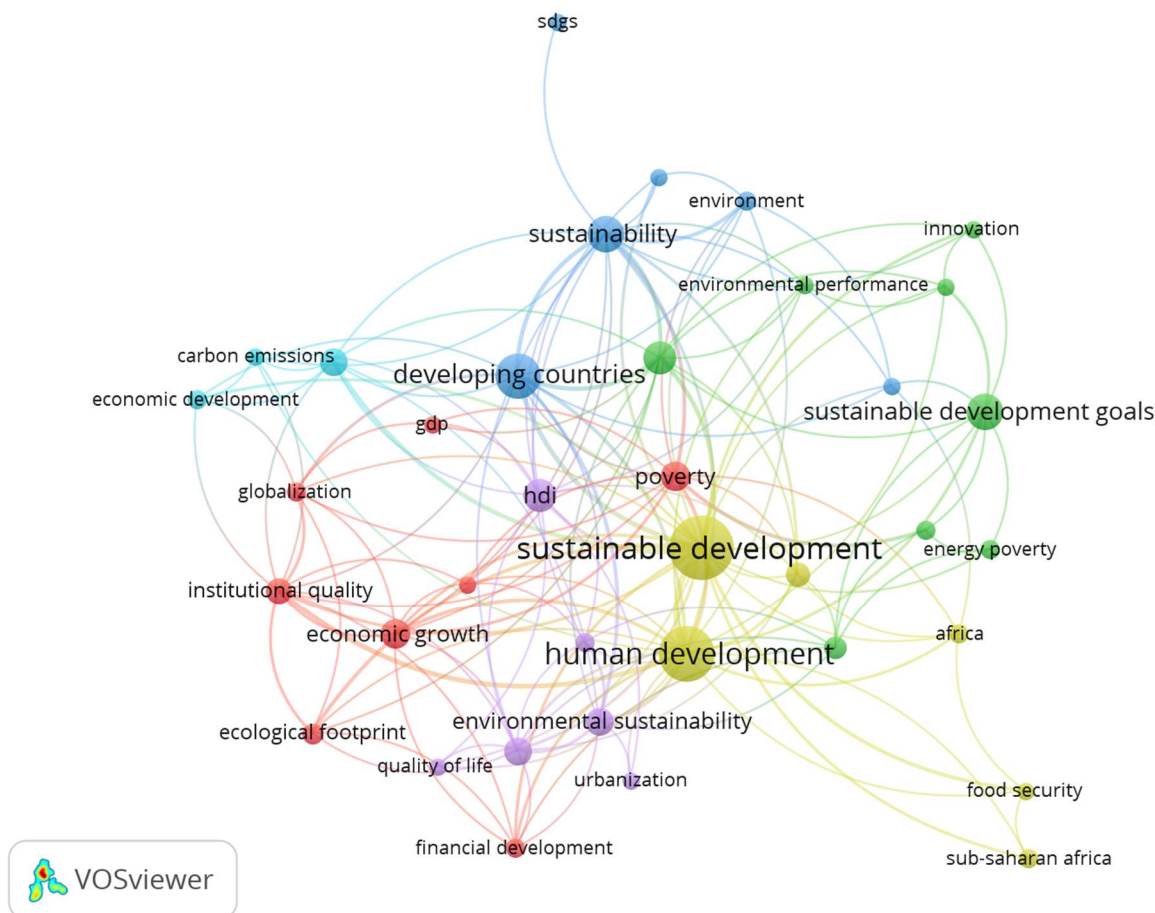
To examine the broader intellectual structure of this research area, a refined bibliometric dataset comprising 296 English-language journal articles and review papers was constructed in accordance with the inclusion criteria presented in Table 3. The dataset was considered sufficiently comprehensive to identify the dominant research themes, conceptual relationships, and emerging directions within the literature while remaining closely aligned with the objectives of the present study. The bibliometric analysis of this dataset is presented in the following section.

2.4.3 Bibliometric Analysis of the Research Landscape

Beyond identifying what has been published, bibliometric mapping makes it possible to examine how a field has developed conceptually—whether its major themes have converged into an integrated body of knowledge or remain organised around relatively separate research streams. This distinction is particularly important in the present study, where ESD, human development, education quality, sustainability, and development indicators are individually well-established areas of research, while their direct intersection remains less clearly developed. The keyword network is therefore used not simply to describe the literature, but to examine the intellectual proximity of these themes and to position the specific research gap addressed by this dissertation.

Figure 1 presents the keyword co-occurrence network generated from the final dataset of 296 publications. The analysis identified 37 author keywords, grouped into six thematic clusters, connected through 155 links with a total link strength of 229. The network illustrates the principal conceptual structure of the literature by identifying the most frequently co-occurring research themes and their relationships.

Figure 1. Network Visualization of Author Keywords



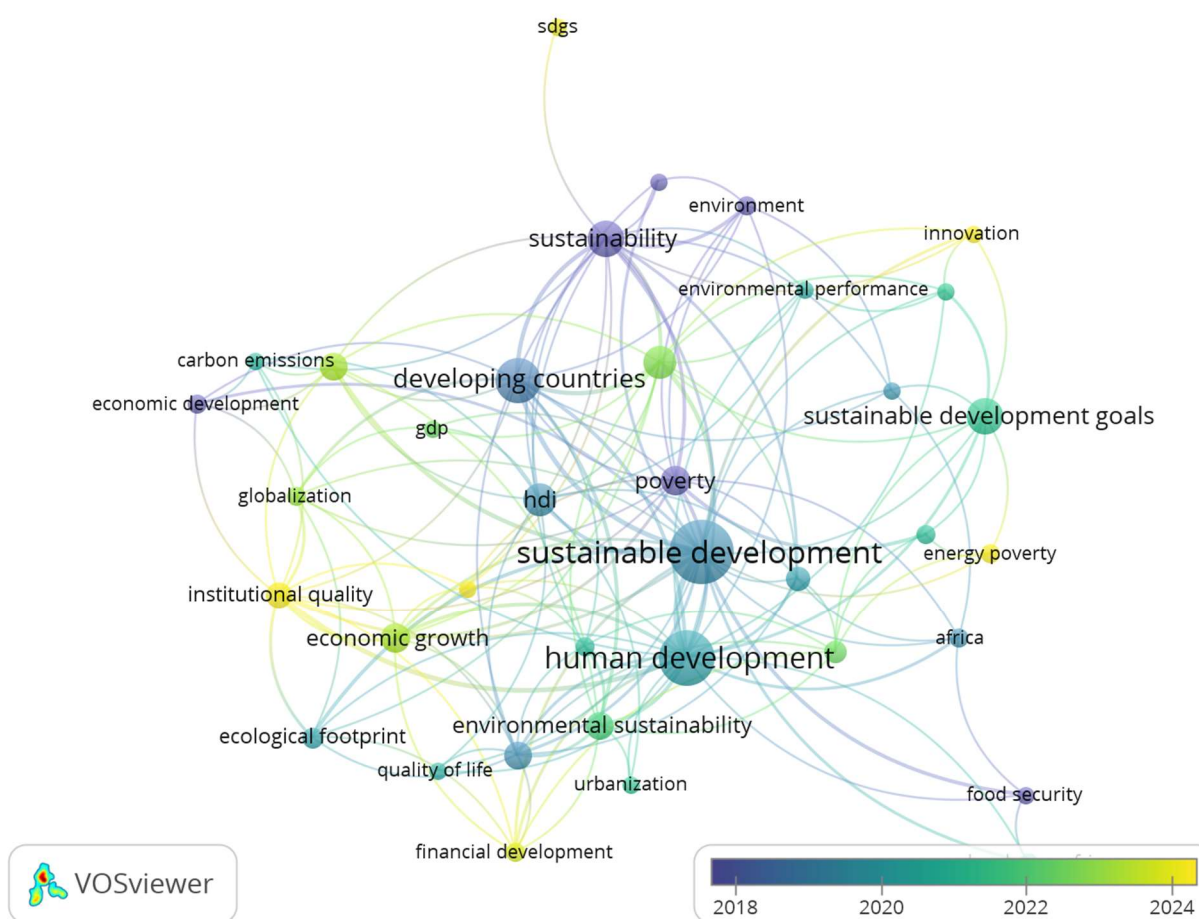
Source: Author's visualization generated in VOSviewer based on the final Scopus dataset.

The network is centred around human development, sustainable development, sustainability, and developing countries, indicating that these concepts constitute the intellectual core of the existing literature. Closely connected themes include economic growth, environmental sustainability, governance, innovation, food security, and the SDGs, reflecting the multidisciplinary nature of research on sustainable development and human well-being.

The six thematic clusters demonstrate that the literature has developed along several interconnected research streams. One cluster primarily focuses on sustainability and environmental issues, another emphasises human development and development outcomes, while others examine institutional quality, governance, economic growth, innovation, and environmental performance. Together, these clusters illustrate that sustainable development has been investigated from economic, environmental, institutional, and social perspectives rather than through a single disciplinary lens.

A notable observation is that ESD does not emerge as one of the dominant author keywords within the network despite its growing prominence in international policy and educational practice. This finding is consistent with the earlier search results, which demonstrated that only a limited number of publications explicitly combine human development and ESD. Consequently, the network analysis reinforces the argument that the educational dimension of sustainable human development remains comparatively underrepresented within the broader literature, particularly in relation to developing and emerging economies.

Figure 2. Overlay Visualization of Author Keywords



Source: Author's visualization generated in VOSviewer based on the final Scopus dataset.

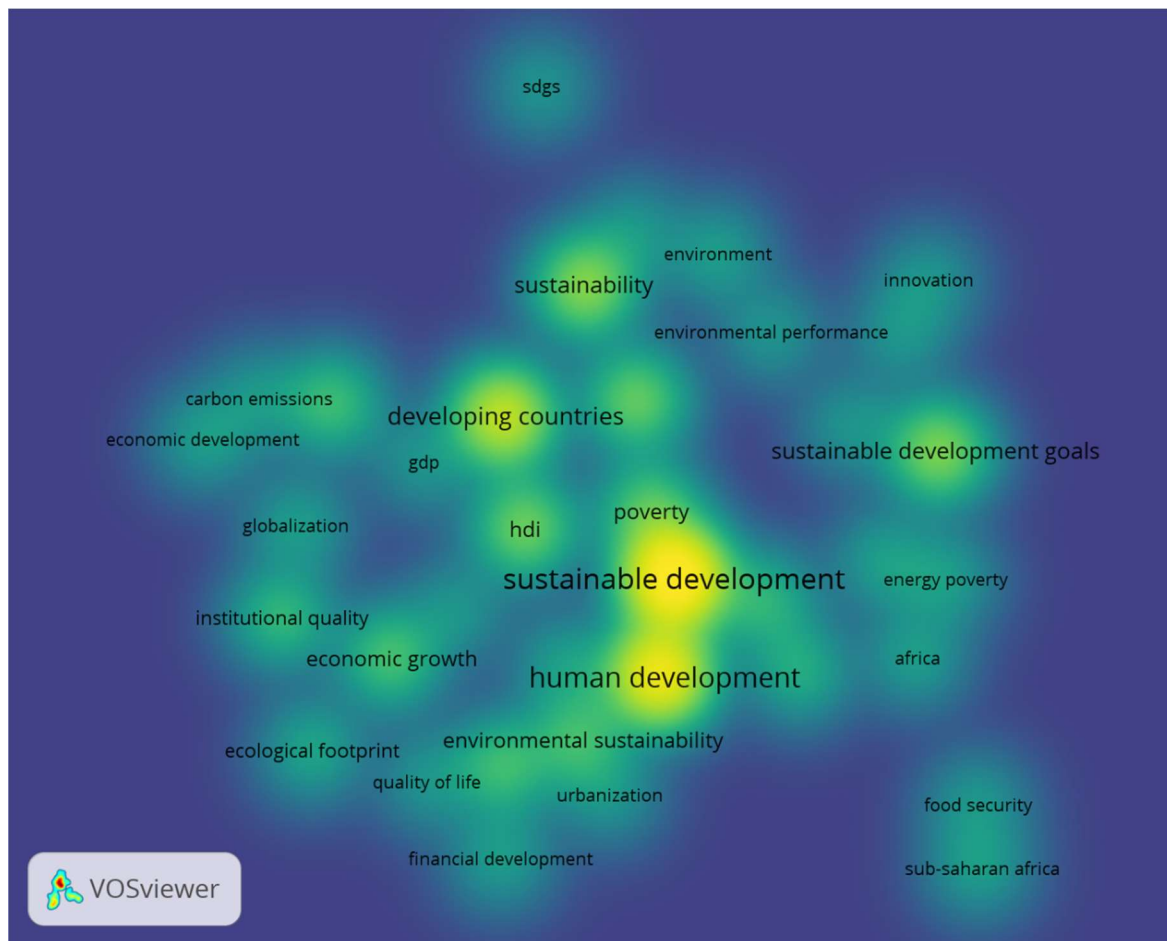
The overlay visualization (Figure 2) illustrates the temporal evolution of the principal research themes within the literature by assigning colours to author keywords according to their average year of publication. Earlier research themes are represented by darker colours, whereas more recent themes appear in lighter shades. This visualization provides insight into how the focus of research has shifted over time and highlights emerging areas of scholarly interest.

The analysis suggests that earlier studies primarily concentrated on broad concepts such as sustainability, economic growth, developing countries, and human development, reflecting the traditional emphasis on development indicators and sustainability challenges. These themes form the intellectual foundation upon which subsequent research has evolved.

More recent publications increasingly incorporate concepts related to SDGs, environmental sustainability, innovation, environmental performance, and governance, indicating a gradual shift from measuring development outcomes towards examining the mechanisms and policies that support sustainable development. This transition reflects the growing influence of the 2030 Agenda for Sustainable Development and the increasing recognition that sustainable development requires integrated environmental, social, economic and institutional approaches.

Despite this evolution, ESD does not emerge as a prominent or rapidly developing research theme within the bibliometric network. This observation is consistent with the findings of the keyword search strategy and further supports the conclusion that the integration of ESD with HDI, particularly within developing and emerging economies, remains comparatively limited. Consequently, the present research addresses a timely and relevant area by explicitly examining the relationship between ESD and HDI within the context of emerging economies.

Figure 3. Density Visualization of Author Keywords



Source: Author's visualization generated in VOSviewer based on the final Scopus dataset.

The density visualization (Figure 3) identifies the areas of greatest scholarly concentration within the analysed literature. In VOSviewer, regions shown in warmer colours (yellow and orange) represent keywords with a higher frequency of occurrence and stronger relationships with other concepts, whereas cooler colours indicate topics that have received comparatively less attention.

The visualization demonstrates that HDI, sustainable development, sustainability, and developing countries constitute the principal research hotspots within the literature. Closely associated concepts, including economic growth, environmental sustainability, SDGs, innovation, governance, and environmental performance, also appear as prominent themes, reflecting the multidisciplinary character of research on sustainable development.

In contrast, educational concepts occupy a comparatively less prominent position within the knowledge network. Although education is widely recognised as one of the fundamental dimensions of HDI and is central to the achievement of SDG 4, the bibliometric analysis indicates that educational perspectives, particularly those related to ESD, have received comparatively less attention within studies linking sustainability and human development. This finding is consistent

with the results of the systematic search, which demonstrated a limited number of publications explicitly integrating these concepts.

Overall, the three bibliometric visualizations provide complementary evidence regarding the current state of the literature. The network visualization illustrates the conceptual relationships among the principal research themes, the overlay visualization demonstrates how these themes have evolved over time, and the density visualization identifies the dominant areas of scholarly attention. Collectively, these findings indicate that while sustainability and human development have been extensively investigated, the explicit integration of ESD within the context of HDI, particularly in developing and emerging economies, remains comparatively underexplored. This observation further justifies the focus of the present dissertation and provides a foundation for the qualitative phase of the research, in which stakeholder perspectives are explored through a focus group discussion conducted in Oman.

CHAPTER 3: METHODOLOGY

3.1 Introduction to the Methodological Framework

This chapter presents the methodological approach used to investigate the relationship between ESD-related educational conditions and human development outcomes and to examine how the education dimension of HDI may be conceptually enhanced through the integration of ESD.

Building on the theoretical foundations and research gaps identified in Chapter Two, the study proceeds from conceptual discussion to empirical investigation. A mixed-methods approach was adopted because the research problem requires both quantitative evidence regarding cross-country relationships and qualitative insight into how these relationships are understood and implemented in practice (Creswell & Plano Clark, 2018).

The study follows a sequential explanatory mixed-methods design, in which the quantitative phase precedes and informs the qualitative phase (Creswell & Plano Clark, 2018; Ivankova et al., 2006). The first phase consists of quantitative panel data analysis across fifteen emerging and developing economies over the period 2000–2023. This phase tests the study hypotheses and examines relationships between HDI and selected education-related, governance, digital, and socio-economic variables. The findings from the quantitative analysis subsequently informed the second, qualitative phase.

The qualitative phase was conducted through an FGD in Oman and was designed to interpret and contextualise the quantitative findings from the perspective of key stakeholders. The following sections present research design, quantitative methodology, sample and variables, model specification and diagnostic procedures, followed by the qualitative research design, participant selection, data collection and thematic analysis.

3.2 Research Design

The study adopts a sequential explanatory mixed-methods design, in which the quantitative phase precedes and informs the qualitative phase. This design is appropriate when quantitative analysis is followed by qualitative inquiry to provide further explanation and contextual understanding of the statistical findings (Creswell & Plano Clark, 2018; Ivankova et al., 2006). In the present study, the quantitative component represents the primary analytical phase, while the subsequent qualitative phase provides additional explanatory and contextual insight.

The choice of a mixed-methods design reflects the nature of the research problem. The relationship between education and human development can be examined quantitatively through internationally comparable indicators; however, ESD also encompasses dimensions such as competencies, values, educational practice, institutional implementation, and collaboration that are not adequately represented in available cross-country datasets. Conversely, qualitative evidence alone would not enable the examination of longitudinal relationships between education-related conditions and HDI across countries. Combining the two approaches therefore allows

complementary forms of evidence to address different dimensions of the same research problem (Creswell & Plano Clark, 2018; Tashakkori et al., 2021).

The research design can be represented as QUAN → qual, indicating both the sequence and the relative priority of the two phases (Creswell & Plano Clark, 2018). In the first phase, panel data regression is used to test the study hypotheses and examine relationships between HDI and the selected explanatory variables. The findings from this phase subsequently inform the qualitative inquiry by identifying relationships and issues requiring further interpretation. The qualitative phase therefore complements the quantitative analysis rather than replicating it.

Integration between the two phases occurs at two principal points. First, the quantitative findings informed the development and refinement of the FGD discussion guide by identifying issues requiring further explanation and contextualisation. Second, the qualitative findings were subsequently interpreted alongside the quantitative results to examine areas of convergence, elaboration, and contextual explanation. This connection between the phases is a defining feature of sequential explanatory mixed-methods research and enables the two forms of evidence to contribute jointly to addressing the research problem (Ivankova et al., 2006; Creswell & Plano Clark, 2018).

The study is informed by a pragmatic methodological position, according to which the research problem and the type of evidence required to address it take precedence over adherence to a single methodological tradition (Morgan, 2014). This position is appropriate for the present research because examining the relationship between ESD and human development requires both empirical evidence concerning cross-country relationships and contextual understanding of how sustainability-oriented education operates in practice.

3.3 Quantitative Phase – Panel Data Regression

The quantitative phase constitutes the first and primary analytical component of the study. It examines the relationship between HDI and selected education-related, governance, digital, and socio-economic indicators across fifteen emerging and developing economies over the period 2000–2023. The purpose of this phase is to test the study hypotheses and identify longitudinal and cross-country relationships relevant to the broader relationship between education and human development.

Given the structure of the dataset, panel data regression was selected as the principal quantitative method. Panel data combine observations across countries and over time, allowing the analysis to capture both differences between countries and changes within countries during the study period. This approach is particularly appropriate for comparative development research because it can account for unobserved country-specific characteristics that may influence the relationships under investigation (Baltagi, 2021; Hsiao, 2014).

19 An important methodological challenge concerns the limited availability of internationally comparable longitudinal indicators that directly measure the implementation of SDG Target 4.7 and ESD. The quantitative analysis therefore does not claim to measure ESD directly. Instead, it employs theoretically informed indicators representing educational participation and conditions, together with governance, digital access, and broader socio-economic factors relevant to sustainable human development. Data were obtained primarily from UNDP, the World Bank World Development Indicators, UNESCO Institute for Statistics, and the Worldwide Governance Indicators.

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1 The balanced panel comprises fifteen countries with 24 annual observations per country, producing 360 country-year observations. The empirical analysis included Pooled Ordinary Least Squares (POLS), Between Effects (BE), Fixed Effects (FE), Random Effects (RE), and First-Difference (FD) estimators. Correlation analysis and Variance Inflation Factors (VIF) were used to assess multicollinearity, while the Hausman specification test informed the choice between the FE and RE estimators. The rationale and operationalisation of the variables are presented in Section 3.3.3, while model specification and diagnostic procedures are detailed in Sections 3.3.4 and 3.3.5.

5 Following completion of the quantitative analysis, the findings were used to identify issues requiring further explanation and contextual interpretation in the qualitative phase.

3.3.1 Strengths and Limitations of Panel Data Regression

85 Panel data regression was selected because it offers several advantages for examining relationships between education-related conditions and human development across countries and over time. Its principal strengths in the context of this study are:

- simultaneous use of cross-country and longitudinal variation;
- explicit treatment of country-specific heterogeneity;
- greater information content and estimation efficiency than purely cross-sectional analysis.

65 First, panel data make it possible to examine both differences between countries and changes within countries over time. This is particularly relevant to human development research because educational, institutional, and socio-economic conditions evolve gradually, and their relationships with HDI cannot be adequately represented through a single cross-sectional observation (Baltagi, 2021; Hsiao, 2014).

Second, panel methods provide a framework for accounting for unobserved country-specific characteristics that may influence the relationships under investigation. Countries differ in historical, institutional, geographical, and social characteristics that are difficult to measure directly. Panel estimators allow such heterogeneity to be treated more explicitly than pooled cross-

sectional approaches, although the manner in which it is handled depends on the assumptions of the specific estimator used (Baltagi, 2021; Hsiao, 2014).

Third, combining observations across countries and time increases the amount of information available for estimation and provides greater variation in the explanatory variables. This can improve the precision of coefficient estimates and supports the simultaneous examination of multiple factors associated with human development (Baltagi, 2021).

At the same time, the application of panel regression in this study is subject to several limitations:

- sensitivity to model specification and estimator assumptions;
- dependence on the quality and comparability of international secondary data;
- reliance on proxy indicators rather than direct measures of ESD;
- limited ability to establish causal relationships.

Model specification is particularly important because alternative panel estimators make different assumptions regarding country-specific effects and their relationship with the explanatory variables. An inappropriate specification may affect the consistency or efficiency of the estimated coefficients. For this reason, alternative estimators were compared and formal diagnostic procedures were used to guide model selection (Baltagi, 2021; Hausman, 1978).

A second limitation concerns the use of international secondary datasets. Although sources such as UNDP, the World Bank and UNESCO apply standardised definitions and reporting procedures, differences in national statistical capacity, reporting practices and data revisions may still affect comparability across countries and over time.

A further limitation arises from the measurement of ESD. Internationally comparable longitudinal indicators that directly capture the implementation of SDG Target 4.7 remain limited. The variables used in this study therefore represent educational conditions and broader enabling factors relevant to sustainable human development rather than direct measures of ESD itself. This requires cautious interpretation of the empirical findings.

Finally, panel regression identifies statistical relationships but does not, by itself, establish definitive causality. Even when longitudinal data and country-specific effects are incorporated, results may remain sensitive to model specification, measurement error and unobserved time-varying factors (Hill et al., 2020). The estimated coefficients are therefore interpreted as associations within the theoretical and methodological framework of the study rather than as conclusive causal effects.

3.3.2 Sample Selection and Data Sources

The quantitative sample comprises fifteen selected emerging and developing economies: Oman, Jordan, Kenya, Rwanda, Egypt, India, Pakistan, Sri Lanka, the Philippines, Vietnam, Brazil, Costa Rica, Ukraine, Serbia, and Georgia.

The balanced panel covers 24 years (2000- 2023) and contains 24 annual observations for each country, resulting in 360 country-year observations. The sample was purposefully constructed to capture variation relevant to the research problem rather than to provide statistical representation of all emerging and developing economies.

Three considerations informed country selection. The first was the relevance of national education and sustainable development policy contexts. The sample includes countries with documented engagement in sustainability-related educational reforms, implementation of the SDGs, national development strategies incorporating ESD principles or environmental or global citizenship education. Examples include Oman through Oman Vision 2040 and countries such as Costa Rica, Sri Lanka, and the Philippines, where sustainability-related themes have been incorporated into education policy, curricula, or teacher development to varying degrees (UNESCO, 2020, 2021). The intention was not to assume a uniform level of ESD implementation across the sample, but to include national contexts in which the relationship between education and sustainable development could be examined comparatively.

The second consideration was developmental and geographical diversity. The countries represent different levels of human development, institutional capacity, educational development, and economic performance. Geographically, the sample covers Eastern Europe and the Caucasus, the Middle East and North Africa, Sub-Saharan Africa, South Asia, Southeast Asia, and Latin America. This heterogeneity provides variation across national contexts and allows the empirical analysis to examine whether relationships between education-related, governance, digital, and socio-economic indicators and HDI are observable across differing development settings.

The third consideration was the availability and comparability of longitudinal data. Panel regression requires sufficiently consistent observations across both countries and time; consequently, the selection was constrained by the availability of comparable data for the variables included in the empirical model. The resulting sample therefore reflects a balance between theoretical relevance, developmental and geographical diversity, and the practical requirements of constructing a balanced longitudinal dataset.

Table 4 presents the 2023 HDI values and human development categories of the selected countries. These values illustrate the breadth of development levels represented in the sample, ranging from very high to low human development. The 2023 values are used here only to characterise the sample; changes in HDI and key education-related indicators over the study period are examined comparatively in Chapter Four.

Table 4. Values and Categories of the Selected Countries

Country	Region	HDI (2023)	HDI Category
Oman*	Middle East and North Africa	0.858	Very High
Georgia	Caucasus	0.844	Very High
Costa Rica	Latin America	0.833	Very High
Serbia	Eastern Europe/Balkans	0.833	Very High
Brazil	Latin America	0.786	High
Ukraine	Eastern Europe	0.779	High
Sri Lanka	South Asia	0.776	High
Vietnam	Southeast Asia	0.766	High
Jordan	Middle East and North Africa	0.754	High
Egypt	Middle East and North Africa	0.754	High
Philippines	Southeast Asia	0.720	High
India	South Asia	0.685	Medium
Kenya	Sub-Saharan Africa	0.628	Medium
Rwanda	Sub-Saharan Africa	0.578	Medium
Pakistan	South Asia	0.544	Low

Source: Human Development Report 2023/2024, UNDP (2024).

*Note: Although Oman is classified by the World Bank as a high-income economy (World Bank, n.d.-a) and by UNDP within the very high human development category, its inclusion is consistent with the scope of the study. Classification systems differ across international organisations, and the International Monetary Fund includes Oman within the group of emerging market and developing economies (International Monetary Fund, 2023). Oman is also included in the quantitative sample and subsequently serves as the national context for the qualitative phase, enabling the statistical findings to be explored in greater contextual depth.

The quantitative analysis relies on secondary data from internationally recognised sources. HDI data were obtained from UNDP. Education, digital access, labour-market, and urbanisation indicators were obtained from the World Bank World Development Indicators (World Bank, n.d.-b) and UNESCO Institute for Statistics, while the governance indicators were obtained from the World Bank Worldwide Governance Indicators (World Bank, n.d.-c). These sources provide standardised indicator definitions and longitudinal data designed to facilitate international comparison. The precise operational definition and data source for each variable are presented in the next section.

3.3.3 Variables and Operationalisation

The selection of variables was guided by the theoretical framework and hypotheses developed in Chapter Two, together with the availability of sufficiently comparable longitudinal data. Because internationally standardised measures directly capturing ESD and the implementation of SDG Target 4.7 remain limited, the study does not treat the selected variables as direct measures of ESD. Rather, the education-related variables represent characteristics of education systems through which ESD can be delivered, while the governance and digital variables represent broader enabling conditions that may support its implementation. This distinction is consistent with ESD frameworks that emphasise curriculum integration, educational participation, educator capacity, institutional implementation, policy support, stakeholder participation, and access to learning opportunities (UNESCO, 2017, 2019, 2020).

The empirical model includes HDI as the dependent variable; six education-related variables; three governance variables; internet access as a digital enabling condition; and two socio-economic control variables. Table 5 summarises their operationalisation and expected relationships with HDI.

Table 5. Operationalisation of Study Variables and Expected Relationships

Variable Name	Abbreviation	Operational Definition	Source	Expected Theoretical Relationship
Human Development Index	HDI	Composite index of health, education and income; dependent/outcome variable.	UNDP	/
Internet access, % of population	INT	Represents digital access and an enabling condition for lifelong learning, knowledge sharing, and implementation of ESD.	World Bank	+
Gov. education expenditure, % of GDP	GEE	Reflects government commitment to education through public investment in educational systems, infrastructure, and human capital development.	World Bank	+
Secondary school enrollment, % gross	SSE	Measures participation in secondary education, supporting development of knowledge, critical thinking, and sustainability awareness.	World Bank	+
Tertiary education enrollment, % gross	TSE	Represents participation in higher education, contributing to advanced knowledge, innovation, leadership, and sustainability competencies.	World Bank	+

Variable Name	Abbreviation	Operational Definition	Source	Expected Theoretical Relationship
Pre-primary enrollment, % gross	PPE	Reflects access to early childhood education, providing the foundation for lifelong learning and future capability development.	UNESCO UIS	+
Adult literacy rate, % ages 15+	ALR	Indicates literacy and lifelong learning capacity, enabling informed participation in economic, social, and civic life.	World Bank	+
Pupil-teacher ratio, primary	PTR	Proxy for educational quality; lower ratios generally indicate more favourable learning environments and greater opportunities for learner-centred education.	UNESCO UIS	–
Political stability	PS	Reflects institutional stability necessary for long-term educational planning, policy continuity, and sustainable development implementation.	World Bank WGI	+
Government effectiveness	GEFF	Measures institutional capacity to formulate and implement effective public policies, including sustainability-oriented educational reforms.	World Bank WGI	+
Voice and accountability	VA	Represents participatory governance, civic engagement, and inclusive decision-making that support implementation of ESD.	World Bank WGI	+
Unemployment, % of labour force	UNEMP	Controls for labour market conditions that may influence human development independently of educational factors.	World Bank	–
Urban population, % of total population	URB	Controls for structural differences in access to education, infrastructure, and public services across countries.	World Bank	±

Source: the author, based on data obtained from the United Nations Development Programme (UNDP), World Bank World Development Indicators, Worldwide Governance Indicators (WGI), and UNESCO Institute for Statistics.

Dependent Variable: Human Development Index

HDI is used as the dependent variable because it captures national achievement across three core dimensions of human development: health, education and standard of living (economy). Its

education component is based on mean years of schooling and expected years of schooling, while the health and income dimensions are represented by life expectancy and GNI per capita, respectively (UNDP, 2025). The use of HDI is consistent with the Capability Approach, in which development is understood as an expansion of individuals' capabilities and opportunities rather than economic growth alone (Sen, 1999; Anand & Sen, 1994). In the present study, HDI therefore provides the outcome against which the relationships of education-related and enabling conditions relevant to ESD are examined and the purpose of the quantitative analysis is to examine whether they are systematically associated with variation in HDI across countries and over time.

Education-Related Variables

Government expenditure on education (GEE) reflects the level of public investment dedicated to the development and maintenance of educational systems. Investment in education supports school infrastructure, curriculum development, teacher recruitment, educational resources, and opportunities for lifelong learning. Its relevance to ESD lies primarily in the resource requirements of implementation. ESD requires investment in areas such as curriculum development, educator training, educational materials, institutional transformation, and opportunities for lifelong and community learning. UNESCO's ESD for 2030 framework specifically identifies mobilisation of financial and institutional resources as necessary for effective implementation and encourages countries to use education budgets to support activities such as teacher training, school development, youth engagement, and lifelong learning (UNESCO, 2020). This interpretation is further supported by Yan and Zhang (2025), who identify financial resources, together with human and material resources, as core inputs to ESD implementation and find that resource-based configurations are among the pathways associated with higher ESD implementation efficiency. Recent evidence from the Middle East and North Africa region identifies limited funding as a major barrier to green education/ESD and sufficient financial support as necessary for curriculum integration, policy implementation and monitoring, reinforcing GEE as an indicator of system-level resource capacity for ESD (Onyeaka & Akinsemolu, 2025). GEE is therefore used as an indirect indicator of the resource capacity available to education systems within which ESD may be implemented, rather than as a direct measure of ESD itself. UNESCO's ESD implementation guidance explicitly identifies resource mobilisation as necessary to implement ESD at system level

Pre-primary, secondary, and tertiary enrolment (PPE, SSE, and TSE) measure participation at successive stages of formal education. Recent analysis of Nordic national curricula shows that sustainability education is already embedded, although unevenly, in early childhood education, supporting pre-primary education as an early institutional entry point for ESD (Norðdahl et al., 2025). Recent research with secondary-school students has operationalised and validated sustainability competencies based on GreenComp, demonstrating that secondary education is a concrete setting for the development and assessment of ESD-related competencies (Monterde-Miralles et al., 2025). This reflects the importance of educational access throughout the learning process and the role of formal education as a principal setting in which sustainability-related

knowledge and competencies may be developed. SDG 4 addresses access to education across these levels, while Target 4.7 specifically calls for learners to acquire the knowledge and skills required to promote sustainable development (United Nations, n.d.; UNESCO, 2017, 2020). The enrolment variables are therefore used as proxies for the reach of educational systems within which ESD may be mainstreamed, rather than for the quality or content of ESD provision. UNESCO's ESD guidance explicitly frames sustainability competencies as relevant to learners of all ages and implementation across educational levels.

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Tertiary education has additional relevance because higher education institutions play an important role in developing advanced sustainability knowledge and competencies, conducting sustainability-related research, preparing future professionals and leaders, and embedding sustainable development across curricula and institutional practice. A recent systematic review of 47 studies found that ESD in higher education strengthens students' sustainability knowledge, attitudes, behaviours and problem-solving competencies, reinforcing tertiary education as an important institutional setting for ESD delivery (Bhuttah et al., 2026). Furthermore, research within higher education has demonstrated the importance of integrating sustainability competencies into university education and of preparing graduates to engage with complex sustainability challenges (Al-Naqbi & Alshannag, 2018; Abdalla et al., 2024). TSE is therefore examined separately to assess whether participation at this advanced level of education demonstrates a distinct relationship with HDI.

Adult literacy rate (ALR) captures a fundamental capability that enables individuals to access information, participate in economic and civic life and continue learning beyond formal schooling. Recent research on adult lifelong learning within an ESD framework found that lower literacy is among the barriers limiting adults' meaningful participation in learning, supporting ALR as a foundational rather than direct proxy for engagement with ESD (Ampofo et al., 2026). Literacy is directly embedded within SDG 4 and provides a foundation upon which more complex competencies—including those associated with ESD—can develop (United Nations, n.d.; UNESCO, 2017). From a capability perspective, literacy expands individuals' opportunities to participate meaningfully in social and economic life and is therefore expected to be positively related to human development (Sen, 1999; UNDP, 2010).

Pupil–teacher ratio (PTR) is included as an education-system input related to the learning environment. Recent panel evidence from 85 developing countries found that greater teacher capacity, measured through the pupil–trained-teacher ratio, significantly improved lower-secondary completion, supporting teacher availability as an education-system capacity condition for progress toward SDG 4 (Lu et al., 2026). ESD emphasises pedagogies that move beyond passive transmission of knowledge towards participatory learning, critical reflection, collaboration, problem-solving, and learner engagement (Tilbury, 2011; UNESCO, 2017). PTR does not directly measure learning outcomes or educational quality, and lower ratios do not automatically imply better educational performance. Nevertheless, the indicator provides

information about the number of pupils relative to teaching personnel and therefore about the potential availability of teacher attention and instructional resources. This is relevant to ESD because participatory, learner-centred and problem-based pedagogies require sufficient instructional capacity (UNESCO Institute for Statistics, n.d.; UNESCO, 2017). The expected relationship with HDI is negative because higher pupil–teacher ratios generally represent greater pressure on available teaching resources.

Governance Variables

Government effectiveness (GEFF), political stability (PS), and voice and accountability (VA) are included as broader institutional conditions associated with the implementation of ESD. UNESCO's ESD implementation literature emphasises that mainstreaming ESD requires supportive policy, institutional capacity, governance and accountability mechanisms, coordination across sectors, stakeholder participation, and continuity of implementation (UNESCO, 2019, 2020).

Government effectiveness (GEFF) reflects perceptions of the quality of public services, policy formulation and implementation, and the credibility of government commitments (Kaufmann et al., 2009). Recent cross-country evidence further shows that the educational gains associated with teacher capacity are 30–40% stronger in countries with higher government effectiveness, providing direct empirical support for GEFF as an institutional condition affecting progress toward SDG 4 (Lu et al., 2026). Its relevance to ESD lies in the fact that national commitments to sustainability education must be translated into curricula, teacher development, institutional programmes, monitoring mechanisms, and coordinated action across education and sustainable development sectors. ESD research identifies governance, coordination, institutional capacity, accountability, and financing as important conditions for effective implementation (Leicht et al., 2018). GEFF is therefore used as a national-level proxy for the institutional capacity within which ESD policy can be translated into educational practice. UNESCO's implementation literature specifically identifies governance, coordination, accountability, financing, and institutional capacity as important to ESD delivery.

Political stability (PS) reflects perceptions of political instability and politically motivated violence (Kaufmann et al., 2009). Using a panel of 145 countries and WGI measures, Ríos et al. (2026) found political stability to have a significant positive effect on overall SDG performance, supporting its inclusion as part of the institutional environment required for sustained progress toward sustainable development. Integrating sustainability into national education systems requires policy continuity, sustained institutional commitment, educator development, curriculum reform, and long-term coordination. UNESCO's review of the UN Decade of ESD found that sustained political support and institutionalisation were important for maintaining ESD beyond changes in leadership, personnel, and priorities (UNESCO, 2014). PS is therefore treated as an indirect enabling condition representing the stability of the wider institutional environment within which sustained ESD implementation can occur. UNESCO's global review specifically identified

political leadership, sustained political support, coordination, and institutional continuity as important to national ESD implementation.

Voice and accountability (VA) captures aspects of citizen participation, freedom of expression, association, and public accountability (Kaufmann et al., 2009). A recent systematic review of participatory approaches to ESD concludes that inclusive stakeholder involvement, local knowledge and collaborative decision-making are central to transformative sustainability learning, supporting the relevance of participatory governance conditions captured by VA (Fernando & Tajan, 2024). Its connection with ESD lies in the participatory character of sustainability education. ESD emphasises dialogue, collaboration, stakeholder engagement, active citizenship, and collective problem-solving rather than purely top-down transfer of knowledge (Wals & Corcoran, 2006; UNESCO, 2017). At the policy level, multi-stakeholder participation and partnerships have also been identified as important mechanisms for developing and implementing ESD strategies (UNESCO, 2014). VA is therefore treated as a broad proxy for participatory governance conditions that may support ESD, rather than as a direct measure of participation in ESD itself.

Digital Enabling Condition

The final independent variable included in the model is internet access (INT), measured as the percentage of the population using the internet. Digital connectivity has become an increasingly important enabling condition for education, lifelong learning, knowledge exchange, and access to sustainability-related information. The role of ICT in supporting ESD was already explicitly recognised during the UN Decade of Education for Sustainable Development; Paas and Creech (2008) identified online environments and ICT as tools through which educators and learners could access sustainability information, educational resources, communication networks, and collaborative learning opportunities. More recently, the ESD for 2030 framework has placed greater emphasis on technological change and on using education to respond to its opportunities and risks (UNESCO, 2020). In practical terms, internet connectivity enables access to online and open educational resources, remote and blended learning, teacher and institutional networks, sustainability-related information, and collaboration beyond national and institutional boundaries. Recent evidence on digital educational transformation shows that adaptive and AI-enabled technologies can increase accessibility, personalise learning and strengthen education's contribution to sustainability, reinforcing internet connectivity as enabling infrastructure for ESD-related learning rather than an ESD outcome in itself (Strielkowski et al., 2025). INT is therefore used to capture differences in the digital infrastructure that can enable the delivery and expansion of ESD across countries and over time, while recognising that internet access alone does not indicate that ESD is actually being implemented (Paas & Creech, 2008; UNESCO, 2020).

Control Variables

Unemployment (UNEMP) is included as a socio-economic control because employment is directly embedded in the sustainable development agenda. SDG 8, Decent Work and Economic Growth, links sustainable development with sustained and inclusive economic growth, productive employment, and decent work, while Target 8.5 specifically calls for full and productive employment for all (United Nations, 2015). High unemployment can constrain sustainable development by reducing economic participation and income security and by limiting individuals' ability to translate education and acquired skills into productive employment. Recent cross-country evidence also demonstrates that unemployment is closely interconnected with other dimensions of the SDGs, including technological development, governance, financial inclusion, and innovation (Soliman & Beram, 2026). Recent panel evidence from developing Asia-Pacific economies identifies unemployment, alongside poverty and carbon emissions, as a core challenge within the sustainable-development agenda, supporting its inclusion as a socio-economic control rather than an ESD proxy (Khan, 2024). UNEMP is therefore included to control for labour-market conditions that may independently influence development outcomes rather than being treated as a proxy for ESD.

Urban population (URB) controls for structural differences associated with urbanisation. Urbanisation may improve proximity to education, healthcare, digital infrastructure and other public services, but rapid or poorly managed urban growth may also increase inequality, pressure on services and environmental challenges. Cross-country evidence from 52 African countries shows that sustainable urbanisation affects climate vulnerability both directly and through digitalisation and institutional quality, confirming that urbanisation can shape sustainability outcomes independently of educational conditions (Yeyouomo & Asongu, 2024).

Youth unemployment (YUNEMP) was initially considered as an additional labour-market control. However, preliminary correlation analysis identified a very high correlation between YUNEMP and overall unemployment ($r = 0.92$). To avoid redundancy and potential multicollinearity, YUNEMP was excluded from the final regression specification and UNEMP was retained as the broader labour-market control.

3.3.4 Model Specification

To test the study hypotheses, HDI was modelled as a function of the selected education-related, governance, digital, and socio-economic variables using panel regression. The empirical specification applied in the quantitative phase is consistent with the model reported in Minić et al. (2026). The model allows the relationship between each explanatory variable and HDI to be estimated while accounting for repeated observations across countries and over time (Baltagi, 2021; Hsiao, 2014).

The general empirical model is specified as follows:

$$HDI_{it} = \alpha + \beta_1 GEE_{it} + \beta_2 SSE_{it} + \beta_3 TSE_{it} + \beta_4 PPE_{it} + \beta_5 ALR_{it} + \beta_6 PTR_{it} + \beta_7 GEFF_{it} + \beta_8 PS_{it} + \beta_9 VA_{it} + \beta_{10} INT_{it} + \beta_{11} URB_{it} + \beta_{12} UNEMP_{it} + \mu_i + \lambda_t + \varepsilon_{it}$$

where HDI_{it} represents the Human Development Index for country i in year t ; β_0 is the intercept; β_1 to β_{12} are the coefficients associated with the explanatory variables; μ_i represents unobserved time-invariant country-specific characteristics; and ε_{it} is the idiosyncratic error term. The country-specific component captures factors that differ across countries but remain relatively stable over time, such as geographical, historical, or institutional characteristics.

The coefficients indicate the estimated direction and magnitude of the association between each explanatory variable and HDI, conditional on the remaining variables in the model. Positive coefficients indicate a positive association with HDI, while negative coefficients indicate an inverse association. Given the observational nature of the data, these coefficients are interpreted as statistical associations rather than definitive causal effects.

The final specification contains ten principal explanatory variables representing education-related conditions, governance, and digital access, together with two socio-economic controls, URB and UNEMP. YUNEMP was initially considered but subsequently excluded because of its very high correlation with UNEMP, as discussed in the diagnostic analysis.

To assess the sensitivity of the estimates to alternative assumptions regarding unobserved heterogeneity, the model was estimated using POLS, BE, FE, RE, and FD specifications. The procedures used to compare these estimators and determine the preferred model are presented in Section 3.3.5.

3.3.5 Model Selection and Diagnostic Testing

Model selection and diagnostic testing were undertaken before interpreting the regression results in order to assess multicollinearity, compare alternative panel estimators, and determine the specification most appropriate for the structure of the data. The procedures comprised pairwise correlation analysis, Variance Inflation Factor (VIF) assessment, estimation of alternative panel models, and the Hausman specification test.

Correlation and Multicollinearity Assessment

Pairwise correlation coefficients were first examined to identify strong linear relationships among the explanatory variables. Correlation analysis provides an initial indication of potential redundancy between variables, although it does not by itself establish problematic multicollinearity. Because education, governance, and socio-economic indicators may be naturally interrelated, correlations were evaluated in conjunction with the theoretical role of each variable rather than being used as an automatic basis for exclusion.

Multicollinearity was subsequently assessed using the Variance Inflation Factor (VIF), which evaluates the extent to which the variance of an estimated coefficient is increased by linear relationships with the other explanatory variables. Following conventional econometric guidance, VIF values above 10 were treated as indicating potentially problematic multicollinearity (Gujarati & Porter, 2009). Where substantial overlap between variables was identified, the specification was reviewed with attention to both statistical redundancy and theoretical relevance.

Alternative Panel Estimators

The empirical model was estimated using POLS, BE, FE, RE, and FD specifications. These estimators were employed because they rely on different assumptions regarding the treatment of unobserved country-specific heterogeneity and the sources of variation used to estimate the coefficients (Baltagi, 2021; Hsiao, 2014).

POLS was used as a benchmark specification because it provides an initial estimate of the relationships between the explanatory variables and HDI without explicitly modelling country-specific effects. This makes it useful for comparison with panel estimators that account for unobserved heterogeneity.

The BE estimator was included because the study compares 15 countries with different long-term educational, institutional, and socio-economic profiles. By using country-level averages over the observation period, BE captures whether countries with systematically higher average levels of variables such as literacy, tertiary enrolment, or government effectiveness also tend to exhibit higher average HDI. FE was employed to examine changes within countries over time while controlling for time-invariant country-specific characteristics, such as geographical, historical, or institutional features that may otherwise influence HDI. This is particularly relevant to the present dataset because each country is observed annually over a 24-year period.

RE was included because it uses both within-country and between-country variation and is therefore suitable for a panel in which the explanatory variables differ both across countries and over time. Its use depends on the assumption that unobserved country-specific effects are uncorrelated with the explanatory variables; this assumption was assessed through the Hausman specification test. FD was estimated as an additional robustness specification because it focuses on changes between consecutive years and removes time-invariant country-specific effects. This provides a complementary perspective on whether short-term changes in the explanatory variables are associated with changes in HDI.

This combination was particularly appropriate for the present balanced panel because the study examines both differences between countries and changes within countries over time, while also assessing the sensitivity of the results to alternative treatments of unobserved country-specific heterogeneity.

Hausman Specification Test

The Hausman specification test was used to inform the choice between the FE and RE estimators (Hausman, 1978). The test evaluates whether the unobserved country-specific effects are systematically correlated with the explanatory variables. Under the null hypothesis, such correlation is absent and the RE estimator is considered consistent and more efficient; rejection of the null hypothesis supports the FE specification.

The Hausman test was interpreted together with the characteristics of the dataset and the comparative results of the alternative estimators rather than as an isolated criterion for model selection. The results of the correlation analysis, VIF assessment, alternative model estimations, and Hausman test are presented in Chapter Four.

3.4 Qualitative Phase - Focus Group Discussion (FGD)

3.4.1 Justification for Focus Group Discussion

Following completion of the quantitative panel regression analysis, a qualitative phase was conducted through an FGD to complement, contextualise, and extend the statistical findings. While panel regression provides evidence of relationships between ESD-related variables and HDI outcomes across countries, it cannot fully explain how these relationships are understood and translated into policy and practice within a specific national context. Quantitative analysis identifies statistical associations but does not capture the contextual factors, institutional realities, or stakeholder perspectives that influence the implementation of ESD. Consequently, qualitative inquiry was undertaken to provide deeper understanding of the empirical findings and explore their practical implications.

Rather than functioning as an independent investigation or repeating hypothesis testing, the FGD was designed to explain, interpret, and enrich the quantitative findings by exploring how key stakeholders understand the role of education in advancing sustainable development and human development. This integration of quantitative and qualitative evidence is consistent with the explanatory sequential mixed-methods design adopted in the study (Creswell & Plano Clark, 2018).

The FGD method was selected because the research investigates a multidimensional and policy-oriented phenomenon situated at the intersection of education, sustainable development, governance, and human development. Unlike individual interviews, focus groups encourage interaction among participants, enabling them to respond to one another's experiences, challenge assumptions, compare perspectives, and collectively develop insights (Krueger & Casey, 2015). This interactive process is particularly valuable in sustainability research, where understanding complex issues often requires perspectives from different sectors and institutional contexts (Lauri, 2019).

An additional advantage of the FGD was its ability to bring together participants from government, higher education, industry, non-governmental organisations, and the student community. This multi-stakeholder composition enabled the challenges and opportunities associated with ESD to be considered from different institutional perspectives and is consistent with the collaborative and participatory principles underpinning ESD.

The FGD was therefore designed to interpret and extend the quantitative findings while identifying implementation challenges, contextual factors, and practical recommendations that cannot be captured through secondary international datasets. In doing so, the qualitative phase contributes to a more comprehensive understanding of the relationship between education, ESD, and human development and informs the development of the proposed E-HDI framework.

More specifically, the discussion sought to achieve the following objectives:

- To interpret and contextualise the findings emerging from the panel regression analysis.
- To explore stakeholder perceptions regarding the relationship between education, sustainable development, and human development in Oman.
- To identify perceived gaps between current educational outcomes and the competencies required for sustainable development and future labour-market needs.
- To examine the extent to which existing educational approaches foster the knowledge, skills, values, and competencies associated with ESD.
- To generate evidence-informed recommendations for policy, curriculum development, and the future integration of ESD into educational systems.

3.4.2 Case Selection: Oman

Oman was selected as the national context for the qualitative phase because it represents a particularly relevant case within the quantitative sample. The rationale was based not on the panel regression results themselves, but on the contrast between Oman's strong human development performance and its comparatively weaker performance across the broader sustainable development agenda. Oman recorded an HDI value of 0.858 and was classified within the very high human development category, ranking 50th in the Human Development Report (United Nations Development Programme, 2025). At the same time, Oman ranked 97th in the Sustainable Development Report 2024, indicating that progress in human development does not necessarily translate into equally strong performance across the SDGs (Sachs et al., 2024). This contrast makes Oman a relevant setting in which to explore how education, and particularly ESD, may contribute to more sustainable forms of human development.

Oman is also a relevant policy context because sustainable development has been positioned as a national priority through Oman Vision 2040. The Vision places education, innovation, human capital development, environmental sustainability, and economic diversification among the country's long-term development priorities. These areas are closely aligned with the broader principles of ESD and provide an appropriate context for examining how sustainability is understood and implemented across education, government, industry, and civil society.

A further reason for selecting Oman is that the systematic integration of ESD within educational policy and practice remains an area requiring closer contextual examination. Internationally comparable indicators directly measuring the implementation of SDG Target 4.7 remain limited, making it difficult to determine from secondary datasets alone how sustainability competencies, curriculum integration, institutional collaboration, and related ESD practices are implemented at national level. The qualitative phase therefore provides an opportunity to explore these dimensions directly through stakeholder perspectives.

Oman's inclusion in the quantitative sample also provides continuity between the two phases of the study. Although Oman is classified by the World Bank as a high-income economy and by UNDP as a country with very high human development, the International Monetary Fund classifies it within the group of Emerging Market and Developing Economies (International Monetary Fund, 2023). This position makes Oman particularly relevant for examining how a country that has achieved relatively high levels of human development continues to address sustainability-related challenges through education and policy.

Finally, the selection of Oman was supported by practical access to information-rich participants across government, higher education, industry, non-governmental organisations, and the student community. The researcher's professional experience in Oman provided knowledge of the institutional landscape and relevant stakeholder organisations across education and sustainability. However, accessibility was not the principal criterion for case selection; rather, it enabled the purposeful recruitment of participants capable of providing informed and diverse perspectives on the implementation of ESD (Creswell & Poth, 2018; Yin, 2018).

Accordingly, Oman was selected because it combines a relevant development profile, a strong national sustainability agenda, inclusion in the quantitative sample, and access to stakeholders capable of providing contextual insight into the opportunities and challenges associated with strengthening ESD. The findings from the Omani case consequently support the interpretation of the quantitative results and contribute to the development of the proposed E-HDI framework.

3.4.3 Participant Selection and Recruitment

Participants were selected using purposive sampling, a non-probability sampling technique widely employed in qualitative research to recruit individuals possessing knowledge, experience, and expertise relevant to the research objectives (Patton, 2015). Unlike probability sampling, which aims to achieve statistical representativeness, purposive sampling seeks to obtain information-rich

cases capable of providing in-depth insight into the phenomenon under investigation. This approach was considered appropriate because the objective of the qualitative phase was not to generalise findings to a wider population but to explore informed stakeholder perspectives on the implementation of ESD and its contribution to sustainable human development.

Consistent with the explanatory sequential mixed-methods design adopted in this dissertation, participants were selected on the basis of their professional experience, institutional role, and involvement in areas related to education, sustainable development, public policy, business, or community engagement. The intention was to ensure that the discussion reflected diverse perspectives across sectors that collectively influence the design, implementation, and outcomes of ESD.

To capture this diversity, participants were recruited from five stakeholder groups:

- Government, including representatives involved in education, sustainability, or national development policy;
- Higher education, including academic staff, researchers, and institutional leaders with expertise in teaching, curriculum development, or sustainability initiatives;
- Industry, including professionals responsible for organisational sustainability, corporate responsibility, innovation, or workforce development;
- Non-governmental organisations (NGOs), representing organisations engaged in sustainability, community development, environmental initiatives, or social development; and
- Students, representing the primary beneficiaries of educational systems and providing perspectives on learning experiences and future workforce expectations.

The inclusion of these stakeholder groups reflects the interdisciplinary and collaborative nature of ESD. Sustainable development requires cooperation across multiple sectors, and the perspectives of policymakers, educators, employers, civil society, and learners are all essential for understanding how sustainability can be embedded within educational systems and translated into improved human development outcomes.

Participants were eligible if they represented one of the five stakeholder groups identified above and satisfied at least one of the following inclusion criteria:

- demonstrate professional knowledge or experience related to education, sustainability, governance, or human development;
- hold a position involving decision-making, policy development, programme implementation, or academic leadership relevant to the research topic;

- possess experience working with sustainability initiatives within government, higher education, industry, or civil society; or
- represent the student perspective through active engagement in sustainability-related educational or community initiatives.

Potential participants were identified through the researcher's professional knowledge of the sustainability and education landscape in Oman and through relevant institutional contacts. In total, fifteen potential participants were approached. Each prospective participant received a formal invitation explaining the purpose of the research together with a Participant Information Sheet outlining the objectives of the study, the voluntary nature of participation, procedures for data collection, confidentiality measures, and the intended use of the research findings. Thirteen participated in the FGD, one declined the invitation, and one initially agreed to participate but did not attend the session. The recruitment strategy was purposively designed to ensure representation of all five stakeholder groups and to include participants with relevant experience across policy, education, sustainability implementation, industry, civil society, and the student perspective. Equal numerical representation across the five stakeholder groups was not an objective of the sampling strategy, as the qualitative phase was designed to capture a breadth of informed cross-sector perspectives rather than to conduct formal comparisons between stakeholder groups.

The use of a single FGD was considered proportionate to the explanatory role of the qualitative phase within the mixed-methods design. The purpose was not to achieve statistical representation or claim thematic saturation across the Omani population, but to contextualise and extend the quantitative findings through informed cross-sector perspectives. A deliberately heterogeneous group was therefore assembled, bringing together thirteen information-rich participants from five stakeholder groups within one discussion. This composition enabled direct comparison and interaction between perspectives from policy, higher education, industry, civil society, and the student community. The relatively large group size was accepted in order to preserve this multi-stakeholder character. Multiple FGDs could have provided greater breadth and enabled more systematic sector-specific comparison; accordingly, the qualitative findings are interpreted as contextual and explanatory rather than representative.

The final participant group intentionally represented a range of institutional backgrounds rather than a single professional community. This multi-stakeholder composition enabled participants to contribute complementary experiences, compare perspectives across sectors, and engage in dialogue regarding both the opportunities and challenges associated with embedding ESD within educational systems. Such diversity strengthened the richness of the discussion and enhanced the credibility of the qualitative findings by incorporating viewpoints from those directly involved in education, policy, implementation, and practice.

A summary of the participant characteristics is provided in Appendix C. To preserve confidentiality, participants are identified throughout this dissertation using anonymised codes rather than personal names or institutional affiliations.

3.4.4 Development of the Discussion Guide

The FGD guide was developed specifically for this study to ensure alignment with the research objectives and the explanatory sequential mixed-methods design. Rather than using a standardised interview protocol, the discussion guide was constructed following completion of the quantitative phase, allowing the statistical findings to inform the qualitative inquiry. This ensured that the discussion focused on explaining, contextualising, and extending the results obtained through the panel regression analysis.

The development of the discussion guide was informed by three principal sources. First, the literature review presented in Chapter Two provided the theoretical foundation by identifying key themes related to ESD, HDI, sustainable development, governance, educational quality, and the implementation of SDG 4, Quality Education, Target 4.7. Second, the research questions and objectives guided the selection of topics requiring further qualitative exploration. Finally, the quantitative findings highlighted areas where additional stakeholder interpretation was required, particularly regarding the practical implementation of ESD, the role of governance, and the relationship between educational systems and sustainable human development.

To facilitate a logical progression throughout the discussion, the questions were organised according to a macro–meso–micro framework. This structure enabled participants to move gradually from broader national perspectives towards institutional and individual considerations while maintaining a coherent flow throughout the discussion.

The macro level explored participants' perceptions of national sustainable development priorities, educational policy, governance, and the extent to which sustainability is embedded within the country's development agenda.

The meso level focused on organisational and institutional dimensions, including higher education, schools, industry, curriculum development, collaboration between sectors, and the alignment of educational outcomes with labour-market and sustainability needs.

The micro level examined individual competencies, values, attitudes, and behaviours associated with ESD, including critical thinking, ethical decision-making, systems thinking, and learners' preparedness to contribute to sustainable development.

Questions were designed to be open-ended, neutral, and exploratory, allowing participants to express their views freely while encouraging interaction among stakeholders. Where appropriate, follow-up prompts were used to clarify responses, encourage elaboration, and explore differences in perspectives across stakeholder groups. The moderator remained flexible throughout the

discussion, allowing new themes to emerge while ensuring that the principal topics relevant to the research objectives were addressed.

Prior to data collection, the discussion guide was pilot tested through a trial online session to evaluate the clarity, sequencing, timing, and technical aspects of the discussion. The pilot confirmed that the questions were understandable and appropriately ordered, and minor adjustments were subsequently made to improve the wording and flow of selected questions before the final FGD was conducted.

The final discussion guide consisted of ten open-ended questions, supported by additional probing questions where clarification or further explanation was required.

3.4.5 Data Collection Procedure

The qualitative data were collected through a single online FGD conducted on 1 July 2026 using Zoom Workplace Pro. The online format enabled participation by stakeholders representing different sectors and organisations across Oman while reducing geographical and scheduling constraints. Previous research has shown that videoconferencing platforms can provide an effective environment for qualitative data collection and facilitate participation across locations (Archibald et al., 2019).

Prior to the discussion, participants received the Participant Information Sheet, which explained the purpose of the research, the voluntary nature of participation, confidentiality arrangements, and the intended use of the data. They subsequently received the meeting date, time, Zoom link, and joining instructions by email. The Participant Information Sheet is provided in Appendix A.

At the beginning of the session, participants were welcomed by the researcher and reminded of the purpose and structure of the discussion, the voluntary nature of participation, confidentiality arrangements, and their right to withdraw. Although the Participant Information Sheet referred only to audio recording, participants were informed before the session commenced that the Zoom discussion would be recorded in both audio and video formats and automatically transcribed. Verbal consent was obtained from all participants before recording commenced.

The discussion was moderated by the researcher using the semi-structured discussion guide. The questions, presented in Appendix B, followed the macro–meso–micro sequence described in Section 3.4.4, while participants were encouraged to interact with one another, elaborate on previous responses, and introduce additional perspectives relevant to the research topic. Follow-up questions and prompts were used where clarification or further elaboration was required.

Following the discussion, the video recording and automatically generated transcript were securely downloaded from the Zoom platform. The transcript was reviewed against the recording to correct minor transcription inaccuracies, improve punctuation, and verify the accuracy of participant quotations before qualitative analysis commenced. The video recording was used only to support

transcript verification and the researcher's observations of participant interaction and non-verbal communication.

Throughout the FGD, the researcher also recorded observational notes concerning participant interaction, areas of agreement and disagreement, notable non-verbal dynamics, and reflections on the moderation process. These observations contributed to the researcher's reflexive documentation and supported the subsequent interpretation of the qualitative data.

The discussion lasted approximately one hour and 45 minutes and included thirteen participants representing government, higher education, industry, non-governmental organisations, and the student community. This composition enabled interaction across sectors and provided a range of perspectives relevant to ESD and sustainable human development.

Following completion of the FGD, the recording, transcript, and researcher notes were stored on password-protected devices accessible only to the researcher. Participant identities were removed from the analytical materials and replaced with anonymised participant codes P1–P13 to maintain confidentiality during analysis and reporting.

3.4.6 Data Analysis

The qualitative data were analysed using thematic analysis, a flexible and widely applied method for identifying, analysing, and interpreting patterns of meaning within qualitative data (Braun & Clarke, 2006; Braun & Clarke, 2022). Thematic analysis was considered appropriate because the objective of the qualitative phase was not to generate a new theory but to interpret stakeholder perspectives and explain the findings emerging from the quantitative panel regression analysis. The method provides a systematic yet flexible approach for organising participants' experiences into meaningful themes while remaining closely aligned with the explanatory sequential mixed-methods design adopted in this dissertation.

Data analysis commenced immediately following the Focus Group Discussion. The Zoom-generated transcript was carefully reviewed alongside the audio recording to verify transcription accuracy, correct minor errors, and improve punctuation where necessary. During this familiarisation stage, the researcher repeatedly read the transcript while reviewing observational notes recorded during the discussion, allowing initial impressions and potential patterns to emerge.

Following transcript preparation, the data were imported into NVivo 15 (Lumivero), which was used to support the organisation, coding and retrieval of qualitative data. Participant cases were created for each stakeholder (P1–P13), and case classifications were assigned according to stakeholder category (e.g., government, higher education, industry and NGO), enabling comparisons across participant groups during the analysis. NVivo served as a data management and analytical support tool; however, the identification and interpretation of themes remained the responsibility of the researcher.

The transcript was subsequently coded using an inductive–deductive approach. Deductive coding was guided by the research objectives, hypotheses, literature review, and quantitative findings, ensuring that themes relevant to the role of ESD, governance, educational quality, and human development were systematically examined. At the same time, inductive coding remained open to new ideas, experiences, and perspectives introduced by participants that had not been anticipated during the design of the discussion guide. This combination enabled the analysis to remain theoretically informed while allowing unexpected findings to emerge from the data.

Following the initial coding process, related codes were grouped into broader categories and progressively refined into candidate themes. Each theme was reviewed to ensure internal coherence and clear distinction from other themes, while maintaining a close connection to the original participant responses. Throughout this iterative process, the researcher continually compared emerging themes with the research objectives and the quantitative findings to ensure that the qualitative analysis contributed directly to explaining and contextualising the statistical results.

The final themes were defined and interpreted in relation to the broader aims of the study, focusing on stakeholder perspectives regarding the implementation of ESD, the relationship between education and human development, institutional and governance challenges, and opportunities for strengthening sustainable human development in Oman. Representative quotations from participants were selected to illustrate each theme while preserving participant anonymity through the use of identification codes (e.g., P1, P2, P3). The qualitative findings are presented in Chapter 4, where they are integrated with the quantitative results to provide a comprehensive understanding of the role of ESD in advancing sustainable human development.

The 33 final codes were organised into five overarching themes:

1. Educational Transformation
 1. ESD
 2. Curriculum Integration
 3. School Education
 4. Tertiary Education
 5. Teacher Professional Development
 6. Experiential Learning
 7. Competency-Based Education
 8. Lifelong Learning

9. Multidisciplinary Learning.
2. Graduate Competencies
 1. Critical Thinking
 2. Problem Solving
 3. Adaptability
 4. Employability
 5. Entrepreneurship
 6. Digital and AI Literacy
 7. Values and Attitudes
3. Governance and Partnerships
 1. Strategic Planning
 2. Cross-sector Collaboration
 3. Industry–Academia Collaboration
 4. International Collaboration
 5. Funding and Resources
 6. Implementation and Monitoring
4. Sustainability Outcomes
 1. Human Development
 2. Progress Towards Sustainable Development
 3. Environmental Sustainability
 4. Renewable Energy Transition
 5. Green Jobs
 6. Inclusion and Equity
5. Societal Engagement
 1. Community Engagement
 2. Innovation
 3. Collaboration and Teamwork
 4. Areas for Improvement
 5. Systems Thinking

13 The credibility and dependability of the analysis were supported through verification of the transcript against the recording, repeated review of the data, iterative refinement of the codes, and the use of verbatim participant quotations. Reflexivity was addressed through observational notes and the researcher's reflexivity memo presented in Appendix D. The final qualitative codebook provided in Appendix E documents the operational definitions, coded references, participant coverage, and supporting quotations, thereby providing an audit trail of the analytical process.

195 3.4.7 Integration of the Quantitative and Qualitative Phases

281 Integration occurred at three stages of the research. First, the quantitative findings informed the topics explored through the Focus Group Discussion. Second, the qualitative themes were compared with the panel regression findings to provide contextual explanations for relationships that could not be interpreted through secondary data alone. Third, the findings from both phases were interpreted together when developing the study conclusions, policy recommendations, and the proposed E-HDI framework. The qualitative phase therefore served an explanatory and complementary function rather than constituting a separate test of the quantitative hypotheses.

CHAPTER 4: RESULTS

This chapter presents the findings in accordance with the explanatory sequential mixed-methods design. Section 4.1 reports the quantitative panel regression results examining the relationships between selected education-related, governance and control variables and the HDI across fifteen emerging economies from 2000 to 2023. Section 4.2 presents the Oman context for education, sustainable development and human development, while 4.3 presents the qualitative findings from the Focus Group Discussion conducted in Oman, providing contextual insights into stakeholder perspectives on ESD, education and human development.

4.1 Quantitative Results

4.1.1 Country and Indicator Profile of the Sample

Before examining the aggregate descriptive statistics and regression results, the characteristics of the countries included in the panel are considered comparatively. The sample captures substantial variation in human development, educational conditions, institutional capacity and digital access across different national contexts. This heterogeneity is analytically relevant in a panel design because it allows the study to examine both differences between countries and changes within countries over time rather than relying on a single cross-sectional comparison (Baltagi, 2021; Hsiao, 2014).

The diversity of the sample is clearly reflected in HDI levels. In 2023, Oman recorded the highest HDI in the sample at 0.858, followed by Georgia at 0.844, while Costa Rica and Serbia both recorded 0.833. At the lower end of the distribution, Pakistan recorded an HDI of 0.544, Rwanda 0.578 and Kenya 0.628. Overall, the sample includes four countries classified as having very high human development, seven as high, three as medium and one as low (UNDP, 2025). This range provides a basis for examining the relationships between education-related and enabling conditions and HDI across countries at different levels of human development.

Country differences extend beyond HDI to the education-related, institutional and digital conditions examined in the model. Table 6 therefore presents a selected set of indicators representing the principal analytical dimensions of the study. Adult literacy and tertiary enrolment represent educational capacity and participation; government education expenditure represents public investment in education; internet access captures digital enabling conditions; and government effectiveness and political stability represent institutional conditions. The indicators were selected to provide a concise comparative profile rather than reproduce the full regression specification. They also correspond closely to the study hypotheses and subsequent empirical findings, while political stability is retained despite its lack of statistical significance in the preferred model in order to preserve the governance dimension examined in H2. For the explanatory variables, period averages over 2000–2023 are reported, while HDI values at the beginning and end of the period indicate the direction and magnitude of human development change.

Table 6. Comparative Country Profile, 2000–2023

Country	HDI 2000	HDI 2023	Δ HDI	Mean ALR (%)	Mean TSE (%)	Mean INT (%)	Mean GEE (% GDP)	Mean GEFF	Mean PS
Oman	0.707	0.858	+0.151	89.3	31.2	49.0	4.51	0.24	0.75
Georgia	0.705	0.844	+0.139	99.9	51.2	35.7	3.00	0.22	-0.67
Costa Rica	0.720	0.833	+0.113	96.8	42.4	46.8	5.92	0.27	0.69
Serbia	0.701	0.833	+0.132	97.8	54.7	50.3	3.89	-0.19	-0.34
Brazil	0.690	0.786	+0.096	91.0	47.3	45.8	5.28	-0.23	-0.21
Ukraine	0.716	0.779	+0.063	99.7	74.5	35.1	5.69	-0.60	-0.83
Sri Lanka	0.702	0.776	+0.074	91.4	17.8	15.4	1.94	-0.17	-0.78
Vietnam	0.604	0.766	+0.162	94.0	24.5	37.3	4.07	-0.15	0.17
Jordan	0.672	0.754	+0.082	93.8	35.7	40.6	3.35	0.12	-0.36
Egypt	0.639	0.754	+0.115	70.5	31.4	31.4	4.08	-0.44	-0.96
Philippines	0.632	0.720	+0.088	95.6	32.6	28.7	3.00	0.03	-1.21
India	0.501	0.685	+0.184	68.5	21.2	16.0	3.84	0.03	-1.05
Kenya	0.500	0.628	+0.128	78.3	6.7	12.6	5.26	-0.53	-1.18
Rwanda	0.340	0.578	+0.238	69.9	5.4	10.8	4.14	-0.26	-0.45
Pakistan	0.436	0.544	+0.108	55.0	7.1	10.6	2.00	-0.63	-2.12

Source: Author's calculations based on the dataset used in the panel analysis.

The comparative profile reveals substantial differences not only in levels of human development but also in development trajectories. Rwanda recorded the largest increase in HDI over the period (+0.238), followed by India (+0.184), Vietnam (+0.162) and Oman (+0.151), whereas the increases were considerably smaller in Ukraine (+0.063), Sri Lanka (+0.074) and Jordan (+0.082). These patterns should be interpreted in relation to different starting points: Rwanda and India began the period with substantially lower HDI values than the countries already positioned at higher levels of human development. The comparison therefore captures both differences in current levels and the extent of change over time.

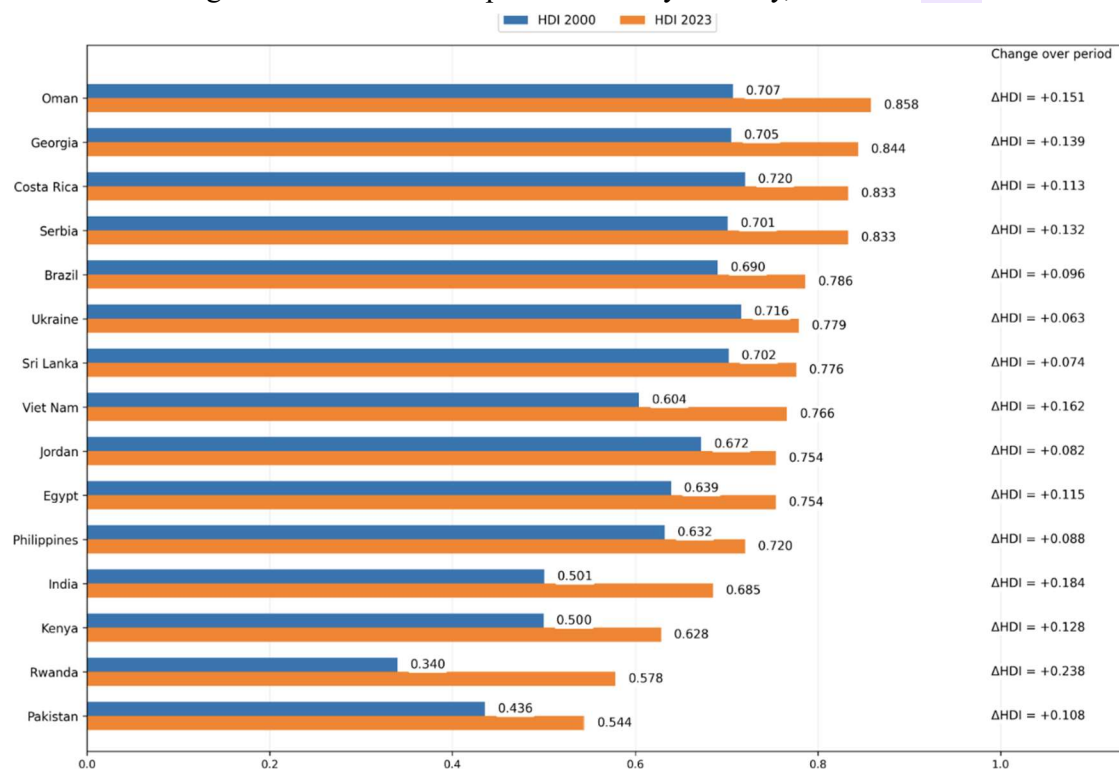
The indicators also show that similar HDI outcomes may coexist with markedly different educational and institutional profiles. Costa Rica and Serbia, for example, both recorded an HDI of 0.833 in 2023, yet their period averages differ in tertiary enrolment, education expenditure, government effectiveness and political stability. A similar contrast is evident between Jordan and Egypt, which both recorded an HDI of 0.754 in 2023 despite considerable differences in adult literacy, internet access and governance indicators. At the lower end of the distribution, Pakistan

combines the lowest 2023 HDI in the sample with comparatively low adult literacy and internet access and the weakest average political-stability score. Conversely, Ukraine records very high adult literacy and tertiary enrolment but a comparatively small increase in HDI over the study period and negative average governance indicators. These contrasts indicate that HDI levels cannot be understood through a single educational or institutional characteristic and provide important context for interpreting the multivariate panel results.

The country profile is descriptive and does not establish causal relationships or treat the fifteen countries as separate case studies. Rather, it makes the heterogeneity underlying the panel explicit and provides a comparative basis for interpreting the subsequent statistical results.

To complement the comparative profile presented in Table 6, the following figures visualise the main differences across the fifteen countries in HDI, educational conditions, digital access and institutional context. Presenting these indicators separately makes it possible to identify country-specific patterns and contrasts that may be less apparent from the aggregate statistics alone and provides a comparative context for the subsequent panel results.

Figure 4. Human Development Index by Country, 2000 and 2023

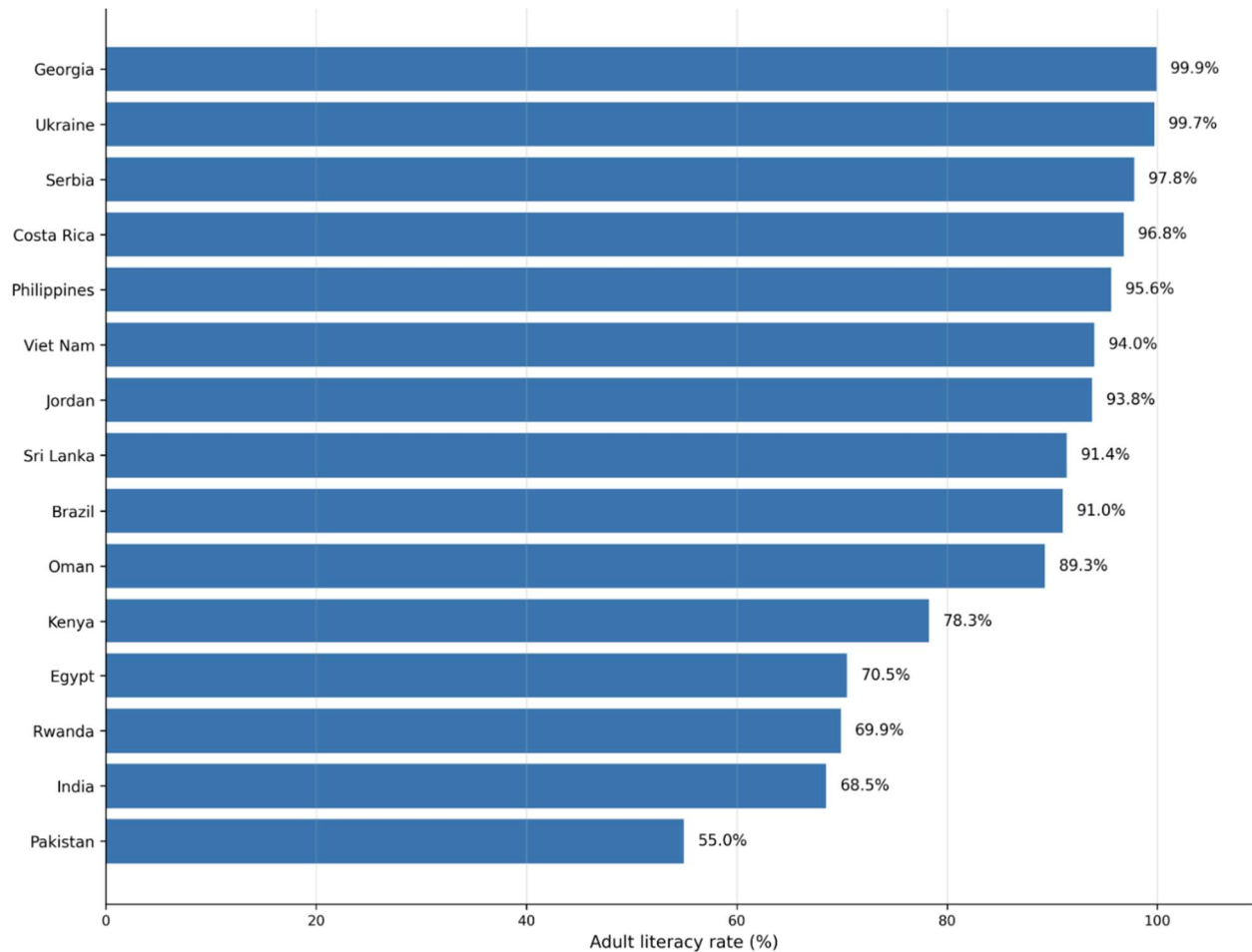


Source: Author's calculations based on the analytical panel dataset.

HDI increased in all fifteen countries between 2000 and 2023, although the magnitude of change varied considerably. Rwanda recorded the largest increase (+0.238), followed by India (+0.184) and Vietnam (+0.162), while Oman combined a relatively substantial increase (+0.151) with the highest 2023 HDI in the sample (0.858).

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Figure 5. Adult Literacy Rate (ALR), Period Mean, 2000–2023

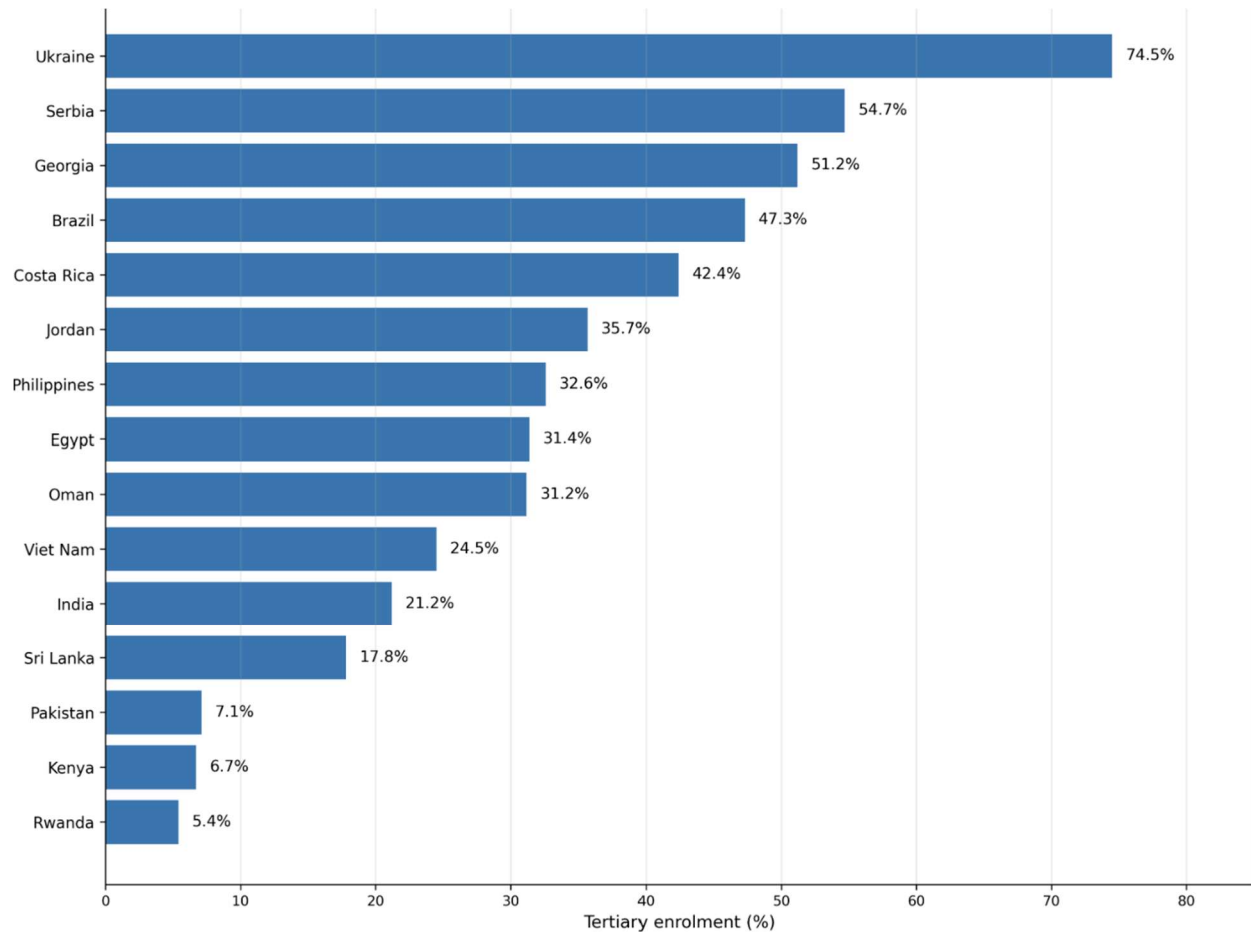


Source: Author's calculations based on the analytical panel dataset.

Adult literacy was particularly high in Georgia, Ukraine, Serbia and Costa Rica, with period means above 96%, while substantially lower averages were observed in Pakistan, India, Rwanda and Egypt. The variation illustrates considerable differences in foundational educational capacity across the sample.

4

Figure 6. Tertiary Enrolment (TSE), Period Mean, 2000–2023

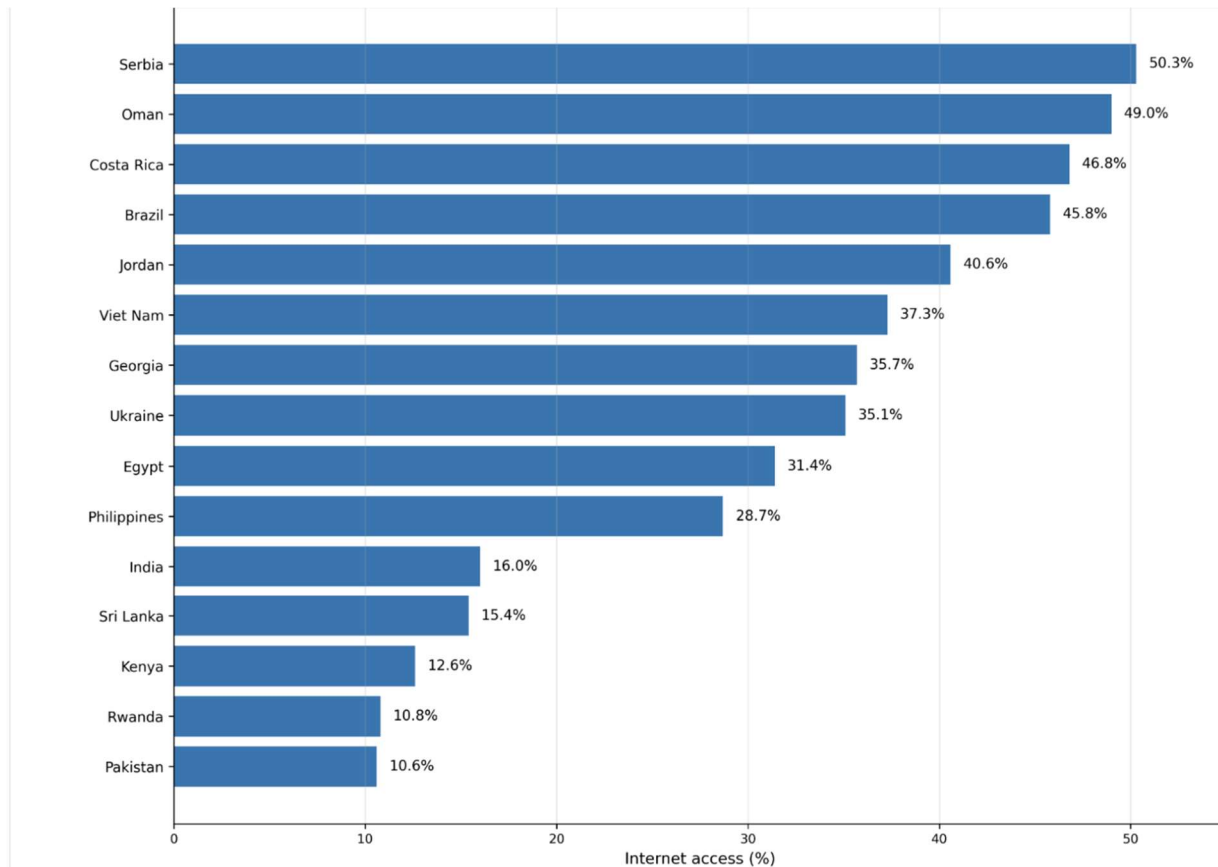


Source: Author's calculations based on the analytical panel dataset.

Tertiary enrolment shows greater variation than adult literacy, ranging from 74.5% in Ukraine to 5.4% in Rwanda. This contrast is important because countries with high basic literacy do not necessarily demonstrate equally high participation in tertiary education.

4

Figure 7. Internet Access (INT), Period Mean, 2000–2023

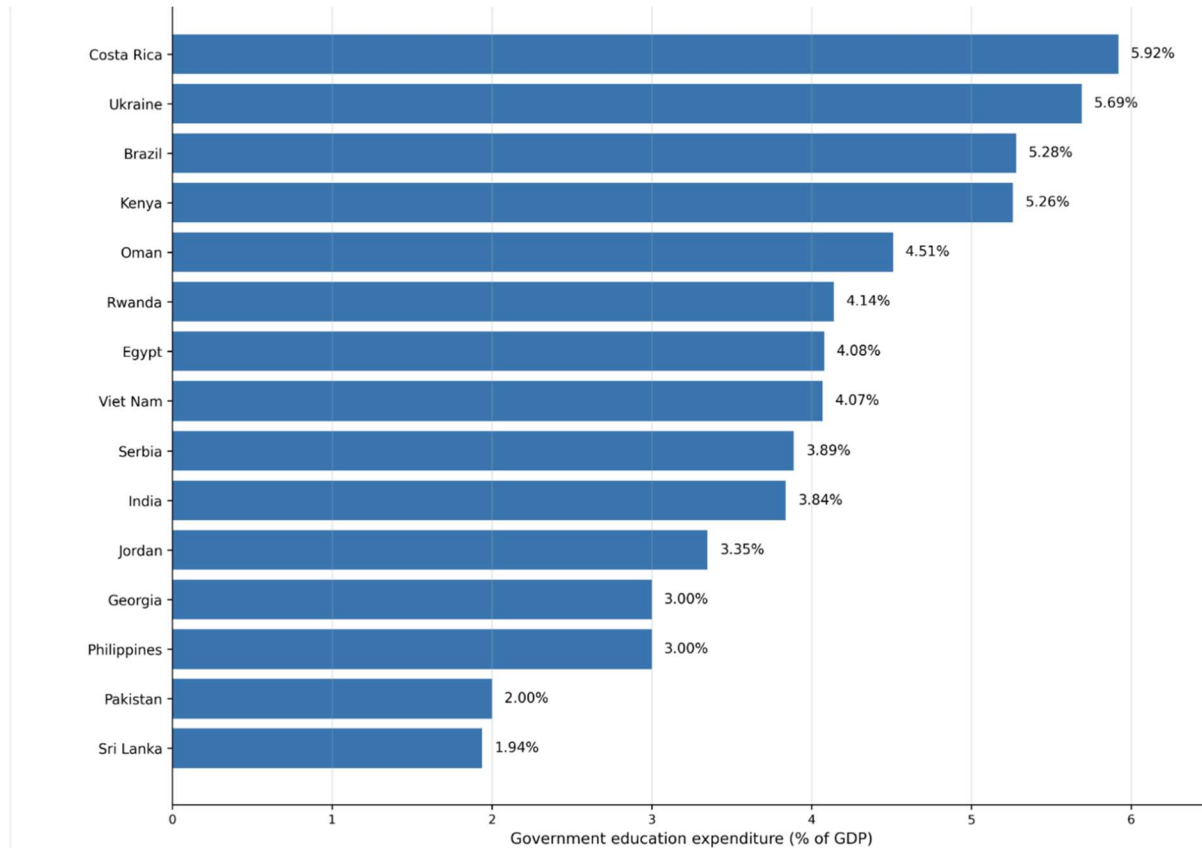


Source: Author's calculations based on the analytical panel dataset.

Average internet access was highest in Serbia, Oman, Costa Rica and Brazil, while substantially lower levels were recorded in Pakistan, Rwanda and Kenya. The differences illustrate unequal digital enabling conditions across countries during the study period.

4

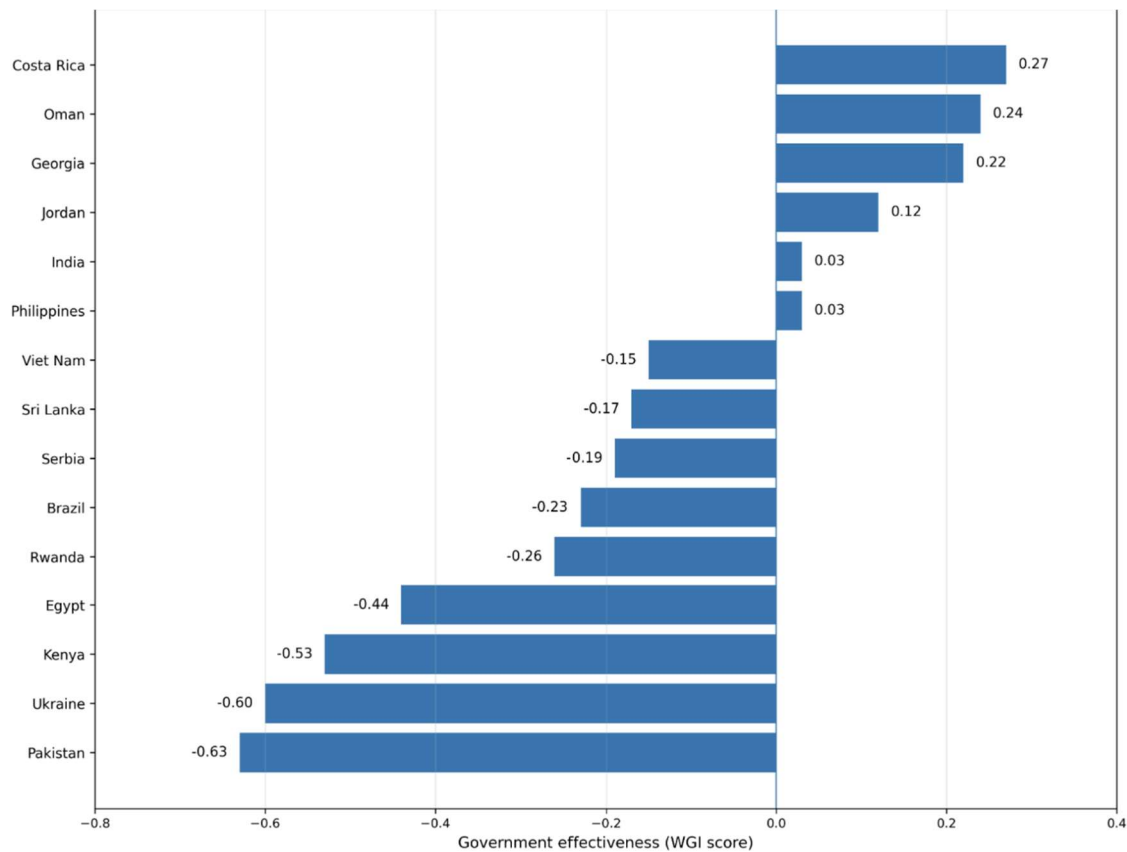
Figure 8. Government Education Expenditure (GEE), Period Mean, 2000–2023



Source: Author's calculations based on the analytical panel dataset.

Average education expenditure varied from 5.92% of GDP in Costa Rica to 1.94% in Sri Lanka. Importantly, relatively high expenditure is observed in countries at different HDI levels, suggesting that the level of spending alone does not explain differences in human development outcomes.

Figure 9. Government Effectiveness (GEFF), Period Mean, 2000–2023

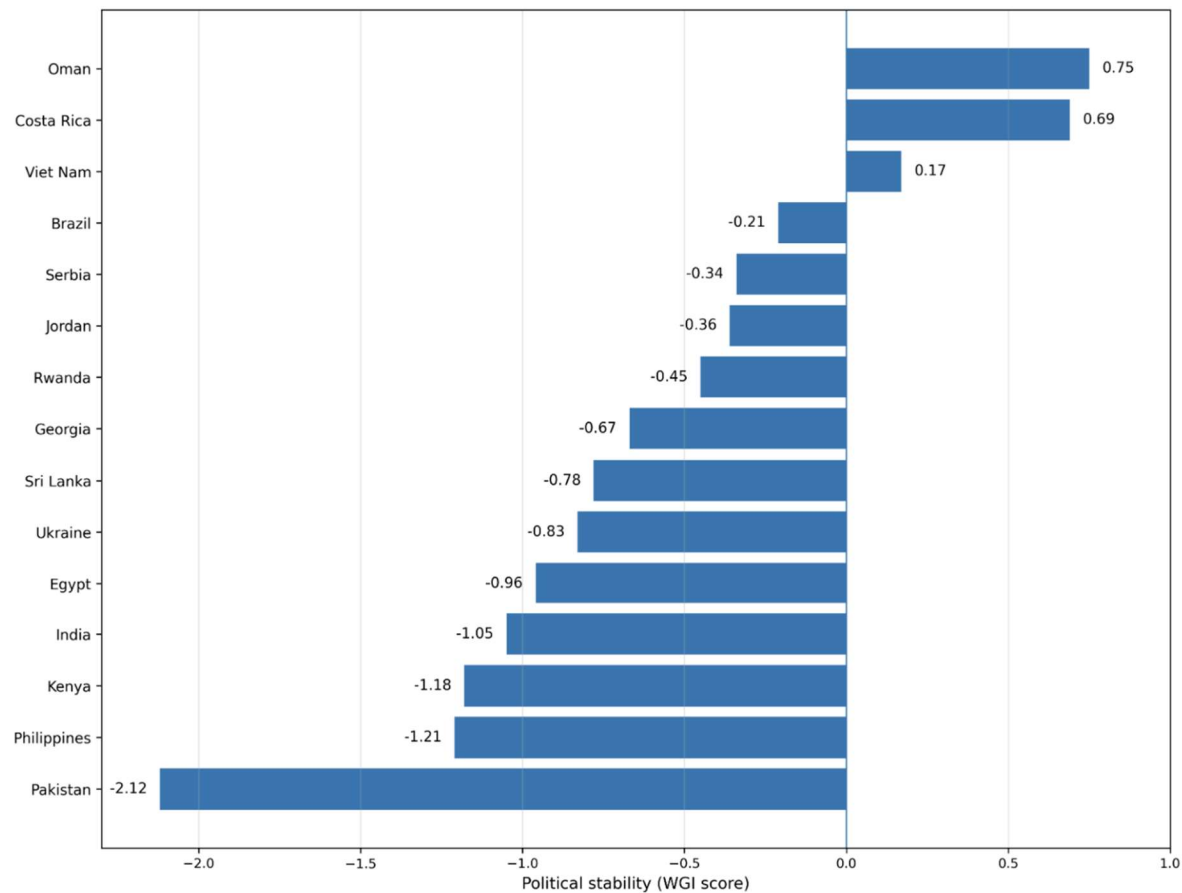


Source: Author's calculations based on the analytical panel dataset.

Government effectiveness also differs markedly across the sample, with positive period averages in Costa Rica, Oman, Georgia and Jordan and negative averages in most other countries. These differences provide a useful institutional context for interpreting the positive association between government effectiveness and HDI identified in the panel analysis.

4

Figure 10. Political Stability (PS), Period Mean, 2000–2023



Source: Author's calculations based on the analytical panel dataset.

Political stability displays particularly wide cross-country variation, ranging from 0.75 in Oman to −2.12 in Pakistan. However, because political stability was not statistically significant in the preferred RE model, these country differences should be treated as contextual characteristics rather than evidence of a direct relationship with HDI.

The graphical comparisons reinforce the heterogeneity identified in Table 6. HDI increased across all fifteen countries between 2000 and 2023, although the magnitude of change differed substantially across the sample. Educational profiles also vary considerably, particularly in the relationship between adult literacy and tertiary enrolment, indicating that high basic educational attainment does not necessarily correspond to equally high participation in tertiary education. Differences in education expenditure and internet access further demonstrate variation in educational resources and digital enabling conditions, while government effectiveness and political stability reveal substantial differences in institutional contexts. Taken together, these comparisons show that countries with similar HDI levels may exhibit different combinations of educational, digital and institutional conditions. These country-specific patterns provide an important comparative context for interpreting the panel results and are revisited in the Discussion.

4.1.2 Descriptive Statistics

Significant variation across the countries and overtime can be observed in the results (Table 7), especially evident in variables that are related to internet access (INT), public expenditure on education (GEE) and secondary school enrollment (SSE). The values of HDI range from 0.34 to 0.858, with a mean of 0.689; these figures reflect the heterogeneity of the country sample and various levels of development represented. The governance indicators (GEFF, PS, VA) display negative mean values indicating broader institutional challenges across the sample. In addition, unemployment, and especially youth unemployment, exhibits considerable cross-country variation.

Table 7. Descriptive Statistics

Variable	N	Mean	St. Dev.	Min	Max
INT	360	31.067	27.24	0.063	95.3
GEE	360	3.999	1.336	1.204	7.397
SSE	360	79.987	24.971	9.514	141.203
TSE	360	32.25	20.758	1.164	84.798
PPE	360	58.242	24.411	2.648	105.103
ALR	360	86.103	13.896	50	100
PTR	360	25.965	13.318	8.68	69.286
URB	360	49.926	23.246	14.926	92.02
UNEMP	360	8.118	5.047	0.398	24
YUNEMP	360	19.512	10.982	0.82	51.244
GEFF	360	-0.154	0.372	-1.213	0.791
PS	360	-0.57	0.824	-2.81	1.121
VA	360	-0.352	0.7	-1.566	1.152
HDI	360	0.689	0.108	0.34	0.858

Source: Author's calculations.

4.1.3 Correlation Analysis

The descriptive analysis above shows that the variables' relationships are assessed before proceeding with regression analysis. Table 8 shows correlation matrix which provides an initial assessment of the strength and direction of relationships among the variables; it also enables the detection of possible multicollinearity arising from variables which detect similar underlying dynamics.

A preliminary view of the relationships among variables is observed through the correlation analysis, enabling detection of meaningful overlap. A notable multicollinearity concern arises

regarding unemployment (UNEMP) and youth unemployment (YUNEMP), which exhibit a correlation coefficient of 0.92. This strong correlation suggests substantial overlap between the two variables. Consequently, including both variables would contribute limited additional explanatory content and while increasing the risk of multicollinearity; therefore, YUNEMP was omitted from the regression models to minimise redundancy and improve estimation stability.

Several strong associations are also evident among the education variables: secondary school enrollment (SSE) is strongly correlated with the pupil–teacher ratio (PTR) ($r = -0.86$) and adult literacy rate (ALR) ($r = 0.83$).

Moderate interrelationships are observed among the governance indicators (GEFF, PS, and VA), with the highest correlation coefficient reaching 0.57. This remains below the generally accepted threshold of 0.80.

Table 8. Correlation Matrix of the Study Variables

	INT	GEE	SSE	TSE	PPE	ALR	PTR	URB	UNEMP	YUNEMP	GEFF	PS	VA	HDI
INT	1													
GEE	0.27	1												
SSE	0.55	0.26	1											
TSE	0.61	0.37	0.71	1										
PPE	0.37	0.16	0.41	0.44	1									
ALR	0.48	0.24	0.83	0.7	0.38	1								
PTR	-0.52	-0.17	-0.86	-0.72	-0.38	-0.73	1							
URB	0.52	0.37	0.62	0.67	0.16	0.53	-0.66	1						
UNEMP	0.17	0.06	0.22	0.36	-0.26	0.25	-0.2	0.33	1					
YUNEMP	0.25	0.01	0.42	0.42	-0.17	0.32	-0.41	0.36	0.92	1				
GEFF	0.38	-0.05	0.48	0.19	0.11	0.4	-0.34	0.33	0.17	0.27	1			
PS	0.32	0.4	0.53	0.26	0	0.49	-0.4	0.43	0.11	0.15	0.57	1		
VA	0.14	0.29	0.4	0.4	0.49	0.36	-0.29	0.32	0.2	0.29	0.29	0.11	1	
HDI	0.28	-0.01	0.21	0.2	0.25	0.05	-0.26	0.29	-0.02	0	0.13	0.16	-0.07	1

Source: Author's calculations.

The correlation analysis provides an initial assessment of the relationships among the variables. To further evaluate whether multicollinearity may affect the reliability of the regression estimates, the Variance Inflation Factor (VIF) was subsequently calculated.

4.1.4 Multicollinearity Assessment

To further evaluate the potential influence of the observed in the correlation on the model, the VIF was calculated, and the results are shown in Table 9. After the removal of YUNEMP, all VIF values were found to be below the conventional threshold of 10. SSE and PTR demonstrated comparatively higher values of 7.09 and 5.19, respectively, but they did not point to a high degree of multicollinearity.

Table 9. Variance Inflation Factor (VIF)

Variable	Updated VIF	Status
SSE	7.09	Cautionary (Acceptable)
PTR	5.19	Cautionary (Acceptable)
TSE	4.43	Acceptable
ALR	3.7	Acceptable
URB	2.7	Acceptable
PPE	2.59	Acceptable
GEFF	2.56	Acceptable
PS	2.89	Acceptable
VA	2.23	Acceptable
INT	2.25	Acceptable
GEE	2.06	Acceptable
UNEMP	1.77	Excellent

Source: Author's calculations.

4.1.5 Panel Regression Results

The choice between FE and RE models was determined using the Hausman specification test. After removing YUNEMP, the test produced a χ^2 value of 20.89 with a p-value of 0.052. Since this is above the usual 0.05 threshold, the null hypothesis was not rejected, which supports the selection of the RE model as more efficient for this dataset. Table 10. shows the RE model explaining a substantial share of variation in the HDI with an adjusted R^2 of 0.784.

Table 10. Panel Regression Results

Variable	POLS (1)	BE (2)	FE (3)	RE (4)	FD (5)
GEE	-0.014*** (0.005)	-0.035 (0.055)	-0.003** (0.001)	-0.008*** (0.002)	-0.001 (0.001)
SSE	0.001 (0.001)	0.003 (0.006)	-0.00001 (0.0001)	0.001*** (0.0002)	0.0002 (0.0001)
TSE	0.0001 (0.0005)	0.0003 (0.005)	0.001*** (0.0002)	0.001*** (0.0002)	0.0004** (0.0002)
PPE	0.002*** (0.0003)	0.004 (0.004)	-0.0001 (0.0001)	0.001*** (0.0001)	0.0001 (0.0001)
ALR	-0.004*** (0.001)	-0.007 (0.005)	0.0001 (0.0004)	0.003*** (0.0004)	-0.0002 (0.0005)
PTR	-0.0003 (0.001)	-0.002 (0.008)	0.0002 (0.0003)	0.001*** (0.0004)	0.0001 (0.0002)
GEFF	-0.006 (0.020)	-0.132 (0.208)	0.002 (0.004)	0.013** (0.006)	0.002 (0.003)
PS	0.032*** (0.010)	0.205 (0.128)	0.005** (0.002)	0.003 (0.003)	-0.001 (0.002)
VA	-0.053*** (0.010)	-0.087 (0.108)	-0.005 (0.005)	0.013* (0.007)	0.003 (0.003)
INT	0.0001 (0.0003)	-0.015 (0.006)	-0.0005*** (0.0001)	0.001*** (0.0001)	-0.0003*** (0.0001)
URB	0.002*** (0.0003)	0.006 (0.003)	-0.0003 (0.0004)	-0.0003 (0.001)	-0.0001 (0.001)
UNEMP	0.003** (0.001)	0.013 (0.015)	0.0002 (0.0004)	-0.0002 (0.001)	-0.001*** (0.0003)
Constant	0.790*** (0.076)	1.089 (0.918)	—	0.319*** (0.052)	0.006*** (0.001)
Hausman Test (p-value)	Significant	Not Significant	Significant	Significant	Significant
Observations	360	15	360	360	345
R2	0.326	0.851	0.296	0.791	0.104
Adj. R2	0.303	-0.044	0.184	0.784	0.071
F-Statistic	13.997***	0.95	10.842***	1,311.341***	3.206***

Source: Author's calculations.

It can be observed, looking at the results in Table 10. above, that adult literacy (ALR), pre-primary (PPE), secondary (SSE), pupil-teacher ratio (PTR), tertiary (TSE) enrollments as well as voice and accountability (VA), government effectiveness (GEFF), and internet access (INT) are positively and statistically significantly associated with HDI in the RE model. Government education expenditure (GEE) exhibits a negative and statistically significant association with HDI. Urbanization (URB), political stability (PS), and unemployment (UNEMP) are statistically insignificant in the RE specification.

4.1.6 Marginal Effects Interpretation

To facilitate interpretation of the statistically significant coefficients, Table 11. presents the marginal effects based on the preferred RE model. Adult literacy exhibits the strongest practical effect, whereby a 10 percentage-point increase is associated with an approximate 0.03 increase in the HDI. Positive marginal effects are also observed for secondary, tertiary and pre-primary enrolment, government effectiveness and internet access, while government education expenditure shows a negative marginal effect.

Table 11. Marginal Effects Interpretation (Based on RE Model)

Variable	Coefficient	Marginal Interpretation
Adult Literacy (ALR)	0.003***	10% ↑ → +0.03 HDI
Government Effectiveness (GEFF)	0.014**	1 pt ↑ → +0.014 HDI
Secondary Enrollment (SSE)	0.001***	10% ↑ → +0.01 HDI
Tertiary Enrollment (TSE)	0.001***	10% ↑ → +0.01 HDI
Pre-primary Enrollment (PPE)	0.001***	10% ↑ → +0.01 HDI
Internet Access (INT)	0.001***	10% ↑ → +0.01 HDI
Gov. Education Expenditure (GEE)	-0.008***	1% ↑ → -0.008 HDI

*Note: Significance levels: *** $p < 0.01$, ** $p < 0.05$. Source: Author's calculations.*

Overall, the quantitative analysis demonstrates that education-related variables are consistently associated with HDI across the selected emerging economies. Institutional quality, particularly government effectiveness, also contributes positively to human development, while internet access further supports development outcomes. However, the statistical analysis does not explain how these relationships are reflected within a specific national context. Before presenting the FGD findings, the following subsection provides a focused examination of Oman's education and sustainable development context in order to establish the policy and empirical background against which stakeholder perspectives are interpreted.

4.2 Oman Context: Education, Sustainable Development and Human Development

The comparative analysis places Oman at the upper end of the fifteen-country sample in terms of human development. In 2023, Oman recorded an HDI of 0.858 and ranked 50th out of 193 countries and territories, placing it within the very high human development category. Expected years of schooling reached 13.4 years and mean years of schooling 11.9 years (UNDP, 2025). These indicators demonstrate substantial progress in education and human development. However, they also illustrate the limitation central to this study: the education dimension of HDI captures years of schooling rather than the quality, content and sustainability-related capabilities developed through education. The relevance of further human development improvement in Oman therefore lies not simply in increasing an already high HDI score, but in strengthening the educational capabilities underlying sustainable and responsible development.

This objective is strongly reflected in Oman Vision 2040. Education, Learning, Scientific Research and National Capabilities are its national priorities, with a strategic direction centred on inclusive education, lifelong learning, scientific research, a knowledge-based society and competitive national capabilities. The Vision calls for a high-quality education system supported by societal partnership, stronger governance and evaluation, development of human capabilities and curricula responsive to sustainable development and future skills. Education is therefore positioned not only as a social service but as an important mechanism for human-capital development, innovation, economic diversification and long-term national development (Oman Vision 2040 Implementation Follow-up Unit, n.d.).

Available implementation evidence shows considerable activity in translating these priorities into education reform. The Oman Vision 2040 Report 2024–2025 identifies the implementation of internationally benchmarked curricula in science, mathematics, English and information technology, development of vocational and technical education for Grades 11 and 12, national electronic assessments, improvements to e-learning systems, teacher-development initiatives and a national framework for evaluating school performance. The report also emphasises stronger links between education and labour-market requirements and the development of future skills (Oman Vision 2040 Implementation Follow-up Unit, 2025).

Basic educational infrastructure is also comparatively strong. According to the UN SDG Data Portal, the participation rate in organised learning one year before the official primary-school entry age increased from 58.6% in 2009 to 88.7% in 2024 (United Nations Statistics Division, 2026). Primary schools reported 100% access to computers and internet for pedagogical purposes, electricity, basic drinking water and adapted infrastructure and materials for students with disabilities. The reported proportion of primary-school teachers meeting minimum organised training requirements was also 100%. These indicators suggest that the challenge increasingly

extends beyond basic access and infrastructure towards the quality and effective use of educational provision.

International learning assessments provide further evidence for this distinction. In TIMSS 2023, Oman recorded a Grade 4 mathematics score of 421 and science score of 433, compared with international averages of 503 and 494 respectively. At Grade 8, Oman recorded 411 in mathematics and 456 in science, compared with international averages of 478 in both subjects (von Davier et al., 2024). Although TIMSS does not measure ESD, these results are relevant because they demonstrate that strong educational access and infrastructure do not automatically translate into equally strong learning outcomes. They also support Oman Vision 2040's continuing emphasis on improving educational quality, teaching methods and student competencies.

At the higher education level, national graduate data provide a more direct indication of challenges associated with the transition from education to employment. The Graduate Survey 2023 found that 29.6% of first-degree graduate respondents were employed at the time of the survey, while 70.4% were seeking employment; among those who had secured employment, 40.3% reported taking more than one year to obtain their first job (Ministry of Higher Education, Research and Innovation, 2024). Practical exposure during university was also uneven, with 43.9% of first-degree respondents reporting that they had received practical training during their studies. The survey identified small gaps between skills acquired during higher education and those perceived as required in the labour market, particularly in time management, creativity and innovation, critical thinking, persuasion and negotiation, and English-language proficiency. At the same time, 83.1% of employed respondents reported that their work was aligned with their field of study, indicating that the evidence points more strongly to challenges in the transition to employment and practical preparation than to a general mismatch between higher education and employment.

More directly relevant to ESD, UNESCO's SDG 4 country profile provides evidence on Target 4.7. In the latest reported values for Oman, referring to 2020, the SDG 4.7.1 score was 0.8 for national education policies, 0.7 for curricula, 0.9 for teacher education and 0.8 for student assessment. The indicator is measured on a scale from zero to one, with values closer to one representing stronger mainstreaming of ESD and global citizenship education. These results suggest that ESD-related principles are substantially reflected within the education system but that mainstreaming was not complete, with curricula showing the lowest of the four scores. The absence of later reported values for 2021–2024 in the UNESCO country profile also limits the ability to assess recent progress systematically (UNESCO Institute for Statistics, 2025).

Recent national initiatives indicate continuing efforts to translate ESD from policy into educational practice. The Green Schools Project was developed as a national initiative to strengthen environmental awareness, sustainability knowledge and skills, positive environmental attitudes and community participation. Its general framework was established in the 2021/2022 academic year, followed by an experimental implementation in 12 schools in 2022/2023 and expansion to 52 schools across all governorates in 2023/2024. The programme included a sustainability

curriculum addressing waste management, climate change, renewable energy, afforestation, water consumption and carbon neutrality, alongside practical school-based projects (Ministry of Education, 2023).

Further development occurred in January 2025, when the Ministry of Education, the Omani National Commission for Education, Culture and Science, the Specialized Institute for Professional Training for Teachers and UNESCO's Regional Office for the Gulf States and Yemen worked on a practical guide for promoting sustainable development concepts in the school environment. The initiative focused on integrating sustainability into curricula, strengthening sustainable behaviours and community partnerships, and promoting transformative learning through critical thinking, problem-solving and environmental leadership (Ministry of Education, 2025a).

Oman has also developed a national ESD initiative structured around five areas—policy, the educational environment, teachers, youth and the local community—and participates in UNESCO-linked global networks for ESD and greening education. This indicates an emerging system-level approach to ESD implementation extending beyond individual school initiatives (Ministry of Education, 2025b).

Although Oman has achieved high levels of educational access, literacy and school infrastructure, available learning-outcome data indicate specific areas where further progress is possible. The World Bank and UNESCO Institute for Statistics estimate that 41% of children at late-primary age were not proficient in reading in the latest available data, while 38% of Grade 4 students did not reach the global minimum proficiency level in reading (World Bank, 2024). Progress in International Reading Literacy Study results nevertheless show improvement in Grade 4 reading achievement, from 391 points in 2011 to 429 in 2021. TIMSS 2023 results similarly indicate room for improvement in mathematics and science achievement at Grades 4 and 8. These findings point to particular learning-outcome challenges rather than a general weakness of the Omani education system.

Taken together, the evidence presents a differentiated picture of education and sustainable development in Oman. The country has achieved very high human development, extensive school infrastructure, high participation and literacy levels, and a clear strategic commitment to education and sustainable development through Oman Vision 2040. At the same time, specific indicators identify areas requiring continued attention. TIMSS 2023 results show room for improvement in mathematics and science achievement at Grades 4 and 8, while national graduate data indicate challenges in the transition from higher education to employment and uneven participation in practical training. UNESCO SDG 4.7.1 data demonstrate that ESD and global citizenship education are reflected in national policies, curricula, teacher education and student assessment; however, the latest reported values for Oman refer to 2020, with no subsequent values reported for 2021–2024. This creates an important monitoring gap and limits the extent to which recent progress in ESD mainstreaming can be assessed from internationally comparable data. This

monitoring gap is not unique to Oman, as incomplete and uneven reporting of SDG 4 indicators remains a broader global challenge (UNESCO Institute for Statistics, 2025). The available indicators also do not establish how consistently these principles are implemented in educational practice or translated into measurable sustainability-related competencies. The central issue is therefore not an absence of policy commitment or educational provision, but how effectively existing strategic priorities and initiatives are translated into learning outcomes, competencies and measurable implementation.

117 This documentary and statistical context provides the basis for interpreting the stakeholder perspectives presented in the following section. The FGD examines how the identified issues are understood in practice by representatives of education, government, industry, civil society and the student community, and whether stakeholder experience supports, qualifies or extends the patterns identified in the available national and international evidence.

4.3 Qualitative Findings

153 The thematic analysis of the Focus Group Discussion resulted in 33 codes organised into five overarching themes: Educational Transformation, Graduate Competencies, Governance and Partnerships, Sustainability Outcomes, and Societal Engagement. The findings reflect the perspectives of thirteen participants representing government, higher education, industry, non-governmental organisations, small and medium-sized enterprises, and the student community. Selected participant quotations are included to illustrate the principal findings, while the complete qualitative codebook is provided in Appendix E.

4.3.1 Educational Transformation

Participants described educational transformation as requiring both the broader integration of ESD and changes in how learning is delivered. Government representatives reported that ESD and the SDGs are already incorporated into the national curriculum through cross-curricular integration, global citizenship education, UNESCO Green Schools, and other national initiatives. As P6 explained, “ESD and the SDGs are embedded throughout the curriculum,” while P4 identified global citizenship as an important component of school education. These findings indicate that important institutional foundations for ESD have already been established, particularly at the school level.

7 Participants across stakeholder groups consistently argued that sustainability should not be treated as a separate subject or confined to environmental programmes. Instead, it should be integrated across disciplines and throughout all levels of education. P2 stated that “sustainability should not be treated only as a separate subject” but should be “embedded across disciplines.” Similar views were expressed by participants from higher education, industry and SMEs, who emphasised that sustainability should be included in every school and degree programme. Participants also associated this approach with multidisciplinary learning, arguing that learners must understand the connections between different fields rather than remain within narrow disciplinary boundaries.

A further finding concerned the need to move beyond theoretical content towards experiential and competency-based learning. Participants recommended practical projects, community engagement, industry collaboration, authentic assessment and opportunities to address real sustainability challenges. P2 stated that “students should experience sustainability rather than only study it,” while P13 argued that programme design should be guided by competency-based learning outcomes rather than knowledge acquisition alone. This suggests that curriculum inclusion is insufficient unless learners are also able to apply sustainability-related knowledge, skills and values in practice.

Teacher and faculty development were identified as essential to this transformation. P6 emphasised that “if we want students to be well prepared for sustainable development, we must first prepare teachers.” Participants highlighted the importance of continuous professional development in sustainability, active learning, digital technologies, artificial intelligence, curriculum design and assessment. Lifelong learning was similarly regarded as necessary because technological, environmental and professional changes require individuals to continue developing their knowledge and competencies beyond graduation.

Overall, this theme indicates that educational transformation requires more than the formal inclusion of sustainability in curricula. It depends on whole-system integration, practical and competency-based learning, multidisciplinary approaches, educator development and continued learning throughout life.

4.3.2 Graduate Competencies

Participants identified a broad set of competencies required for graduates to contribute effectively to sustainable development and succeed in a changing labour market. Critical thinking and problem-solving were among the most frequently emphasised. P9 described them as “among the skills most in demand in today’s job market,” while participants also highlighted the ability to analyse real problems, propose practical solutions and think beyond established approaches. These competencies were considered particularly important because sustainability challenges require learners to evaluate complex information and apply knowledge rather than reproduce it.

Employability was discussed in relation to the continuing gap between educational outcomes and workplace expectations. Several participants considered graduates not yet fully prepared for the practical requirements of employment. P9 stated that “graduates are not yet fully meeting the needs of the market,” while P10 emphasised that graduates require “broader capabilities and greater adaptability.” Internships, mentoring, career preparation, industry-based projects and stronger university–industry links were recommended as ways to support graduates’ transition into employment.

Digital and AI literacy, adaptability, innovation and entrepreneurship were also identified as essential future-oriented competencies. Participants noted that technological change is altering both employment and the role of education. P9 described AI literacy as “an essential competency,”

while P3 argued that learners must be able to adapt, continue teaching themselves and transform knowledge into meaningful action. Entrepreneurship and innovation were similarly associated with the ability to recognise opportunities and develop sustainable solutions.

In addition to technical and cognitive competencies, participants placed strong emphasis on values and attitudes. Responsibility, belief, ethical awareness and commitment to sustainability were viewed as necessary for translating knowledge into behaviour. P10 stated that graduates should develop “a genuine sense of responsibility for their workplace, their environment and the resources they use.” Participants also connected sustainability with existing cultural and religious values in Oman, suggesting that ESD may be more effectively internalised when it is presented as consistent with learners’ established beliefs and everyday lives.

Overall, the findings show that graduate preparedness extends beyond academic knowledge. It requires critical thinking, problem-solving, adaptability, digital and AI literacy, innovation, employability skills and values that support responsible action

4.3.3 Governance and Partnerships

Participants described governance and collaboration as central to the effective implementation of ESD. Oman Vision 2040 was recognised by several participants as providing a clear strategic direction and aligning national development priorities with the SDGs. P3 stated that “Oman Vision 2040 was developed in alignment with the SDGs,” while P2 considered the education system broadly aligned with national priorities at the policy and strategic levels.

However, participants distinguished between strategic alignment and practical implementation. Several noted that policies and plans were already in place, but that greater attention was required to translate them into measurable action. P2 observed that “the real challenge now is implementation,” while P9 identified a continuing gap between intention and practice. Participants therefore emphasised the need for clear action plans, measurable outcomes, monitoring mechanisms and continuous evaluation.

Cross-sector collaboration was viewed as essential because responsibility for ESD extends beyond educational institutions. Government representatives described national initiatives involving ministries, universities, civil society, the private sector and youth representatives. As P6 explained, achieving SDG 4 is “a collaborative national effort” rather than the responsibility of the Ministry of Education alone. Participants also highlighted the importance of international collaboration through UNESCO networks, curriculum review, expert workshops and knowledge exchange.

Industry–academia collaboration received particular attention. Participants argued that universities require stronger partnerships with employers to ensure that curricula, assessment and learning experiences reflect workplace needs. P11 stated that universities “cannot develop authentic project-based learning in isolation,” while others recommended internships, mentoring, guest

lectures, joint research and industry-supported projects. Such partnerships were seen as beneficial both for graduate preparedness and for the implementation of sustainability initiatives.

Participants also acknowledged that effective implementation requires adequate financial and institutional resources. Adequate financing, institutional resources and private-sector support were identified as necessary for expanding ESD programmes and sustaining long-term initiatives. Overall, the findings indicate that strategic direction is already established, but stronger implementation, monitoring, resourcing and collaboration are required to translate policy commitments into educational practice.

4.3.4 Sustainability Outcomes

Participants generally considered Oman to be progressing towards sustainable development. Representatives from government, higher education, industry and civil society referred to national initiatives, educational reforms and the alignment of institutional priorities with Oman Vision 2040. P5 described sustainable development as “an ongoing journey rather than a final destination,” while P6 considered Oman to be making substantial progress in embedding ESD within the education system. At the same time, participants emphasised that continued progress depends on translating strategic commitments into measurable results.

Environmental sustainability was discussed through renewable energy, climate action, biodiversity conservation, circular economy initiatives and sustainable transport. Participants referred to the expansion of solar and wind energy, environmental programmes in schools, conservation-based learning and the transformation of waste into new products. Several participants stressed that environmental knowledge should be supported by practical experience. P1 explained that direct engagement with conservation research enables students to understand environmental issues more effectively than classroom instruction alone.

The renewable energy transition was also linked to education and behavioural change. This is consistent with earlier research on sustainability and energy transition readiness in the GCC, which identified the need for greater sustainability awareness and more systematic implementation of sustainable practices across the region (Minić & Filipović, 2024). Participants noted that investment in renewable energy and sustainable technologies must be accompanied by public understanding and willingness to adopt new practices. Using electric vehicles as an example, P9 stated that “consumer behaviour requires a great deal of education.” This indicates that education contributes not only to technical knowledge but also to the attitudes and decisions required for environmental transition.

Green employment emerged as an important but insufficiently developed outcome. Participants observed growing awareness of green jobs and increasing interest among graduates, but noted that corresponding employment opportunities remain limited. P9 explained that universities and colleges understand the concept of green jobs, while these opportunities are “not yet sufficiently available in the labour market.” This suggests that educational preparation must be accompanied

by economic and institutional conditions capable of absorbing graduates into sustainability-related careers.

Human development and inclusion were mentioned less frequently as explicit terms, but remained present within the discussion. P12 concluded that greater emphasis should be placed on human development “throughout the entire education system and across all stages of life.” Participants also referred to equitable access to educational and career opportunities, including the need to avoid excluding students solely on the basis of examination results. Overall, the theme demonstrates that sustainability outcomes involve environmental progress, behavioural change, employment opportunities, inclusion and the continued development of human capabilities

4.3.5 Societal Engagement

Participants emphasised that ESD should extend beyond formal classroom learning and involve communities, organisations and wider society. Community engagement, volunteering and participation in sustainability projects were viewed as important ways of developing responsibility and connecting education with real social and environmental needs. P4 explained that volunteer activities help students develop responsibility towards their communities and surroundings, while P1 noted that practical conservation experiences strengthen understanding more effectively than classroom instruction alone.

Collaboration and teamwork were also identified as essential competencies for societal participation. Participants argued that students should gain experience working with others through group projects, interdisciplinary activities and shared problem-solving. From the student perspective, P13 observed that working with classmates exposes learners to “perspectives that are not found in textbooks,” thereby broadening their understanding. Such interaction was seen as particularly relevant to sustainability, where complex problems require cooperation across disciplines and sectors.

Participants further highlighted innovation as a mechanism for transforming sustainability knowledge into practical solutions. Examples included hackathons, idea-generation competitions, support for start-ups and student projects addressing local sustainability challenges. These activities were considered valuable because they encourage learners to move beyond conventional approaches and apply creativity to real problems.

Systems thinking emerged through participants’ emphasis on the connections between disciplines and the need to avoid treating sustainability as an isolated environmental topic. Participants argued that learners should understand how different fields relate and approach sustainability through multidisciplinary perspectives.

Despite recognising national progress, participants identified several areas requiring further improvement. These included stronger implementation of existing strategies, deeper curriculum integration, greater public awareness, improved collaboration, adequate financing and more

practical learning opportunities. Overall, the findings indicate that societal engagement strengthens ESD by linking learning with community responsibility, teamwork, innovation and an understanding of interconnected social, economic and environmental systems.

4.4 Integration of Quantitative and Qualitative Findings

The quantitative and qualitative findings were integrated to identify areas of convergence and to provide contextual interpretation of the statistical results. The panel regression analysis showed that adult literacy and pre-primary, secondary and tertiary enrolment were positively associated with HDI. The FGD findings expanded these results by showing that stakeholders viewed educational participation alone as insufficient. Participants emphasised the importance of curriculum integration, competency-based learning, experiential education, teacher development and the practical application of sustainability knowledge.

Government effectiveness was also positively associated with HDI in the quantitative analysis. This finding was reflected in participants' emphasis on strategic planning, implementation and monitoring and institutional coordination. Although Oman Vision 2040 and national sustainability priorities were generally viewed positively, participants repeatedly distinguished between the existence of policies and their effective implementation. Cross-sector and industry-academia collaboration were therefore identified as important mechanisms for translating national strategies into educational practice.

The positive association between internet access and HDI was complemented by qualitative findings concerning digital and AI literacy. Participants considered technological competencies increasingly important for graduate preparedness, innovation and future employment. However, they also emphasised that access to technology must be accompanied by critical thinking, adaptability and the ability to apply knowledge responsibly.

The negative association between government education expenditure and HDI should be interpreted cautiously. The qualitative findings did not suggest that financial resources were unimportant; participants explicitly identified adequate funding as necessary for implementing ESD initiatives. Instead, their emphasis on implementation, monitoring and effective use of resources suggests that the contribution of expenditure may depend on how effectively resources are allocated and translated into educational outcomes.

The qualitative phase also expanded the quantitative results by identifying dimensions not directly captured by the panel indicators, including sustainability values, multidisciplinary learning, community engagement, green employment, innovation and collaboration. Overall, the two phases indicate that education contributes to human development not only through access and attainment, but also through the quality, relevance and sustainability orientation of educational systems.

CHAPTER 5: DISCUSSION AND IMPLICATIONS

5.1 Introduction

This chapter interprets the findings of the study in relation to research objectives, hypotheses, theoretical framework and existing literature. Rather than repeating the results presented in Chapter 4, the discussion examines their meaning for understanding the contribution of education to sustainable human development. Particular attention is given to education-related determinants of HDI, the role of governance and digital access, the importance of sustainability competencies and educational transformation, and the implications of the integrated findings for the proposed E-HDI framework. The chapter concludes by outlining the theoretical, policy and practical implications of the study.

5.2 Education-Related Determinants of Human Development

The quantitative findings confirm the central role of education in human development. Adult literacy produced the strongest practical effect among the education-related variables, while pre-primary, secondary and tertiary enrolment were all positively and significantly associated with HDI. These results indicate that human development is supported not by one stage of education alone, but by continued participation across the educational life course. Early education establishes the foundation for later learning, secondary education broadens knowledge and capabilities, and tertiary education strengthens the advanced competencies required for participation in increasingly knowledge-based societies. Accordingly, the findings support H1, which proposed a positive association between education enrolment and HDI, and H5, which specifically anticipated a positive relationship between tertiary enrolment and HDI.

The country-level profile presented in Section 4.1.1 qualifies these aggregate relationships by showing that countries have followed different educational and human-development trajectories. For example, Ukraine combined very high average tertiary enrolment and adult literacy with a comparatively modest increase in HDI over the study period, whereas Rwanda experienced the largest increase in HDI from a much lower educational and development base. This contrast does not challenge the positive panel associations; rather, it illustrates that the same education indicators operate under different starting conditions and national contexts. The regression coefficients should therefore be interpreted as average relationships across a heterogeneous panel rather than as evidence of a uniform pathway to human development.

The particularly strong contribution of adult literacy is consistent with the Capability Approach, according to which development involves the expansion of people's substantive opportunities to participate in social, economic and civic life. Literacy represents more than a formal educational outcome; it is a foundational capability that enables access to information, employment, public services and continued learning. The result also suggests that the education dimension of HDI should not be interpreted only through years of schooling. Literacy provides evidence of an

achieved capability, whereas enrolment and years of schooling primarily indicate participation. This distinction supports earlier criticism that conventional HDI measures give insufficient attention to educational quality and learning outcomes (Sagar & Najam, 1998; Grisolia et al., 2022).

The FGD findings further clarified that educational access and participation are necessary but insufficient conditions for sustainable human development. Stakeholders consistently emphasised curriculum integration, experiential learning, competency-based education, multidisciplinary learning and teacher development. They argued that learners should not only acquire knowledge but should also be able to apply it through problem-solving, critical thinking, collaboration and responsible decision-making. The qualitative findings therefore extend the quantitative results by showing that participation in education creates the foundation for human development, while the content, quality and practical relevance of education influence what learners are ultimately capable of doing. This interpretation is consistent with the principles of ESD, which move beyond educational attainment towards the development of knowledge, skills, values and behaviours required for sustainable action.

The positive coefficient for the pupil–teacher ratio requires more cautious interpretation. A higher ratio normally indicates that more pupils are taught by each teacher and is commonly associated with greater pressure on educational resources. Its small positive relationship with HDI therefore appears contrary to conventional expectations. One plausible explanation is that, in some emerging economies, expanding access to education may temporarily increase class sizes while still contributing positively to overall human development. Under these circumstances, the benefits of bringing more learners into the education system may initially outweigh the disadvantages associated with less favourable classroom conditions. However, the result should not be interpreted as evidence that larger classes improve educational quality. Rather, it demonstrates that the relationship between educational access, system capacity and learning conditions may differ across national contexts.

Government education expenditure was negatively and significantly associated with HDI, contrary to the positive direction proposed in H3. Therefore, H3 was not supported in its expected form. Nevertheless, this result does not imply that public investment in education reduces human development. Government expenditure measured as a percentage of GDP does not reveal how resources are allocated, whether they reach priority areas, or how effectively they are converted into educational outcomes. The negative coefficient may reflect differences in spending efficiency, delayed effects of educational investment, or higher expenditure undertaken in response to existing structural weaknesses. It may also reflect the limitations of using expenditure levels as a proxy for educational quality.

178 The country-level comparison supports this cautious interpretation. Costa Rica and Kenya both recorded relatively high average education expenditure as a percentage of GDP over the study period, at 5.92% and 5.26% respectively, yet their 2023 HDI levels differed substantially. This contrast illustrates that the share of national income devoted to education does not by itself indicate how effectively resources are allocated or converted into educational and human development outcomes. The negative coefficient should therefore not be interpreted as evidence that greater education spending is harmful, but as an indication that expenditure as a percentage of GDP is an incomplete measure of the effectiveness of educational investment.

137 The qualitative findings reinforce this interpretation. Participants regarded adequate financing as necessary, but repeatedly connected resources with clear planning, implementation, monitoring and institutional collaboration. Their perspectives suggest that the developmental contribution of education expenditure depends not only on the amount invested but also on how effectively that investment supports curriculum improvement, teacher preparation, practical learning and equitable educational opportunities. Financial inputs alone therefore cannot guarantee stronger human development outcomes.

72 Overall, the integrated findings indicate that educational participation remains fundamental to human development, but access must be accompanied by quality, relevance and capability development. Literacy and enrolment provide the institutional and individual foundations upon which ESD can operate, while competency-based curricula, prepared educators and practical learning determine whether education enables individuals to respond effectively to contemporary sustainability challenges. This distinction between educational participation and the substantive outcomes of education is central to the argument for enhancing the education dimension of HDI.

5.3 Governance, Digital Access and Implementation Capacity

75 The quantitative findings indicate that institutional quality and digital access form important enabling conditions for human development. Government effectiveness was positively and significantly associated with HDI, while voice and accountability also showed a positive association, although at a lower level of statistical significance. Political stability, by contrast, was not statistically significant in the preferred RE model. These findings suggest that the capacity of institutions to formulate, coordinate and implement policy may be more directly connected with human development outcomes than political stability considered in isolation.

209 The country-level profile illustrates this distinction between governance dimensions. Oman and Georgia recorded similar positive period averages for government effectiveness (0.24 and 0.22 respectively), while their political stability averages differed considerably (0.75 and -0.67). This contrast shows that government effectiveness and political stability capture different aspects of the institutional environment and should not be treated as interchangeable. It also provides useful context for the regression findings, in which government effectiveness was positively associated with HDI while political stability was not statistically significant.

45 The positive effect of government effectiveness is particularly relevant to ESD because educational reform depends on the ability of institutions to translate national priorities into curricula, programmes, teacher development and measurable outcomes. The FGD findings strongly supported this interpretation. Participants generally recognised Oman Vision 2040 as providing a clear strategic direction, but repeatedly distinguished between policy alignment and practical implementation. Several participants argued that the principal challenge was no longer the absence of strategies, but their effective execution, monitoring and continuous improvement.

This distinction between policy formulation and implementation capacity is important. Formal commitment to sustainable development does not automatically lead to educational transformation. Participants emphasised the need for clear action plans, measurable learning outcomes, monitoring mechanisms and adequate institutional resources. Government effectiveness therefore appears to influence human development not only through the existence of public policies, but through the capacity to coordinate institutions, allocate responsibilities and ensure that planned initiatives produce practical results.

7 7 Cross-sector collaboration was also identified as an important element of implementation capacity. Participants described ESD and SDG 4 as shared responsibilities involving government, educational institutions, industry, civil society and international organisations. Industry–academia partnerships were considered particularly important for aligning curricula with labour market needs, developing authentic assessment, expanding internships and enabling students to work on locally relevant sustainability challenges. The qualitative findings therefore suggest that effective governance extends beyond the performance of government institutions alone and includes their ability to facilitate cooperation across sectors. Previous research in Omani SME context similarly highlights the importance of embedding sustainability in the strategies of organisations through stakeholder engagement, sustainable leadership, innovation and alignment with the SDGs. Previous research in the Omani SME context similarly highlights the importance of embedding sustainability into organisational strategy through stakeholder engagement, sustainable leadership, innovation and alignment with the SDGs (Minic et al., 2025).

29 Internet access was positively and significantly associated with HDI, indicating the growing developmental importance of digital connectivity. Access to the internet can expand opportunities for education, information, employment, public services and lifelong learning. From the perspective of the Capability Approach, digital access may be understood as an enabling resource that broadens the opportunities available to individuals. However, access alone does not ensure that technology is used effectively or equitably. The positive and statistically significant association between internet access and HDI supports H4. Although the hypothesis anticipated a marginal association, the empirical result indicates a stronger positive relationship in the preferred RE specification. This finding reinforces the importance of digital connectivity as an enabling condition for education, knowledge access and human development.

The FGD findings extended this result by emphasising digital and AI literacy as increasingly important competencies. Participants argued that learners must not only access technology but also understand how to use digital tools, data and AI responsibly and productively. They further stressed that technological competencies should be combined with critical thinking, adaptability, innovation and the ability to transform information into meaningful action. Digital access therefore contributes most effectively to human development when it is accompanied by the competencies required to use technology critically and purposefully.

Political stability was not statistically significant in the preferred RE specification. Accordingly, H2 was not supported, as the analysis did not identify a statistically significant positive association between political stability and HDI. This finding should not be interpreted as evidence that political stability is unimportant for human development. Rather, its contribution may operate through institutional or policy pathways that were not directly tested in the present model, such as policy continuity, investment conditions, service delivery, or long-term planning. The result may also reflect the stronger explanatory contribution of government effectiveness when the governance indicators are considered simultaneously. These possible mechanisms would require further empirical investigation.

Overall, the findings demonstrate that governance and digital access support human development through their contribution to implementation, coordination and capability expansion. National strategies provide direction, but their developmental effect depends on institutional effectiveness, monitoring, collaboration and the ability to translate policy into educational practice. Similarly, digital infrastructure provides access, but its benefits depend on digital literacy and the responsible application of technology. These findings reinforce the need to consider both institutional capacity and digital competencies when assessing the broader contribution of education to sustainable human development.

5.4 Educational Transformation and Competencies for Sustainable Human Development

The qualitative findings indicate that ESD requires a broader transformation of education rather than the addition of isolated sustainability content. Participants acknowledged that sustainability and the SDGs are increasingly reflected in Omani curricula and educational initiatives, particularly through cross-curricular approaches, global citizenship education and UNESCO-related programmes. However, they consistently argued that sustainability should be embedded across all disciplines and levels of education rather than confined to environmental subjects or selected programmes.

This finding supports an understanding of ESD as a whole-system educational approach. Sustainability challenges connect environmental, social, economic, technological and institutional dimensions and therefore cannot be addressed through narrow disciplinary knowledge alone. Participants' emphasis on multidisciplinary learning and systems thinking reflects the need for learners to recognise interdependence, consider the wider consequences of decisions and apply

knowledge across different contexts. Educational transformation therefore involves not only changing curriculum content, but also changing how knowledge is organised and connected.

Participants also identified a need to move from knowledge transmission towards experiential and competency-based learning. Practical projects, community engagement, authentic assessment, industry collaboration and real-world problem-solving were repeatedly recommended. This suggests that learning about sustainability is insufficient unless students are given opportunities to apply knowledge and demonstrate observable competencies. The findings are consistent with Transformative Learning Theory, as meaningful educational change requires learners to question assumptions, examine alternative perspectives and translate reflection into action.

The competencies identified by participants extended beyond conventional academic achievement. Critical thinking and problem-solving were considered particularly important, together with adaptability, innovation, entrepreneurship, teamwork, digital and AI literacy, and the capacity for continued learning. These findings reflect the changing nature of work and society, where graduates must respond to uncertainty and integrate knowledge from multiple fields. They also support the Capability Approach by emphasising what individuals are able to understand, choose and accomplish rather than focusing only on formal educational participation or qualifications.

The Oman-specific evidence provides further context for these stakeholder perspectives. National SDG 4.7.1 data indicate that ESD and global citizenship education are already reflected in education policies, curricula, teacher education and student assessment, supporting participants' recognition that sustainability has entered the formal education system. However, these indicators measure system-level mainstreaming rather than the consistency of implementation or the competencies developed by learners. This distinction is consistent with the FGD emphasis on moving beyond formal inclusion towards practical, competency-based and experiential learning. National graduate data provide additional support for this concern, particularly through uneven participation in practical training and the small reported gaps in competencies such as critical thinking, creativity and innovation (Ministry of Higher Education, Research and Innovation, 2024).

Values and attitudes emerged as an equally important dimension of competency development. Participants emphasised responsibility, ethical awareness, personal belief and commitment to sustainable behaviour. Sustainability was viewed as more likely to influence action when it became part of learners' everyday values rather than remaining a curriculum requirement or a "box-ticking" exercise. The connection made by participants between sustainability principles and existing cultural and religious values in Oman also suggests that ESD may be strengthened when it is contextualised within locally meaningful ethical frameworks.

Teacher and faculty development were identified as essential conditions for this transformation. Educators cannot effectively develop sustainability competencies in learners without appropriate knowledge, pedagogical preparation and institutional support. Continuous professional

development is therefore required in ESD, active learning, competency-based assessment, digital technologies and emerging industry needs. Participants similarly emphasised lifelong learning, recognising that sustainability, technological change and evolving labour-market requirements require individuals to continue developing throughout their professional lives.

Overall, the findings demonstrate that sustainable human development depends not only on access to education, but also on the type of learning that education enables. Educational transformation requires integrated curricula, experiential and multidisciplinary learning, prepared educators, and competencies that combine knowledge, practical capability and responsible values. These dimensions extend beyond the conventional educational indicators included in HDI and provide further justification for incorporating the transformative contribution of ESD into the proposed E-HDI framework.

5.5 Implications for the Proposed E-HDI Framework

The integrated findings support the need to broaden the way education is represented within human development measurements. The conventional HDI education dimension primarily reflects educational attainment through expected and mean years of schooling. Although these indicators capture access and participation, they do not show whether education develops the competencies, values and practical capabilities required for sustainable development.

The quantitative findings confirm the importance of educational participation. Adult literacy and pre-primary, secondary and tertiary enrolment were positively associated with HDI, indicating that access to education across different stages remains fundamental to human development. However, the FGD findings demonstrated that participation alone does not adequately reflect the developmental contribution of education. Stakeholders emphasised curriculum integration, experiential learning, teacher preparation, multidisciplinary education and competency-based approaches as essential conditions for meaningful educational outcomes.

The proposed E-HDI framework should therefore retain conventional indicators of educational access and attainment while incorporating a broader representation of educational quality and sustainability orientation. In particular, the findings suggest the relevance of competencies such as critical thinking, problem-solving, adaptability, collaboration, digital and AI literacy, systems thinking and responsible decision-making. These dimensions reflect what learners are able to apply in practice rather than only the duration of their participation in education.

Figure 11. Proposed Enhanced Human Development Index (E-HDI) Framework



Note: The E-HDI retains the UNDP HDI structure (three dimensions) but conceptually enhances the education dimension by adding ESD-related capabilities.

Source: Author's conceptual framework (2026), developed from the quantitative and qualitative findings of this study and informed by UNDP HDI methodology, UNESCO ESD frameworks and SDG 4.7.

As illustrated in Figure 11, the proposed framework retains the established health and income dimensions of HDI while expanding the education dimension through an ESD capability component. Within this expanded education dimension, values and attitudes represent an important element. Participants emphasised responsibility, ethical awareness, personal commitment and the integration of sustainability into everyday behaviour. These findings indicate that ESD contributes to human development not only through knowledge and skills, but also through the values that influence how individuals use their capabilities and make decisions.

The findings further show that educational outcomes depend on enabling institutional conditions. Government effectiveness, digital access, implementation capacity, monitoring and cross-sector collaboration influence whether educational policies are translated into practice. These factors may not necessarily constitute direct components of the education dimension, but they provide important contextual indicators for understanding differences in the effectiveness of educational systems.

The proposed E-HDI framework should therefore be understood as an extension of human development measurement rather than a replacement for the HDI. Its purpose is to complement conventional educational indicators with dimensions reflecting the transformative contribution of ESD. By incorporating access, learning quality, sustainability competencies, values and implementation capacity, the framework would provide a more comprehensive representation of how education contributes to sustainable human development.

5.6 Theoretical, Policy and Practical Implications

5.6.1 Theoretical Implications

The findings contribute to the theoretical understanding of the relationship between education, sustainability and human development by demonstrating that educational participation alone does not fully represent the developmental contribution of education. Although enrolment and literacy were positively associated with HDI, the qualitative findings showed that educational outcomes also depend on the knowledge, competencies, values and opportunities that learners acquire through education. This supports a broader interpretation of education as a process of capability development rather than solely a measure of access or years of schooling.

The findings are consistent with Sen's Capability Approach, which conceptualises development as the expansion of people's substantive freedoms and opportunities. Literacy, educational participation and digital access provide important resources, but their developmental value depends on whether individuals can convert them into meaningful capabilities. Critical thinking, problem-solving, adaptability, collaboration and digital literacy strengthen individuals' ability to participate in economic, social and civic life. The study therefore reinforces the distinction between educational inputs and the capabilities that education enables individuals to exercise.

The qualitative findings also support Transformative Learning Theory. Participants emphasised experiential learning, reflection, multidisciplinary perspectives, values and the practical application of knowledge. These elements reflect a form of learning that moves beyond the transmission of information by encouraging learners to reconsider assumptions, understand alternative perspectives and translate learning into responsible action. ESD can therefore be interpreted as a transformative educational process through which individuals develop the capacity to respond to complex sustainability challenges.

The study further contributes to the concept of sustainable human development by connecting the expansion of human capabilities with environmental responsibility and long-term societal wellbeing. Conventional human development measurement focuses primarily on health, income and educational attainment. The findings demonstrate that education also shapes how individuals use their capabilities, make decisions and contribute to sustainable social, economic and environmental outcomes.

Accordingly, the study positions ESD as a link between human development and sustainable development. Its contribution extends beyond educational access by incorporating educational quality, practical competencies, ethical responsibility and the ability to act. This theoretical interpretation provides the basis for the proposed E-HDI framework, which seeks to complement conventional educational indicators with dimensions reflecting the transformative contribution of education.

5.6.2 Policy and Practical Implications

The findings indicate that education policy should continue to support access and participation while placing greater emphasis on educational quality, relevance and sustainability orientation. ESD should be integrated across educational levels and disciplines rather than confined to individual subjects, environmental programmes or elective courses. National and institutional policies should therefore translate sustainability priorities into clear curricula, learning outcomes, implementation plans and monitoring mechanisms.

Curriculum reform should be accompanied by changes in teaching and assessment. Participants consistently recommended experiential, project-based and competency-based approaches that enable learners to apply knowledge to authentic challenges. Assessment should measure not only content knowledge but also critical thinking, problem-solving, collaboration, innovation and responsible decision-making. Local sustainability challenges can provide relevant contexts for projects, case studies and community-based learning.

Teacher and faculty development represents a central practical requirement. Educators need continuous professional development in ESD, active learning, competency-based assessment, digital technologies and AI. They also require practical guidance and institutional support to integrate sustainability without treating it as an additional and disconnected responsibility.

Investment in teacher preparation is therefore essential for converting curriculum intentions into classroom practice.

Government coordination and implementation capacity should also be strengthened. The findings suggest that strategic alignment alone is insufficient without clear responsibilities, adequate resources, measurable targets and regular monitoring. Coordination among ministries, educational institutions, industry, civil society and international organisations can reduce fragmentation and support more consistent implementation of ESD.

Stronger industry–academia collaboration is required to improve graduate preparedness and connect education with workplace and societal needs. Partnerships can support internships, mentoring, guest lectures, joint research, authentic assessment and industry-based sustainability projects. Such collaboration can also assist institutions in identifying emerging competencies and creating stronger pathways into green and sustainability-related employment.

For Oman, the recommendations should build on existing policy commitments and initiatives rather than imply an absence of action. The national evidence points to several specific priorities. TIMSS 2023 results support continued attention to mathematics and science learning outcomes, although these assessments do not directly measure ESD. At the higher education level, the national graduate survey indicates a need to strengthen practical training and the transition from education to employment. In addition, the absence of more recent internationally comparable SDG 4.7.1 data after 2020 highlights the importance of stronger monitoring of ESD implementation and sustainability-related learning outcomes. These priorities are consistent with the FGD emphasis on experiential and competency-based learning, industry–academia collaboration, effective implementation and measurable outcomes.

For other emerging economies, the findings indicate that increasing enrolment and educational expenditure alone may not be sufficient. Educational investment should be connected with institutional effectiveness, teacher capacity, digital access, relevant curricula and the development of capabilities that enable sustainable action.

5.7 Chapter Summary

This chapter interpreted the quantitative and qualitative findings in relation to the hypotheses, theoretical framework and broader objectives of the study. The results confirmed the importance of literacy, educational participation, tertiary enrolment, institutional effectiveness and digital access, while also demonstrating that educational inputs alone do not guarantee sustainable human development. The qualitative findings highlighted the importance of curriculum integration, experiential and competency-based learning, teacher development, values, collaboration and effective implementation. Together, the findings support a broader understanding of education as a process that expands capabilities and prepares individuals to contribute responsibly to sustainable development. These conclusions provide the theoretical and empirical foundation for the proposed E-HDI framework and the final conclusions and recommendations presented in the following chapter.

CHAPTER 6: CONCLUSION AND RECOMMENDATIONS

6.1 Overview and Main Conclusions

This study examined the role of ESD in advancing human development in emerging economies. An explanatory sequential mixed-methods design was applied, combining panel data analysis across fifteen emerging economies from 2000 to 2023 with a qualitative FGD involving thirteen stakeholders in Oman. This design enabled the study to identify statistical relationships between education-related factors and HDI and subsequently examine how these relationships are understood and implemented within a specific national context.

The quantitative findings confirmed that education remains a central determinant of human development. Adult literacy and pre-primary, secondary and tertiary enrolment were positively and significantly associated with HDI. Internet access and government effectiveness also demonstrated positive relationships with HDI. In contrast, government education expenditure was negatively associated with HDI, indicating that expenditure levels alone do not necessarily translate into improved human development outcomes. Political stability was not statistically significant as a direct predictor in the preferred model.

Accordingly, H1 and H5 were supported, as educational enrolment and tertiary education enrolment were positively associated with HDI. H4 was also supported, with internet access demonstrating a positive and statistically significant relationship with HDI. H3 was not supported in the expected direction because education expenditure was significantly but negatively associated with HDI. H2 was not supported with respect to the proposed direct positive relationship between political stability and HDI.

The qualitative findings demonstrated that access to education, although essential, is insufficient without corresponding attention to educational quality, relevance and implementation. Participants emphasised the integration of ESD across curricula and disciplines, experiential and competency-based learning, teacher development, multidisciplinary education, digital and AI literacy, sustainability values, effective governance and stronger collaboration between education, government, industry and civil society.

The integrated findings therefore indicate that education contributes to human development through both participation and capability development. Literacy, enrolment and digital access provide important foundations, while the quality and sustainability orientation of education determine whether individuals are able to apply knowledge, respond to complex challenges and contribute responsibly to society. These conclusions support the development of the proposed E-HDI framework, which seeks to complement conventional measures of educational attainment with dimensions reflecting competencies, values, educational quality and the transformative contribution of ESD.

6.2 Proposed E-HDI Framework and Research Contribution

The principal contribution of this study is the development of a conceptual E-HDI framework that extends the conventional understanding of education within human development measurement. The existing HDI education dimension captures educational attainment primarily through mean years of schooling and expected years of schooling. Although these indicators remain important, they do not fully reflect the quality, relevance or sustainability orientation of education, nor the capabilities that individuals develop through the learning process.

The proposed E-HDI framework retains educational access and attainment as essential foundations of human development while introducing a broader understanding of educational contribution. Based on the integrated findings, this contribution includes literacy, participation across educational levels, educational quality, sustainability competencies, values, practical learning and the capacity to apply knowledge in real-life contexts. The framework therefore distinguishes between participation in education and the substantive capabilities that education enables individuals to develop.

The findings suggest that the enhanced education dimension should reflect three interconnected areas. The first concerns educational access and attainment, including literacy and participation across pre-primary, secondary and tertiary education. The second concerns the quality and transformative character of learning, including experiential and competency-based education, multidisciplinary learning, teacher preparation and curriculum integration. The third concerns sustainability-oriented capabilities, including critical thinking, problem-solving, adaptability, collaboration, systems thinking, digital and AI literacy, responsibility and sustainable decision-making.

The framework also recognises that educational outcomes are influenced by enabling contextual conditions. Government effectiveness, digital access, implementation capacity, institutional coordination and cross-sector collaboration affect the extent to which educational policies and resources are converted into meaningful outcomes. These factors provide an important context for interpreting differences in the contribution of education to human development, although they should not necessarily be treated as direct components of the education dimension itself.

The study makes an empirical contribution by combining panel data from fifteen emerging economies over the period 2000–2023 with stakeholder evidence from Oman. The quantitative phase identified significant relationships between HDI and several education-related, governance and infrastructure variables, while the qualitative phase explained how educational quality, implementation and sustainability competencies influence these relationships in practice.

A further contribution arises from the systematic mapping analysis. Although sustainable development and human development were prominent within the bibliometric network, ESD was not among the dominant author keywords. This finding, together with the limited number of studies explicitly connecting ESD and human development, demonstrates that the relationship remains

18 fragmented within literature. The present study addresses this gap by positioning ESD as a mechanism through which education may contribute to both human capability development and long-term sustainability.

The proposed E-HDI framework should therefore be understood as a conceptual extension rather than a replacement for the HDI. It provides a foundation for future research aimed at identifying measurable indicators, developing weighting procedures and empirically testing an enhanced education dimension across a wider range of countries.

19 **6.3 Recommendations**

44 Based on the integrated findings, the following recommendations are proposed for strengthening the contribution of education to sustainable human development.

162 **6.3.1 Integrate ESD Across Educational Levels and Disciplines**

197 ESD should be embedded throughout school, vocational and higher education rather than treated as an isolated subject or elective component. Sustainability principles should be reflected in curricula, programme learning outcomes and institutional strategies across disciplines, including business, engineering, information technology, health and the social sciences. This recommendation is supported by the FGD findings, in which participants repeatedly called for sustainability to be integrated across disciplines and educational levels. In Oman, SDG 4.7.1 data indicate that ESD-related principles are already incorporated into national policies, curricula, teacher education and student assessment, but the available indicators do not show how consistently this integration is implemented in practice or translated into measurable learner competencies. The priority is therefore to deepen and monitor existing integration rather than introduce ESD as an entirely new educational agenda.

66 **6.3.2 Strengthen Competency-Based and Experiential Learning**

Educational institutions should place greater emphasis on critical thinking, problem-solving, adaptability, collaboration, systems thinking, digital and AI literacy, and responsible decision-making. Teaching and assessment should include projects, authentic tasks, community engagement and locally relevant sustainability challenges, with greater opportunities for learners to apply knowledge in practice. This recommendation is supported by the integrated findings, including national evidence on graduate preparation and broader evidence on learning outcomes (Ministry of Higher Education, Research and Innovation, 2024; von Davier et al., 2024), together with the FGD emphasis on experiential and competency-based learning. These findings reinforce the broader argument that educational participation alone does not fully capture the quality, relevance or practical application of learning.

6.3.3 Prioritise Teacher and Faculty Development

Continuous professional development should be provided to teachers, academic staff, curriculum developers and assessment specialists. Training should focus on ESD, active learning,

competency-based assessment, digital technologies and methods for integrating sustainability across disciplines. Educators should also receive practical resources and institutional support to implement these approaches effectively. This recommendation follows directly from the FGD findings, where teacher and faculty capacity was identified as a key condition for translating ESD from curriculum intentions into meaningful learning experiences. Strengthening educator competence is therefore essential not only for delivering sustainability content, but also for developing the critical, practical and values-based capabilities emphasised throughout this study.

6.3.4 Strengthen Implementation and Monitoring

National strategies should be translated into clear implementation plans, assigned responsibilities, measurable targets and monitoring mechanisms. Education expenditure should be evaluated not only by the amount allocated but also by how effectively resources are converted into educational and human development outcomes. This recommendation follows from the positive association between government effectiveness and HDI and from the FGD participants' repeated distinction between policy commitment and effective implementation. For ESD, monitoring should therefore extend beyond the presence of sustainability in policies and curricula to examine whether intended competencies and learning outcomes are implemented and assessed in practice. Coordination among government institutions, educational organisations and other stakeholders should also be strengthened to reduce fragmentation and support more consistent implementation.

6.3.5 Expand Industry–Academia and Community Partnerships

Higher education institutions should deepen and extend partnerships with industry, government, civil society and local communities, building on mechanisms that are already developing in Oman. EJAAD, the national platform connecting industry and academia for research, development and innovation, reports 31 members, 107 industry challenges and 73 joint industry–academia projects, demonstrating an existing foundation for collaborative problem-solving (EJAAD, n.d.). The Oman Vision 2040 Report 2024–2025 also documents partnerships involving universities and major employers through student field training, applied research and industry-linked projects, including collaborations with Petroleum Development Oman, BP Oman, OQ and Nama Holding (Oman Vision 2040 Implementation Follow-up Unit, 2025). The priority is therefore not simply to create partnerships, but to extend their reach into student learning through internships, mentoring, authentic assessment, community projects and sustained workplace experience. Such collaboration can help universities identify emerging competencies and connect education more closely with economic and societal needs, including pathways into green and sustainability-related employment

6.3.6 Advance Digital Inclusion and Responsible Technology Use

Oman's high level of digital connectivity shifts the policy challenge increasingly from access alone towards the quality and purpose of technology use. Approximately 95% of the population used the internet in 2024, indicating that digital infrastructure already provides a strong foundation for learning and capability development (World Bank, n.d.-b). The positive association between

internet access and HDI identified in this study reinforces the developmental importance of connectivity, but access should be accompanied by digital and AI literacy, critical evaluation of information, ethical awareness and responsible use. This is particularly relevant as Oman expands its national AI agenda and has introduced a national policy for the safe and ethical use of AI. Educational institutions should therefore prepare learners not simply to use emerging technologies, but to assess their limitations, implications and appropriate application in academic, professional and societal decision-making. This approach is also consistent with UNESCO's recommendation that technology in education should serve clearly defined learning objectives and be supported by appropriate governance and educator capacity (UNESCO, 2023).

For Oman, these recommendations do not imply the need to build an ESD system from the beginning. Oman Vision 2040, the Green Schools initiative, national guidance for integrating sustainable development concepts into education, and existing industry-academia mechanisms demonstrate that important foundations are already in place (Ministry of Education, 2023, 2025b; Oman Vision 2040 Implementation Follow-up Unit, 2025). The priority is to connect these elements more systematically through effective implementation, competency-focused learning, educator development, collaboration and measurable outcomes. For other emerging economies, the comparative findings show that there is no single educational pathway to higher human development. The recommendations should therefore be adapted to each country's educational, institutional and digital context rather than applied uniformly.

6.4 Limitations and Future Research

Several limitations should be acknowledged. First, the quantitative analysis relied on internationally available secondary indicators. Direct and comparable measures of ESD, particularly those reflecting SDG Target 4.7, sustainability competencies, values and behavioural outcomes, were not available for the full sample and period. This limitation also reflects a broader international monitoring challenge, as SDG 4.7 data remain incomplete and uneven across countries and years, which restricts consistent cross-country comparison (UNESCO Institute for Statistics, 2025). The Oman case illustrates this issue, with the latest reported SDG 4.7.1 values referring to 2020 despite more recent national ESD initiatives. The selected education indicators therefore represent important dimensions of educational access and participation but cannot capture the complete transformative contribution of ESD.

Second, the panel consisted of fifteen emerging economies observed between 2000 and 2023. Although the sample provided variation in educational, institutional and human development conditions, the findings should not be generalised automatically to all emerging or developed economies. In addition, the regression results identify statistical associations rather than definitive causal relationships.

Third, the qualitative phase was based on one FGD involving thirteen purposively selected stakeholders in Oman. The findings provide contextually rich insights but are not statistically

representative of the wider Omani population. Differences in institutional seniority and stakeholder roles may also have influenced group dynamics and individual participation. Furthermore, the researcher's professional background within Omani higher education may have influenced the interpretation of the qualitative data; reflexive documentation and transparent coding procedures were used to address this potential influence.

Finally, the proposed E-HDI remains a conceptual framework. The study identifies relevant dimensions, but it does not establish a final set of indicators, weights or calculation procedures. Consequently, the framework requires further development and empirical validation before it can be applied as a comparative measurement.

Future research should develop internationally comparable indicators capable of measuring ESD competencies, curriculum integration, educational quality, values and practical sustainability outcomes. The quantitative analysis could also be extended to a larger group of countries, alternative time periods and additional model specifications, including interaction effects between governance and education indicators.

Further qualitative research could involve multiple FGDs or individual interviews across Oman and other emerging economies. Comparative country studies would help distinguish context-specific findings from patterns that are more widely applicable. Future studies should also operationalise the proposed E-HDI, examine alternative weighting methods, conduct sensitivity analysis and test whether the enhanced framework provides additional explanatory value beyond the conventional HDI.

6.5 Final Conclusion

This study examined how education, and particularly ESD, can contribute to enhanced human development in emerging economies. The findings confirm that educational participation, literacy, tertiary education, institutional effectiveness and digital access are important components of human development. However, they also demonstrate that conventional measures of enrolment, expenditure and years of schooling do not fully capture the contribution of education to sustainable human development.

The qualitative findings showed that education becomes transformative when sustainability is integrated across curricula and disciplines and when learners develop practical competencies, values and the ability to apply knowledge to real-world challenges. Experiential learning, critical thinking, problem-solving, adaptability, collaboration, digital and AI literacy, teacher development and effective implementation emerged as central elements of this process.

The study therefore concludes that the developmental value of education depends not only on access, but also on its quality, relevance and sustainability orientation. The proposed E-HDI framework responds to this limitation by extending the education dimension of human

development beyond educational attainment towards the capabilities that education enables individuals to develop.

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By integrating cross-country quantitative evidence with stakeholder perspectives from Oman, the study provides a broader understanding of the relationship between education, sustainability and human development. It positions ESD as an important mechanism through which educational systems can support individuals, institutions and societies in responding to contemporary development challenges and advancing more sustainable forms of human progress.

REFERENCES

1. Abdalla, S., Ramadan, E., Al-Belushi, M. A. K., & Al-Hooti, N. (2024). Unveiling the role of Arab universities in advancing Sustainable Development Goals: A multi-dimensional analysis. *Sustainability*, 16(14), 5829. <https://doi.org/10.3390/su16145829>
2. Ahuja, V. (2023). Equity and access in digital education: Bridging the divide. In A. A. Arinushkina, A. V. Morozov, & I. V. Robert (Eds.), *Contemporary challenges in education: Digitalization, methodology, and management* (pp. 45–59). IGI Global. <https://doi.org/10.4018/979-8-3693-1826-3.ch005>
3. Al-Naqbi, A. K., & Alshannag, Q. (2018). The status of education for sustainable development and sustainability knowledge, attitudes, and behaviors of UAE University students. *International Journal of Sustainability in Higher Education*, 19(3), 566–588. <https://doi.org/10.1108/IJSHE-06-2017-0091>
4. Ampofo, J., Li, J., Zou, W., & Zhu, W. (2026). Inclusive lifelong learning for adults: Institutional obligations under UNESCO's education for sustainable development framework. *International Journal of Educational Development*, 122, 103562. <https://doi.org/10.1016/j.ijedudev.2026.103562>
5. Anand, S., & Sen, A. (1994). *Human Development Index: Methodology and measurement* (Human Development Report Office Occasional Paper 1994/2). United Nations Development Programme.
6. Archibald, M. M., Ambagtsheer, R. C., Casey, M. G., & Lawless, M. (2019). Using Zoom videoconferencing for qualitative data collection: Perceptions and experiences of researchers and participants. *International Journal of Qualitative Methods*, 18, 1–8. <https://doi.org/10.1177/1609406919874596>
7. Bala, P. (2024). The impact of mobile broadband and internet bandwidth on human development—A comparative analysis of developing and developed countries. *Journal of the Knowledge Economy*, 15, 16419–16453. <https://doi.org/10.1007/s13132-023-01711-0>
8. Baltagi, B. H. (2021). *Econometric analysis of panel data* (6th ed.). Springer. <https://doi.org/10.1007/978-3-030-53953-5>
9. Bhuttah, T. M., Xiongying, L., Xusheng, Q., & Tabassum, M. F. (2026). Education for sustainable development in higher education: Effects on learning and well-being. *Sustainable Development*. Advance online publication. <https://doi.org/10.1002/sd.70883>
10. Borg, C., Gericke, N., Höglund, H.-O., & Bergman, E. (2014). Subject- and experience-bound differences in teachers' conceptual understanding of sustainable development. *Environmental Education Research*, 20(4), 526–551. <https://doi.org/10.1080/13504622.2013.833584>
11. Braun, V., & Clarke, V. (2006). Using thematic analysis in psychology. *Qualitative Research in Psychology*, 3(2), 77–101. <https://doi.org/10.1191/1478088706qp0630a>
12. Braun, V., & Clarke, V. (2022). *Thematic analysis: A practical guide*. SAGE.
13. Cling, J.-P., & Delecourt, C. (2022). Interlinkages between the Sustainable Development Goals. *World Development Perspectives*, 25, 100398. <https://doi.org/10.1016/j.wdp.2022.100398>
14. Creswell, J. W., & Plano Clark, V. L. (2018). *Designing and conducting mixed methods research* (3rd ed.). SAGE.

15. Creswell, J. W., & Poth, C. N. (2018). *Qualitative inquiry and research design: Choosing among five approaches* (4th ed.). SAGE.
16. Daly, H. E. (1996). *Beyond growth: The economics of sustainable development*. Beacon Press.
17. Desan, C. (2014). *Making money: Coin, currency, and the coming of capitalism*. Oxford University Press. <https://doi.org/10.1093/acprof:oso/9780198709572.001.0001>
18. Donthu, N., Kumar, S., Mukherjee, D., Pandey, N., & Lim, W. M. (2021). How to conduct a bibliometric analysis: An overview and guidelines. *Journal of Business Research*, 133, 285–296. <https://doi.org/10.1016/j.jbusres.2021.04.070>
19. EJAAD. (n.d.). *EJAAD: Fostering Oman's knowledge-based economy through RDI progression*. Ministry of Higher Education, Research and Innovation.
20. Ekins, P., Simon, S., Deutsch, L., Folke, C., & de Groot, R. S. (2003). A framework for the practical application of the concepts of critical natural capital and strong sustainability. *Ecological Economics*, 44(2–3), 165–185. [https://doi.org/10.1016/S0921-8009\(02\)00272-0](https://doi.org/10.1016/S0921-8009(02)00272-0)
21. Elkholy, A. (2024). *A comprehensive analysis of the integration of ESD competencies in a Primary Four curriculum in Egypt: A case study* [Master's thesis, The American University in Cairo]. AUC Knowledge Fountain.
22. Elkington, J. (2013). Enter the triple bottom line. In A. Henriques & J. Richardson (Eds.), *The triple bottom line: Does it all add up?* (pp. 23–38). Routledge.
23. Eschenbacher, S., & Fleming, T. (2020). Transformative dimensions of lifelong learning: Mezirow, Rorty and COVID-19. *International Review of Education*, 66(5–6), 657–672. <https://doi.org/10.1007/s11159-020-09859-6>
24. Eyieyien, O. G., Idemudia, C., Paul, P. O., & Ijomah, T. I. (2024). The impact of ICT projects on community development and promoting social inclusion. *International Journal of Engineering Research and Development*, 20(7), 300–310.
25. Fernando, A. R. R., & Tajan, G. P. (2024). Education for sustainable development (ESD) through participatory research (PR): A systematic review. *Journal of Cleaner Production*, 482, 144237. <https://doi.org/10.1016/j.jclepro.2024.144237>
26. Fuentes-Nieva, R., & Pereira, I. (2010). *The disconnect between indicators of sustainability and human development* (Human Development Research Paper 2010/34). United Nations Development Programme.
27. Fukuda-Parr, S. (2003). The human development paradigm: Operationalizing Sen's ideas on capabilities. *Feminist Economics*, 9(2–3), 301–317. <https://doi.org/10.1080/1354570022000077980>
28. Geissdoerfer, M., Savaget, P., Bocken, N. M. P., & Hultink, E. J. (2017). The circular economy—A new sustainability paradigm? *Journal of Cleaner Production*, 143, 757–768. <https://doi.org/10.1016/j.jclepro.2016.12.048>
29. GlobeScan & SustainAbility. (2019). *Evaluating progress on the Sustainable Development Goals*.
30. Gorobets, A. (2011). Corrections to the human development index and alternative indicators of sustainability. *International Journal of Sustainable Society*, 3(2), 107–115. <https://doi.org/10.1504/IJSSOC.2011.039916>

31. Grisolia, G., Lucia, U., & Torchio, M. F. (2022). Sustainable development and workers ability: Considerations on the education index in the Human Development Index. *Sustainability*, 14(14), 8372. <https://doi.org/10.3390/su14148372>
32. Gujarati, D. N., & Porter, D. C. (2009). *Basic econometrics* (5th ed.). McGraw-Hill.
33. Hanushek, E. A., & Woessmann, L. (2007). *The role of education quality for economic growth* (World Bank Policy Research Working Paper No. 4122). World Bank. <https://doi.org/10.1596/1813-9450-4122>
34. Hausman, J. A. (1978). Specification tests in econometrics. *Econometrica*, 46(6), 1251–1271. <https://doi.org/10.2307/1913827>
35. Head, B. W. (2008). Wicked problems in public policy. *Public Policy*, 3(2), 101–118.
36. Head, B. W., & Alford, J. (2015). Wicked problems: Implications for public policy and management. *Administration & Society*, 47(6), 711–739. <https://doi.org/10.1177/0095399713481601>
37. Hill, T. D., Davis, A. P., Roos, J. M., & French, M. T. (2020). Limitations of fixed-effects models for panel data. *Sociological Perspectives*, 63(3), 357–369. <https://doi.org/10.1177/0731121419863785>
38. Hsiao, C. (2014). *Analysis of panel data* (3rd ed.). Cambridge University Press. <https://doi.org/10.1017/CBO9781139839327>
39. Huynh, K. P., & Jacho-Chávez, D. T. (2009). Growth and governance: A nonparametric analysis. *Journal of Comparative Economics*, 37(1), 121–143. <https://doi.org/10.1016/j.jce.2008.08.003>
40. International Monetary Fund. (2023). *World Economic Outlook Database: Groups and aggregates*.
41. Isac, M. M., Sandoval-Hernández, A., & Sass, W. (Eds.). (2025). *Knowledge and willingness to act pro-environmentally: Perspectives from IEA TIMSS 2019 and ICCS 2016 data*. Springer. <https://doi.org/10.1007/978-3-031-76033-4>
42. Ivankova, N. V., Creswell, J. W., & Stick, S. L. (2006). Using mixed-methods sequential explanatory design: From theory to practice. *Field Methods*, 18(1), 3–20. <https://doi.org/10.1177/1525822X05282260>
43. Kanbur, R., Patel, E., & Stiglitz, J. E. (2018). Sustainable Development Goals and the measurement of economic and social progress. In J. E. Stiglitz, J.-P. Fitoussi, & M. Durand (Eds.), *For good measure: Advancing research on well-being metrics beyond GDP* (pp. 33–48). OECD Publishing. <https://doi.org/10.1787/9789264307278-4-en>
44. Kane, J. (2025, February 21). Broadband policies are wasting the chance to make America connected. *DC Journal*.
45. Kaufmann, D., Kraay, A., & Mastruzzi, M. (2009). *Governance matters VIII: Aggregate and individual governance indicators, 1996–2008* (Policy Research Working Paper No. 4978). World Bank. <https://doi.org/10.1596/1813-9450-4978>
46. Khan, M. A. (2024). Analyzing three Zeros (zero poverty, unemployment, and carbon emissions) in Asia and the Pacific region: Assessment of sustainable development goals through the STIRPAT model. *Sustainable Development*, 32(5), 4782–4799. <https://doi.org/10.1002/sd.2928>
47. Klugman, J., Rodríguez, F., & Choi, H.-J. (2011). The HDI 2010: New controversies, old critiques. *The Journal of Economic Inequality*, 9(2), 249–288. <https://doi.org/10.1007/s10888-011-9178-z>

48. Krueger, R. A., & Casey, M. A. (2015). *Focus groups: A practical guide for applied research* (5th ed.). SAGE.
49. Kumar, P., Kaur, R., Radulescu, M., Kalaš, B., & Hagi, A. (2025). Drivers of environmental sustainability, economic growth, and inequality: A study of economic complexity, FDI, and human development role in BRICS+ nations. *Sustainability*, 17(9), 4180. <https://doi.org/10.3390/su17094180>
50. Lauri, M. A. (2019). WASP (Write a Scientific Paper): Collecting qualitative data using focus groups. *Early Human Development*, 133, 65–68. <https://doi.org/10.1016/j.earlhumdev.2019.03.015>
51. Leicht, A., Heiss, J., & Byun, W. J. (Eds.). (2018). *Issues and trends in education for sustainable development*. UNESCO Publishing. <https://doi.org/10.54675/YELO2332>
52. Li, B., & Kang, C. (2025). Research on the contribution of higher education to the sustainable development of the economy in China: An empirical analysis based on provincial panel data from 2014 to 2023. *Sustainability*, 17(3), 1024. <https://doi.org/10.3390/su17031024>
53. Lu, C., Alahmari, K., & Mohammed, A. (2026). When teachers matter more: Governance quality, educational returns, and progress toward SDG 4 in developing countries. *Sustainable Development*. Advance online publication. <https://doi.org/10.1002/sd.71291>
54. McGillivray, M. (1991). The human development index: Yet another redundant composite development indicator? *World Development*, 19(10), 1461–1468. [https://doi.org/10.1016/0305-750X\(91\)90088-Y](https://doi.org/10.1016/0305-750X(91)90088-Y)
55. McGillivray, M., & White, H. (1993). Measuring development? The UNDP's human development index. *Journal of International Development*, 5(2), 183–192. <https://doi.org/10.1002/jid.3380050210>
56. Mezirow, J. (1991). *Transformative dimensions of adult learning*. Jossey-Bass.
57. Mezirow, J. (1997). Transformative learning: Theory to practice. *New Directions for Adult and Continuing Education*, 1997(74), 5–12. <https://doi.org/10.1002/ace.7401>
58. Minić, A., & Al Hinai, A. (2025). Development without growth: Circular economy, Doughnut Economics, and related models. In *FINIZ 2025 – The Importance of Business Agility in the Modern Business Environment* (pp. 121–130). Singidunum University. <https://doi.org/10.15308/finiz-2025-121-130>
59. Minic, A., Al Naamany, A. M., Al Naamany, K. A., & Filipovic, S. (2025). Towards developing sustainability-driven strategic framework in ICT SMEs in Oman: Case study. In B. Awwad (Ed.), *AI and IoT: Driving Business Success and Sustainability in the Digital Age* (pp. 595–605). Springer. https://doi.org/10.1007/978-3-031-88874-8_52
60. Minić, A., & Filipović, S. (2023). Underpinning sustainability paradigms: Circular economy and enhanced triple bottom line. In *FINIZ 2023 – Sustainable Development as a Measure of Modern Business Success* (pp. 66–73). Singidunum University. <https://doi.org/10.15308/finiz-2023-66-73>
61. Minić, A., & Filipović, S. (2024). On the path to sustainability in Gulf Cooperation Council states: Readiness for energy transition. *The European Journal of Applied Economics*, 21(1), 143–163. <https://doi.org/10.5937/EJAE21-49448>
62. Minić, A., Filipović, S., & Naeem, M. (2026). Education for sustainable development as a driver of enhanced human development: A cross-country analysis. *Energy, Sustainability and Society*. <https://doi.org/10.1186/s13705-026-00596-6>

63. Ministry of Education. (2023, July 3). *Green Schools Project: Enlightened generation and sustainable environment*. Sultanate of Oman.
64. Ministry of Education. (2025a, May 28). *Ministry of Education and Ooredoo launch the Mobile Puppet Theatre Initiative for Sustainable Development*. Sultanate of Oman.
65. Ministry of Education. (2025b, January 29). *Seminar on preparing a guide for promoting sustainable development concepts in school environment concludes*. Sultanate of Oman.
66. Ministry of Higher Education, Research and Innovation. (2024). *Graduate Survey Study 2023*. Department of Statistics and Information, Sultanate of Oman.
67. Modarress-Fathi, B., Ansari, A., & Ansari, A. (2022). Technological convergence impacts on human development. *Sustainability and Climate Change*, 15(2), 126–137. <https://doi.org/10.1089/scc.2021.0072>
68. Monterde-Miralles, N., Cebrián, G., Martín-Arbós, S., & Junyent, M. (2025). Sustainability competence vignette questionnaire for secondary education students: Design and validation. *Sustainable Development*, 33(S1), 971–987. <https://doi.org/10.1002/sd.70046>
69. Morgan, D. L. (2014). Pragmatism as a paradigm for social research. *Qualitative Inquiry*, 20(8), 1045–1053. <https://doi.org/10.1177/1077800413513733>
70. Neumayer, E. (2003). *Weak versus strong sustainability: Exploring the limits of two opposing paradigms* (2nd ed.). Edward Elgar. <https://doi.org/10.4337/9781781007082>
71. Neumayer, E. (2018). Human development and sustainability. In S. Fukuda-Parr & A. K. Shiva Kumar (Eds.), *Readings in human development* (pp. 251–272). Routledge.
72. Nikolaou, I. E., Jones, N., & Stefanakis, A. (2021). Circular economy and sustainability: The past, the present and the future directions. *Circular Economy and Sustainability*, 1(1), 1–20. <https://doi.org/10.1007/s43615-021-00030-3>
73. Norðdahl, K., Pálmadóttir, H., Heggen, M. P., Jørgensen, N. J., Hirvi, J., Møller, T., & Staffans, E. (2025). Early childhood education for sustainable development in the Nordic national curricula: Status and content. *Environmental Education Research*, 31(3), 648–660. <https://doi.org/10.1080/13504622.2024.2389945>
74. Oketch, M., McCowan, T., & Schendel, R. (2014). *The impact of tertiary education on development: A rigorous literature review*. Department for International Development.
75. Oman Vision 2040 Implementation Follow-up Unit. (n.d.). *Oman Vision 2040*.
76. Oman Vision 2040 Implementation Follow-up Unit. (2025). *Oman Vision 2040 report 2024–2025*. Oman Vision 2040 Implementation Follow-up Unit.
77. Onyeaka, H., & Akinsemolu, A. A. (2025). Advancing green education in MENA region: Challenges, opportunities and best practices. *Sustainable Development*, 33(1), 1354–1365. <https://doi.org/10.1002/sd.3182>
78. Paas, L., & Creech, H. (2008). *How information and communications technologies can support education for sustainable development: Current uses and trends*. International Institute for Sustainable Development.
79. Patton, M. Q. (2015). *Qualitative research & evaluation methods* (4th ed.). SAGE.
80. Pearce, D. W., & Atkinson, G. D. (1993). Capital theory and the measurement of sustainable development: An indicator of “weak” sustainability. *Ecological Economics*, 8(2), 103–108. [https://doi.org/10.1016/0921-8009\(93\)90039-9](https://doi.org/10.1016/0921-8009(93)90039-9)
81. Petersen, K., Feldt, R., Mujtaba, S., & Mattsson, M. (2008). Systematic mapping studies in software engineering. In *Proceedings of the 12th International Conference on*

- Evaluation and Assessment in Software Engineering (EASE '08)* (pp. 68–77). BCS Learning & Development. <https://doi.org/10.14236/ewic/EASE2008.8>
82. Raihan, M. M. H., Subroto, S., Chowdhury, N., Koch, K., Ruttan, E., & Turin, T. C. (2025). Dimensions and barriers for digital (in)equity and digital divide: A systematic integrative review. *Digital Transformation and Society*, 4(2), 111–127. <https://doi.org/10.1108/DTS-04-2024-0054>
 83. Raworth, K. (2017). *Doughnut economics: Seven ways to think like a 21st-century economist*. Random House Business.
 84. Reisch, L. A., Cohen, M. J., Thøgersen, J., & Tukker, A. (2016). Frontiers in sustainable consumption research. *GAIA*, 25(4), 234–240. <https://doi.org/10.14512/gaia.25.4.4>
 85. Ríos, A.-M., Raimo, N., Benito, B., Vitolla, F., & Guillamón, M.-D. (2026). Governing for the goals: How governance quality shapes the achievement of the Sustainable Development Goals. *Sustainable Development*, 34(S2), 422–436. <https://doi.org/10.1002/sd.70361>
 86. Rittel, H. W. J., & Webber, M. M. (1973). Dilemmas in a general theory of planning. *Policy Sciences*, 4(2), 155–169. <https://doi.org/10.1007/BF01405730>
 87. Rockström, J., Steffen, W., Noone, K., Persson, Å., Chapin, F. S., III, Lambin, E. F., Lenton, T. M., Scheffer, M., Folke, C., Schellnhuber, H. J., Nykvist, B., de Wit, C. A., Hughes, T., van der Leeuw, S., Rodhe, H., Sörlin, S., Snyder, P. K., Costanza, R., Svedin, U., ... Foley, J. A. (2009). A safe operating space for humanity. *Nature*, 461, 472–475. <https://doi.org/10.1038/461472a>
 88. Ruggerio, C. A. (2021). Sustainability and sustainable development: A review of principles and definitions. *Science of the Total Environment*, 786, 147481. <https://doi.org/10.1016/j.scitotenv.2021.147481>
 89. Sachs, J. D., Lafortune, G., & Fuller, G. (2024). *The SDGs and the UN Summit of the Future: Sustainable Development Report 2024*. Sustainable Development Solutions Network & Dublin University Press. <https://doi.org/10.25546/108572>
 90. Sachs, J. D., Schmidt-Traub, G., Kroll, C., Lafortune, G., & Fuller, G. (2019). *Sustainable Development Report 2019*. Bertelsmann Stiftung & Sustainable Development Solutions Network.
 91. Sagar, A. D., & Najam, A. (1998). The human development index: A critical review. *Ecological Economics*, 25(3), 249–264. [https://doi.org/10.1016/S0921-8009\(97\)00168-7](https://doi.org/10.1016/S0921-8009(97)00168-7)
 92. Sen, A. (1985). *Commodities and capabilities*. North-Holland.
 93. Sen, A. (1999). *Development as freedom*. Oxford University Press.
 94. Sen, A. (2009). *The idea of justice*. Harvard University Press.
 95. Soliman, P. E. N., & Beram, R. S. (2026). Sustainable Development Goals and unemployment: Worldwide evidence. *Journal of the Knowledge Economy*. <https://doi.org/10.1007/s13132-025-02782-x>
 96. Solow, R. M. (1993). An almost practical step toward sustainability. *Resources Policy*, 19(3), 162–172. [https://doi.org/10.1016/0301-4207\(93\)90001-4](https://doi.org/10.1016/0301-4207(93)90001-4)
 97. Sterling, S. (2011). Transformative learning and sustainability: Sketching the conceptual ground. *Learning and Teaching in Higher Education*, 5, 17–33.
 98. Strielkowski, W., Grebennikova, V., Lisovski, A., Rakhimova, G., & Vasileva, T. (2025). AI-driven adaptive learning for sustainable educational transformation. *Sustainable Development*, 33(2), 1921–1947. <https://doi.org/10.1002/sd.3221>

99. Stryzhak, O., Tupa, M., & Rodzik, J. (2022). Relationship between the level of human development and institutional quality. *Economics & Sociology*, 15(2), 274–295.
<https://doi.org/10.14254/2071-789X.2022/15-2/17>
100. Tashakkori, A., Johnson, R. B., & Teddlie, C. (2021). *Foundations of mixed methods research: Integrating quantitative and qualitative approaches in the social and behavioral sciences* (2nd ed.). SAGE.
101. Tilbury, D. (2011). *Education for sustainable development: An expert review of processes and learning*. UNESCO.
102. Torchio, M. F., Lucia, U., & Grisolia, G. (2024). Development indexes, environmental cost impact, and well-being: Trends and comparisons in Italy. *Sustainability*, 16(11), 4380. <https://doi.org/10.3390/su16114380>
103. UNESCO Institute for Statistics. (2025). *SDG 4 country profile: Oman*. UNESCO Institute for Statistics.
104. UNESCO Institute for Statistics. (n.d.). *UIS Data Browser*.
105. United Nations. (2015). *Transforming our world: The 2030 Agenda for Sustainable Development*.
106. United Nations. (n.d.). *Goal 4: Quality education*. Sustainable Development Goals.
107. United Nations Development Programme. (1990). *Human Development Report 1990*. Oxford University Press. <https://doi.org/10.18356/7007ef44-en>
108. United Nations Development Programme. (2010). *Human Development Report 2010: The real wealth of nations—Pathways to human development*. Palgrave Macmillan.
<https://doi.org/10.18356/e5a0500a-en>
109. United Nations Development Programme. (2020). *Human Development Report 2020: The next frontier—Human development and the Anthropocene*.
<https://doi.org/10.18356/9789210055161>
110. United Nations Development Programme. (2024). *Human Development Report 2023/2024: Breaking the gridlock—Reimagining cooperation in a polarized world*.
<https://doi.org/10.18356/9789213588703>
111. United Nations Development Programme. (2025). *Human Development Report 2025: A matter of choice—People and possibilities in the age of AI*.
<https://doi.org/10.18356/9789211542639>
112. United Nations Educational, Scientific and Cultural Organization. (2014). *Shaping the future we want: UN Decade of Education for Sustainable Development (2005–2014) final report*. UNESCO.
113. United Nations Educational, Scientific and Cultural Organization. (2017). *Education for Sustainable Development Goals: Learning objectives*.
<https://doi.org/10.54675/CGBA9153>
114. United Nations Educational, Scientific and Cultural Organization. (2019). *Framework for the implementation of Education for Sustainable Development (ESD) beyond 2019*. General Conference, 40th session.
115. United Nations Educational, Scientific and Cultural Organization. (2020). *Education for sustainable development: A roadmap*. <https://doi.org/10.54675/YFRE1448>
116. United Nations Educational, Scientific and Cultural Organization. (2021). *Learn for our planet: A global review of how environmental issues are integrated in education*.
<https://doi.org/10.54675/IXWG7117>

117. United Nations Educational, Scientific and Cultural Organization. (2023). *Global education monitoring report 2023: Technology in education: A tool on whose terms?* <https://doi.org/10.54676/UZQV8501>
118. United Nations Statistics Division. (2026). *SDG country profile: Oman*. United Nations Department of Economic and Social Affairs.
119. Üstün, N., & Ürey, M. (2024). Investigating variables predicting environmental awareness in the context of education for sustainable development: An analysis based on TIMSS 2019 data. *International Journal of Turkish Educational Sciences*, 12(1), 85–129. <https://doi.org/10.46778/goputeb.1320538>
120. Vázquez, C., Alsina, Á., Seckel, M. J., & García-Alonso, I. (2023). Integrating sustainability in mathematics education and statistics education: A systematic review. *EURASIA Journal of Mathematics, Science and Technology Education*, 19(11), em2357. <https://doi.org/10.29333/ejmste/13809>
121. von Davier, M., Kennedy, A., Reynolds, K., Fishbein, B., Khorramdel, L., Aldrich, C., Bookbinder, A., Bezirhan, U., & Yin, L. (2024). *TIMSS 2023 international results in mathematics and science*. TIMSS & PIRLS International Study Center, Boston College. <https://doi.org/10.6017/lse.tpisc.timss.rs6460>
122. Wals, A. E. J., & Corcoran, P. B. (2006). Sustainability as an outcome of transformative learning. In J. Holmberg & B. E. Samuelsson (Eds.), *Drivers and barriers for implementing sustainable development in higher education* (pp. 103–112). UNESCO.
123. World Bank. (n.d.-a). *World Bank country and lending groups*. World Bank Data Help Desk.
124. World Bank. (n.d.-b). *World Development Indicators*.
125. World Bank. (n.d.-c). *Worldwide Governance Indicators*.
126. World Bank. (2018). *World development report 2018: Learning to realize education's promise*. World Bank. <https://doi.org/10.1596/978-1-4648-1096-1>
127. World Bank. (2024). *Oman learning poverty brief* (Version 2). World Bank.
128. World Commission on Environment and Development. (1987). *Our common future*. Oxford University Press.
129. Yan, H., & Zhang, H. (2025). External resource dependence and implementation efficiency of Education for Sustainable Development (ESD): A hybrid design based on data envelopment analysis (DEA) and dynamic qualitative comparative analysis (QCA). *Sustainability*, 17(9), 3809. <https://doi.org/10.3390/su17093809>
130. Yeyoumo, A. K., & Asongu, S. A. (2024). Sustainable urbanization and vulnerability to climate change in Africa: Accounting for digitalization and institutional quality. *Sustainable Development*, 32(1), 1188–1216. <https://doi.org/10.1002/sd.2721>
131. Yin, R. K. (2018). *Case study research and applications: Design and methods* (6th ed.). SAGE.
132. Župic, I., & Čater, T. (2015). Bibliometric methods in management and organization. *Organizational Research Methods*, 18(3), 429–472. <https://doi.org/10.1177/1094428114562629>

APPENDIX A

Participant Information Sheet Focus Group Discussion

Study Title:

Enhancing the Human Development Index through Education for Sustainable Development in Emerging Economies

Researcher:

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Supervisor:

Prof. Dr Sanja Filipović

Singidunum University, Belgrade, Serbia

Thank you for considering participation in this Focus Group Discussion (FGD).

You are invited to take part in this discussion because of your professional experience and contribution in at least one of the following areas: higher education, industry, government, or non-governmental organisations.

Purpose of the Study

This doctoral research explores the relationship between Education for Sustainable Development (ESD) and human development and examines how education can better contribute to sustainable development outcomes.

The study combines quantitative international analysis with qualitative stakeholder perspectives from Oman to understand how educational approaches may support long-term social, economic, and environmental development.

You have been invited because your expertise and experience may contribute valuable insights into:

- Alignment between education and sustainable development priorities;
- Graduate preparedness and future skills;
- Sustainability competencies and decision-making;
- Opportunities and challenges in improving education systems.

What Participation Involves

Participation includes attending one online Focus Group Discussion.

181 Date: 1 July 2026

Time: 1:30 pm – 3:00 pm

Format: Virtual discussion.

243 Estimated duration: 60–90 minutes

Participants will be invited to discuss a series of open-ended questions related to education and sustainable development in Oman.

50 Voluntary Participation

Participation is entirely voluntary.

You may choose not to answer any question and may withdraw from the discussion at any point before anonymisation of the data.

Confidentiality

The discussion will be audio-recorded for transcription purposes.

All data will be anonymised before analysis and reporting. No individual participant names or organisations will be identified in the dissertation or future publications unless explicit permission is granted.

Please note that because this is a group discussion, complete confidentiality among participants cannot be guaranteed. Participants are respectfully asked not to disclose discussion content outside the session.

Data Storage

211 Research data will be securely stored and accessed only by the researcher and academic supervisor for academic purposes.

Further Information

If you have any questions about the study, please contact:

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Thank you for your consideration and support.

APPENDIX B

Focus Group Discussion Questions

Core Questions (Required):

Q1. Direction of Development (Macro level, national level)

In your view, is Oman currently moving in the direction of sustainable development? Can you give specific examples, and where do you see the areas for improvement, if any?

Possible probes (if needed):

- Which dimensions of sustainable development do you think Oman is addressing particularly well?
- Are there any examples of good practice that stand out?
- Are there areas where progress has been slower than expected?

Q2. System / Institutions (Meso level)

How well do you think the current education system in Oman is aligned with the country's long-term development priorities, including sustainable development?

Possible probes (if needed):

- Which parts of the education system are performing well?
- Are there stages of education that require greater attention (school, vocational education, higher education, adult/lifelong learning)?
- Is there sufficient collaboration between education and policymakers?

Q3. Education and Real-World Preparedness (Meso level)

From your experience, how well does higher education in Oman prepare graduates for real-world challenges and the competencies needed to contribute to sustainable development in your sector?

Possible probes (if needed):

- What role does higher education play within the broader education system?
- How effectively are graduates prepared for the realities of your sector?
- Are there competencies that are consistently missing?
- Do employers' expectations align with what education currently provides?

Q4. Skills Gap (Micro level)

What knowledge and skills do you think young people in Oman are currently lacking when they enter the workforce?

Possible probes (if needed):

- Which knowledge or skills gaps do you observe most frequently among new graduates?
- Are these gaps mainly technical, digital, interpersonal, or related to critical thinking and problem-solving?
- Do the gaps differ across sectors or types of employment?
- How well prepared are young people to communicate, collaborate, adapt, and make decisions in real workplace situations?

Q5. Competencies for Sustainable and Human Development (Micro level)

Which knowledge, skills, values or competencies do you believe are most important for supporting sustainable development and, ultimately, human development?

Possible probes (if needed):

- Which competencies will become increasingly important over the next decade?
- What role do values and attitudes play alongside knowledge?
- How important is lifelong learning and adult education?
- Which competencies are currently underdeveloped in Oman?

Q6. Future of Education (Action level)

What specific changes would you recommend across the education system—including higher education—not only in curriculum content but also in teaching and learning approaches, to better prepare learners for contemporary challenges and enable them to contribute to sustainable development and human development?

Possible probes (if needed):

- Should assessment methods change?
- Should universities and schools collaborate more closely with industry?
- What role should experiential learning or community engagement play?
- Are there international examples that Oman could adapt?

Optional Question (If time allows):

Q7. Cross-Sector Collaboration

How can educational institutions, industry, government and civil society work more closely to ensure learners are better prepared to contribute to sustainable development and human development?

Possible probes (if needed):

- What types of partnerships are currently missing?
- How can employers become more involved in education?
- What role should government play in facilitating collaboration?

APPENDIX C

Participants' Case Classification

Transcript ID/Participant's Code	Stakeholder Category	Relevant Expertise/Perspective
P1	NGO	Biodiversity conservation / sustainability education and outreach
P2	Higher Education	Academic leadership/curriculum and ESD integration
P3	Industry (Government-owned)	Industry-education collaboration/innovation and work force development
P4	Government (UNESCO-related)	UNESCO-related education/global citizenship and sustainability programs
P5	Industry (Global Organisation)	Professional development/industry-academia collaboration
P6	Government	Ministry of Education/educational policy, national curriculum and ESD implementation
P7	Higher Education	Curriculum integration/institutional sustainability
P8	Higher Education	Sustainability education/faculty development and experiential learning
P9	Industry (Publicly Listed Company)	Sustainability practice/graduate employability and green skills
P10	Industry (Sustainable Business)	Sustainable business/practical and experiential sustainability

Transcript ID/Participant's Code	Stakeholder Category	Relevant Expertise/Perspective
P11	Higher Education	Sustainability / workforce development and industry collaboration
P12	Industry (SME)	Business leadership / sustainability education and innovation
P13	Student	Student perspective/competency-based and experiential learning

Source: The researcher

APPENDIX D

Researcher's Reflexivity Memo

Immediately following the focus group discussion, several observations were recorded to capture impressions that may not be evident from the transcript alone.

The opening question generated the richest discussion. Although one participant commented that the question was broad, this was intentional, as it was designed to begin the discussion from a macro perspective before progressively narrowing towards more specific educational issues and practical recommendations. The broad opening successfully encouraged participants from different sectors to engage and establish a common understanding of sustainable development within the Omani context.

One planned question concerning the skills gap among young people entering the workforce was omitted during the discussion. This decision was made because participants had already addressed many of the intended issues while responding to the previous question regarding the preparedness of graduates for real-world challenges. Rather than interrupting the natural flow of the discussion by repeating similar topics, the moderator chose to move directly to the following question. This decision allowed additional time for participants to elaborate on new ideas while maintaining the momentum of the conversation.

Different stakeholder groups contributed in distinctive ways. Participants from higher education generally provided longer and more detailed responses, often drawing upon educational theory and curriculum development. Industry representatives tended to offer shorter but highly practical recommendations grounded in workplace experience. Government representatives contributed substantial information regarding current national initiatives, policies and programmes, providing valuable contextual insight into ongoing implementation efforts. The diversity of perspectives enriched the discussion and demonstrated the value of including multiple stakeholder groups.

One observation that stood out was the unexpectedly extensive contribution from government representatives. Their willingness to describe current initiatives, partnerships and implementation strategies provided richer contextual information than initially anticipated and strengthened the discussion considerably.

Although the discussion remained respectful throughout, a notable difference in perspective emerged between one government representative and one industry representative regarding the extent to which the current curriculum requires improvement. While no direct conflict occurred, this exchange illustrated that stakeholders viewed the current state of education through different professional lenses, thereby adding depth to the discussion.

Several themes emerged that had not been anticipated during the development of the discussion guide. One participant from higher education highlighted the challenge of translating sustainability competencies into observable and measurable behaviours, raising important questions regarding competency-based assessment and implementation. In addition, two participants independently emphasised the importance of personal belief and values. One argued that sustainability becomes

meaningful only when individuals genuinely believe in its principles, while another observed that many sustainability principles are already closely aligned with local cultural and religious values. This perspective introduced an important cultural dimension that had not been explicitly anticipated but may provide valuable insight when interpreting the findings.

Reflecting on the moderation process, the overall structure of the discussion functioned well. If the discussion were to be conducted again, the primary area for improvement would be the conclusion. A more structured closing summary and final reflective question could provide an even stronger ending and allow participants an additional opportunity to synthesise the key ideas discussed.

APPENDIX E

Final Qualitative Codebook

CODE 1: Education for Sustainable Development (ESD)

Definition:

References describing the principles, implementation, promotion and integration of Education for Sustainable Development (ESD) as a holistic educational approach supporting the achievement of the SDGs.

Frequency: 19 references

Participants represented: P6 (Government), P4 (Government, UNESCO), P2 (Higher Education), P7 (Higher Education), P3 (Government-owned Industry), P8 (Higher Education), P12 (SME)

Ref. No.	Exact quotation	Participant	Summary
ESD-01	"As everyone here knows, SDG 4 includes Target 4.7, which focuses on Education for Sustainable Development (ESD)."	P6 (Government)	Explains the central role of ESD within SDG 4.
ESD-02	"UNESCO has consistently emphasised that the Sustainable Development Goals cannot be achieved without education."	P6 (Government)	Education is presented as essential for achieving the SDGs.
ESD-03	"We have worked with various stakeholders across Oman to promote ESD through different initiatives."	P6 (Government)	National promotion of ESD through collaboration.
ESD-04	"A mobile public theatre programme was developed to introduce ESD concepts to young children."	P6 (Government)	Practical implementation of ESD in schools.
ESD-05	"Overall, Oman is making substantial progress in embedding ESD within the education system."	P6 (Government)	Positive assessment of ESD implementation nationally.
ESD-06	"ESD and the SDGs are embedded throughout the curriculum."	P6 (Government)	Sustainability integrated into the national curriculum.
ESD-07	"Sustainability concepts are integrated across almost all subjects rather than being limited to a few disciplines."	P6 (Government)	Cross-curricular integration of ESD.
ESD-08	"UNESCO Green Schools...projects are directly aligned with ESD."	P6 (Government)	Green Schools as an ESD implementation mechanism.

Ref. No.	Exact quotation	Participant	Summary
ESD-09	"UNESCO Associated Schools integrate sustainable development throughout their programmes."	P6 (Government)	International school network supporting ESD.
ESD-10	"Global citizenship is an important component of the curriculum...closely aligned with the SDGs."	P4 (Government, UNESCO)	Global citizenship education as part of ESD.
ESD-11	"Sustainability should not be treated only as a separate subject...it should be embedded across disciplines."	P2 (Higher Education)	Advocates institution-wide ESD integration.
ESD-12	"Sustainability is increasingly being embedded within the curriculum across different specialisations."	P7 (Higher Education)	ESD expanding across higher education disciplines.
ESD-13	"Sustainability should become part of everyone's education, daily life and professional practice."	P3 (Government-owned Industry)	ESD should be universal rather than specialist.
ESD-14	"It should become something that is learned continuously, across all courses and subjects, at all levels."	P3 (Government-owned Industry)	Lifelong and whole-system vision of ESD.
ESD-15	"I would like to see the same approach applied to sustainable development."	P8 (Higher Education)	Calls for sustainability to become compulsory like entrepreneurship.
ESD-16	"All disciplines and fields of study should be grounded in the principles of sustainable development."	P8 (Higher Education)	Every discipline should reflect ESD principles.
ESD-17	"Sustainability should not be limited to selected schools or selected degree programmes."	P12 (SME)	ESD should be universal across education.
ESD-18	"Every school and every degree programme should include sustainability."	P12 (SME)	Whole-system integration of ESD.
ESD-19	"Sustainability is no longer treated only as an elective topic."	P2 (Higher Education)	Evidence that ESD is becoming mainstream.

CODE 2: School Education

Definition:

References describing the implementation of ESD, sustainability initiatives, curriculum, teaching, programmes and student development within primary and secondary education.

Frequency: 25 references

Participants represented: P6 (Government), P4 (Government, UNESCO), P3 (Government-owned Industry), P9 (Industry, Publicly Listed Company), P10 (Industry, Sustainable Business), P11 (Higher Education), P12 (SME)

Ref. No.	Exact quotation	Participant	Summary
SE-01	"One example is the UNESCO Green Schools Programme, which currently includes approximately 325 schools across Oman."	P6 (Government)	National Green Schools initiative supports sustainability in schools.
SE-02	"A five-year national plan has been approved with the objective of achieving UNESCO's target of having 50% of schools recognised as Green Schools."	P6 (Government)	National expansion of Green Schools.
SE-03	"One example is the development of a mobile public theatre programme designed to introduce ESD concepts to young children. Initially implemented in twenty schools..."	P6 (Government)	Early childhood sustainability education through interactive learning.
SE-04	"If we examine the national curriculum framework... ESD and the SDGs are embedded throughout the curriculum."	P6 (Government)	Sustainability integrated into the school curriculum.
SE-05	"The SDGs are explicitly mentioned in our curriculum..."	P6 (Government)	SDGs formally included in school education.
SE-06	"Sustainability concepts are integrated across almost all subjects rather than being limited to a few disciplines."	P6 (Government)	Cross-curricular sustainability teaching.
SE-07	"We conducted a comprehensive review of the national curriculum..."	P6 (Government)	Curriculum review to strengthen sustainability integration.
SE-08	"Through the UNESCO Green Schools Programme, we currently add approximately 120 schools each year."	P6 (Government)	Continuous expansion of Green Schools.
SE-09	"Schools that belong to the UNESCO Associated Schools Network... integrate sustainable development throughout their programmes."	P6 (Government)	UNESCO schools embed sustainability across activities.
SE-10	"Global citizenship is also an important component of the curriculum in Oman's government schools."	P4 (Government, UNESCO)	Global citizenship incorporated into school education.

Ref. No.	Exact quotation	Participant	Summary
SE-11	"Students are now able to study it as part of the curriculum, and we can already observe its positive impact."	P4 (Government, UNESCO)	Positive outcomes of school curriculum changes.
SE-12	"We work with students on numerous programmes related to sustainable development..."	P4 (Government, UNESCO)	School-based sustainability programmes.
SE-13	"At our organisation, we implement initiatives that begin with school students..."	P3 (Government-owned Industry)	Industry engagement starts at school level.
SE-14	"Younger students may be exposed to sustainability through enjoyable activities and practical programmes..."	P9 (Industry, Publicly Listed Company)	Practical sustainability education begins in schools.
SE-15	"I believe future generations will face a smaller gap because they are already learning..."	P9 (Industry, Publicly Listed Company)	School education is shaping future sustainable behaviour.
SE-16	"We need far more practical learning experiences rather than relying primarily on theory. Students need more hands-on activities in schools and classrooms."	P10 (Industry, Sustainable Business)	Schools should provide more experiential learning.
SE-17	"At school level, I believe considerable progress has been made in raising awareness of sustainability."	P11 (Higher Education)	Schools have successfully increased sustainability awareness.
SE-18	"We run school programmes that originally began as Green School initiatives..."	P12 (SME)	Green School programmes develop students' sustainability skills.
SE-19	"The greatest gap remains practical implementation. This applies from primary education through to universities."	P12 (SME)	Practical sustainability learning should begin in schools.
SE-20	"Every school and every degree programme should include sustainability..."	P12 (SME)	Sustainability should be universal across education.
SE-21	"Students often need to achieve extremely high grades in secondary school..."	P12 (SME)	Assessment practices still emphasise memorisation.
SE-22	"The educational foundation established during primary and secondary school shapes critical thinking..."	P12 (SME)	School years are fundamental for future competencies.
SE-23	"When children genuinely believe in these values from an early age..."	P4 (Government, UNESCO)	Sustainability values should begin in childhood.

Ref. No.	Exact quotation	Participant	Summary
SE-24	"When I visit schools participating in UNESCO programmes..."	P4 (Government, UNESCO)	Schools play a central role in developing sustainability values.
SE-25	"Teachers... inspire others without viewing sustainability as an additional burden."	P4 (Government, UNESCO)	Teachers are key agents of sustainability education in schools.

CODE 3: Tertiary Education

Definition: References describing the role of higher education institutions in integrating sustainability, preparing graduates, supporting research and responding to labour market and societal needs.

Frequency: 13 references

Participants represented: P2 (Higher Education), P7 (Higher Education), P5 (Industry, Global Organisation), P9 (Industry, Publicly Listed Company), P3 (Government-owned Industry), P8 (Higher Education), P10 (Industry, Sustainable Business), P12 (SME), P13 (Student)

Ref. No.	Exact quotation	Participant	Summary
TE-01	"Higher education institutions have an important responsibility in preparing graduates who can contribute to sustainable development."	P2 (Higher Education)	Universities have a key role in sustainable development.
TE-02	"Sustainability should not remain within environmental programmes but should extend across all university disciplines."	P7 (Higher Education)	Sustainability should be integrated throughout higher education.
TE-03	"Previously, sustainability was integrated only within environmental specialisations. Now it is expanding to other disciplines."	P7 (Higher Education)	Higher education is broadening sustainability integration.
TE-04	"We are beginning to establish sustainability centres within universities."	P7 (Higher Education)	Universities are strengthening institutional sustainability initiatives.
TE-05	"Professional development, including executive education, should become part of the university's contribution."	P5 (Industry, Global Organisation)	Universities should support lifelong professional learning.
TE-06	"Partnerships between universities and industry can provide valuable learning opportunities."	P5 (Industry, Global Organisation)	Universities should collaborate with industry.
TE-07	"Universities should prepare graduates for the real needs of the labour market."	P9 (Industry, Publicly Listed Company)	Higher education should improve graduate readiness.

Ref. No.	Exact quotation	Participant	Summary
TE-08	"The colleges and universities need to embed AI literacy alongside critical thinking and innovation."	P3 (Government-owned Industry)	Universities should update curricula with emerging competencies.
TE-09	"All disciplines and fields of study should be grounded in sustainable development principles."	P8 (Higher Education)	Sustainability should underpin all university programmes.
TE-10	"I would like to see sustainability treated the same way entrepreneurship has been introduced into higher education."	P8 (Higher Education)	Sustainability should become a compulsory university component.
TE-11	"The gap remains between what universities teach and what graduates experience in practice."	P10 (Industry, Sustainable Business)	Higher education needs stronger links with practice.
TE-12	"Every degree programme should include sustainability."	P12 (SME)	Sustainability should be embedded in all higher education programmes.
TE-13	"Competency-based learning outcomes should guide programme design rather than knowledge alone."	P13 (Student)	Universities should focus on competencies rather than rote knowledge.

CODE 4: Curriculum Integration

Definition: References describing the integration of sustainability, ESD principles and the SDGs into curricula, learning outcomes, subjects and educational programmes rather than treating sustainability as a standalone topic.

Frequency: 12 references

Participants represented: P6 (Government), P4 (Government, UNESCO), P2 (Higher Education), P7 (Higher Education), P3 (Government-owned Industry)

Ref. No.	Exact quotation	Participant	Summary
CI-01	"If we examine the national curriculum framework, we can see that ESD and the SDGs are embedded throughout the curriculum. These concepts are integrated across different subjects, rather than being confined to a single discipline."	P6 (Government)	Sustainability is embedded across the national curriculum rather than taught as a standalone subject.

Ref. No.	Exact quotation	Participant	Summary
CI-02	"We have also worked closely with UNESCO on reviewing how these sustainability concepts are reflected within the curriculum and educational practice."	P6 (Government)	Curriculum review undertaken with UNESCO to strengthen sustainability integration.
CI-03	"The SDGs are explicitly mentioned in our curriculum..."	P6 (Government)	Sustainability is formally incorporated into the curriculum.
CI-04	"In Oman, sustainability concepts are integrated across almost all subjects rather than being limited to a few disciplines."	P6 (Government)	Cross-disciplinary curriculum integration.
CI-05	"We conducted a comprehensive review of the national curriculum to examine how sustainable development concepts are integrated and embedded throughout the curriculum."	P6 (Government)	National curriculum reviewed to strengthen sustainability integration.
CI-06	"Global citizenship is also an important component of the curriculum in Oman's government schools."	P4 (Government, UNESCO)	Global citizenship incorporated into the school curriculum.
CI-07	"One important area requiring further improvement is curriculum integration."	P2 (Higher Education)	Curriculum integration identified as a priority for improvement.
CI-08	"Sustainability should not be treated only as a separate subject... Instead, it should be embedded across disciplines..."	P2 (Higher Education)	Sustainability should be embedded throughout all disciplines.
CI-09	"How do we translate Oman Vision 2040 and the SDGs into everyday teaching practice? This requires updated curricula, measurable learning outcomes..."	P2 (Higher Education)	Calls for curriculum reform to support implementation.
CI-10	"This year we have expanded that alignment to include other disciplines, such as business, engineering and information technology."	P7 (Higher Education)	Sustainability expanded beyond environmental programmes.
CI-11	"Sustainability is no longer reflected only in institutional policies but is increasingly being embedded within the curriculum across different specialisations."	P7 (Higher Education)	Sustainability becoming integrated across university programmes.

Ref. No.	Exact quotation	Participant	Summary
CI-12	"I agree with the earlier point that sustainability should be integrated into all degree programmes, rather than existing only as a separate specialisation."	P3 (Government-owned Industry)	Supports curriculum-wide integration across all university programmes.

CODE 5: Lifelong Learning

Definition: References describing continuous learning, professional development and the ongoing acquisition of knowledge and competencies throughout an individual's personal and professional life.

Frequency: 9 references

Participants represented: P5 (Industry, Global Organisation), P3 (Government-owned Industry), P9 (Industry, Publicly Listed Company), P10 (Industry, Sustainable Business), P11 (Higher Education)

Ref. No.	Exact quotation	Participant	Summary
LL-01	"In addition to traditional academic development, I would also emphasise professional development, including executive and professional development within industry."	P5 (Industry, Global Organisation)	Highlights the importance of continuous professional learning beyond university.
LL-02	"Partnerships with the private sector could provide universities with opportunities for executive education and professional development."	P5 (Industry, Global Organisation)	Universities should collaborate with industry to support lifelong learning.
LL-03	"Greater effort could be made to develop these opportunities within Oman itself."	P5 (Industry, Global Organisation)	Calls for expanding lifelong learning opportunities nationally.
LL-04	"Learning should not stop after graduation."	P3 (Government-owned Industry)	Lifelong learning should continue throughout professional life.
LL-05	"People need to continue updating their knowledge because the world is changing very quickly."	P3 (Government-owned Industry)	Continuous learning is necessary in a rapidly changing world.

Ref. No.	Exact quotation	Participant	Summary
LL-06	"AI, technology and sustainability require professionals to keep learning throughout their careers."	P3 (Government-owned Industry)	Technological and sustainability changes demand ongoing learning.
LL-07	"Universities should support graduates even after they complete their studies."	P9 (Industry, Publicly Listed Company)	Higher education institutions should contribute to lifelong learning after graduation.
LL-08	"Continuous professional development should become a normal part of working life."	P10 (Industry, Sustainable Business)	Professional development should continue throughout employment.
LL-09	"Learning is a continuous journey rather than something that finishes with a degree."	P11 (Higher Education)	Emphasises lifelong learning as an ongoing process.

CODE 6: Teacher Professional Development

Definition: References describing the preparation, training, continuous professional development and support of teachers and educators to effectively implement ESD and innovative teaching practices.

Frequency: 9 references

Participants represented: P2 (Higher Education), P6 (Government), P8 (Higher Education)

Ref. No.	Exact quotation	Participant	Summary
TPD-01	"Faculty development is equally important. Academic staff should receive continuous professional development in sustainability, digital technologies, active learning approaches, artificial intelligence, data analytics and current industry developments."	P2 (Higher Education)	Recommends continuous professional development for higher education faculty in both sustainability and emerging competencies.
TPD-02	"One area I would particularly emphasise is teacher professional development."	P6 (Government)	Identifies teacher professional development as a priority for strengthening ESD implementation.
TPD-03	"If we want students to be well prepared for sustainable development, we must first prepare teachers."	P6 (Government)	Effective ESD depends on well-prepared teachers.

Ref. No.	Exact quotation	Participant	Summary
TPD-04	"This is not always easy because teachers already have demanding workloads, and sustainability is sometimes perceived as an additional responsibility."	P6 (Government)	Acknowledges the practical challenges teachers face in implementing ESD.
TPD-05	"For this reason, we have been working with a specialised teacher training institute to strengthen teachers' understanding of ESD and to help them integrate sustainability into their teaching."	P6 (Government)	Describes national teacher training initiatives to improve ESD delivery.
TPD-06	"We have also organised workshops with international experts to support curriculum developers, assessment specialists, school leaders and teachers."	P6 (Government)	Professional development is supported through international collaboration and specialised workshops.
TPD-07	"At present, we are developing a practical toolkit that will help schools promote sustainable development throughout the school environment. The toolkit provides guidance for teachers, school leaders, curriculum developers and assessment specialists on how to embed ESD across teaching, learning and assessment."	P6 (Government)	Development of practical resources to support teachers in embedding ESD.
TPD-08	"Although teacher development is challenging, I believe it is one of the most important priorities."	P6 (Government)	Reinforces teacher development as a strategic priority.

Ref. No.	Exact quotation	Participant	Summary
TPD-09	"As educators, we ourselves need to learn how to do this effectively. Sustainable development requires a different approach to teaching and assessment, and I believe educators must continue developing these competencies themselves before they can effectively develop them in students."	P8 (Higher Education)	Educators must continuously develop their own competencies before they can develop them in students.

CODE 7: Competency-Based Education

Definition: References describing educational approaches that prioritise the development of practical competencies, behaviours, values and measurable learning outcomes over knowledge acquisition alone.

Frequency: 6 references

Participants represented: P2 (Higher Education), P5 (Industry, Global Organisation), P8 (Higher Education), P11 (Higher Education), P13 (Student)

Ref. No.	Exact quotation	Participant	Summary
CBE-01	"How do we translate these competencies into observable and measurable behaviours and practices?"	P2 (Higher Education)	Raises the challenge of operationalising sustainability competencies into measurable learning outcomes.
CBE-02	"It is not enough simply to teach knowledge; we need to develop competencies that students can apply in practice."	P2 (Higher Education)	Emphasises application of competencies rather than content acquisition.
CBE-03	"Graduates need competencies that enable them to contribute to sustainable development in their organisations."	P5 (Industry, Global Organisation)	Industry expects graduates to possess sustainability-related competencies.
CBE-04	"Critical thinking, innovation and problem-solving should become core competencies rather than optional skills."	P8 (Higher Education)	Advocates embedding sustainability competencies throughout higher education.

Ref. No.	Exact quotation	Participant	Summary
CBE-05	"Education should focus not only on academic achievement but also on behaviours, values and practical competencies."	P11 (Higher Education)	Supports a broader competency-based educational approach.
CBE-06	"Students need competencies that prepare them for real-world challenges rather than examinations alone."	P13 (Student)	Student perspective on competency-focused education.

CODE 8: Experiential Learning

Definition: References describing learning through practical experience, projects, authentic tasks, community engagement and real-world application of knowledge.

Frequency: 8 references

Participants represented: P6 (Government), P2 (Higher Education), P5 (Industry, Global Organisation), P7 (Higher Education), P8 (Higher Education), P10 (Industry, Sustainable Business), P11 (Higher Education), P13 (Student)

Ref. No.	Exact quotation	Participant	Summary
EL-01	"One example is the development of a mobile public theatre programme designed to introduce ESD concepts to young children."	P6 (Government)	Uses interactive theatre as an experiential learning approach.
EL-02	"Students should experience sustainability rather than only study it."	P2 (Higher Education)	Calls for learning through practice instead of theory alone.
EL-03	"Universities should provide students with opportunities to work directly with industry on sustainability projects."	P5 (Industry, Global Organisation)	Industry-based projects strengthen experiential learning.
EL-04	"Students learn much more effectively when they participate in real sustainability initiatives."	P7 (Higher Education)	Practical participation enhances learning.
EL-05	"We need more project-based learning rather than traditional classroom teaching."	P8 (Higher Education)	Encourages project-based learning.
EL-06	"Students should engage with communities and solve real sustainability challenges."	P10 (Industry, Sustainable Business)	Community engagement develops practical competencies.

Ref. No.	Exact quotation	Participant	Summary
EL-07	"Learning should move beyond memorising information for examinations."	P11 (Higher Education)	Supports authentic learning rather than rote learning.
EL-08	"Hands-on activities help students understand sustainability much better."	P13 (Student)	Student emphasises practical learning experiences.

CODE 9: Critical Thinking

Definition: References describing analytical thinking, independent reasoning, evaluation of information and the ability to solve complex problems and make informed decisions.

Frequency: 9 references

Participants represented: P9 (Industry, Publicly Listed Company), P3 (Government-owned Industry), P12 (SME), P1 (NGO)

Ref. No.	Exact quotation	Participant	Summary
CT-01	"The first, and perhaps the most important, is critical thinking and problem-solving. These are among the skills most in demand in today's job market."	P9 (Industry, Publicly Listed Company)	Critical thinking identified as one of the most important employability skills.
CT-02	"Graduates need to understand market needs and be able to propose practical solutions to real-world problems."	P9 (Industry, Publicly Listed Company)	Links critical thinking with solving authentic workplace problems.
CT-03	"Many of the activities we discussed earlier, such as hackathons and idea-generation competitions, are designed specifically to develop critical thinking, problem-solving, innovation and the ability to move beyond conventional approaches."	P9 (Industry, Publicly Listed Company)	Experiential activities develop higher-order thinking skills.

Ref. No.	Exact quotation	Participant	Summary
CT-04	"If schools, colleges and universities can equip graduates with these three competencies—critical thinking and problem-solving, innovation and entrepreneurship, and AI literacy—they will be much better prepared to succeed in the labour market."	P9 (Industry, Publicly Listed Company)	Critical thinking viewed as a core graduate competency.
CT-05	"In today's world, if you cannot adapt, if you cannot think beyond what you have been taught, and if you cannot continue teaching yourself, it becomes very difficult to succeed."	P3 (Government-owned Industry)	Emphasises independent thinking and lifelong learning.
CT-06	"These competencies are closely related to critical thinking..."	P3 (Government-owned Industry)	Connects critical thinking with wider interpersonal competencies.
CT-07	"Today, we are moving away from that model towards one based on critical thinking, independent thinking and problem-solving."	P9 (Industry, Publicly Listed Company)	Contrasts critical thinking with traditional memorisation.
CT-08	"This demonstrates how the educational foundation established during primary and secondary school shapes critical thinking, analytical ability and innovation later in life."	P12 (SME)	Early education is seen as the foundation for critical thinking.
CT-09	"I really appreciated the earlier discussion about moving away from memorisation and encouraging greater critical thinking and independent learning."	P1 (NGO)	Recommends strengthening critical thinking through educational reform.

CODE 10: Cross-sector Collaboration

Definition: References describing collaboration between government, industry, academia, civil society and other stakeholders in advancing ESD and sustainable development.

Frequency: 7 references

Ref. No.	Exact quotation	Participant	Summary
CSC-01	"This team brings together representatives from multiple sectors, including the Ministry of Social Development, higher education institutions, public and private universities, civil society organisations, the private sector, and youth representatives. In other words, achieving SDG 4 is not viewed solely as the responsibility of the Ministry of Education, but rather as a collaborative national effort."	P6 (Government)	SDG 4 implementation is presented as a shared national responsibility rather than the responsibility of one ministry alone.
CSC-02	"Within these cities, multidisciplinary teams have been established involving municipalities, the Ministry of Health, the Ministry of Social Development, educational institutions and other stakeholders. This demonstrates that sustainable development is being implemented through collaboration across sectors."	P6 (Government)	Learning Cities initiative illustrates multi-sector implementation of sustainability.
CSC-03	"We have worked with various stakeholders across Oman to promote ESD through different initiatives."	P6 (Government)	ESD promotion relies on broad stakeholder engagement.
CSC-04	"This initiative was financed through a partnership with the private sector, specifically Ooredoo, demonstrating the value of cross-sector collaboration in supporting ESD."	P6 (Government)	Public–private partnerships provide resources for ESD initiatives.
CSC-05	"Universities and colleges in Oman need stronger collaboration with industry, professional bodies,	P2 (Higher Education)	Greater cross-sector partnerships are needed to align education with labour market needs.

Ref. No.	Exact quotation	Participant	Summary
	regulatory authorities and government institutions."		
CSC-06	"At our organisation, we implement initiatives that begin with school students through partnerships with the Ministry of Education and other organisations. We also collaborate with universities..."	P3 (Government-owned Industry)	Industry participates in educational partnerships across sectors.
CSC-07	"Stronger collaboration is also needed between higher education institutions, industry, government and professional bodies."	P2 (Higher Education)	Collaboration is presented as essential for graduate preparation and ESD implementation.

Participants represented: P6 (Government), P2 (Higher Education), P3 (Government-owned Industry)

CODE 11: Digital and AI Literacy

Definition: References describing digital competencies, artificial intelligence literacy and the effective use of emerging technologies to support education and sustainable development.

Frequency: 6 references

Participants represented: P4 (Government, UNESCO), P9 (Industry, Publicly Listed Company), P12 (SME), P2 (Higher Education), P3 (Government-owned Industry)

Ref. No.	Exact quotation	Participant	Summary
DAI-01	"These programmes address topics including climate change, environmental protection, cultural exchange, digital transformation, artificial intelligence and technology."	P4 (Government, UNESCO)	International school programmes expose students to digital transformation and AI alongside sustainability themes.

Ref. No.	Exact quotation	Participant	Summary
DAI-02	"Another increasingly important area is digitalisation and artificial intelligence. I believe AI literacy is now becoming an essential competency. Even within our organisation, some of our most successful sustainability projects have been built around the effective use of AI, digital technologies and data."	P9 (Industry, Publicly Listed Company)	AI literacy and digital technologies are identified as essential competencies for future graduates.
DAI-03	"If schools, colleges and universities can equip graduates with these three competencies—critical thinking and problem-solving, innovation and entrepreneurship, and AI literacy—they will be much better prepared to succeed in the labour market."	P9 (Industry, Publicly Listed Company)	AI literacy is presented as one of the three priority competencies for employability.
DAI-04	"Another important point is that sustainability should not be limited to selected schools or selected degree programmes. Every school and every degree programme should include sustainability because, together with artificial intelligence, it represents one of the defining priorities of the future."	P12 (SME)	AI is viewed as a defining future priority alongside sustainability across all levels of education.
DAI-05	"Faculty development is equally important. Academic staff should receive continuous professional development in sustainability, digital technologies, active learning approaches, artificial intelligence, data analytics and current industry developments."	P2 (Higher Education)	Recommends continuous professional development in digital and AI-related competencies for academic staff.

Ref. No.	Exact quotation	Participant	Summary
DAI-06	"Knowledge is increasingly available through AI. The real challenge is helping learners generate new knowledge, communicate effectively, collaborate across disciplines and transform knowledge into meaningful action."	P3 (Government-owned Industry)	AI changes the role of education from acquiring knowledge to generating and applying it.

CODE 12: Employability

Definition: References describing graduate preparedness, workplace competencies, career readiness and alignment between education and labour market needs.

Frequency: 12 references

Participants represented: P2 (Higher Education), P9 (Industry, Publicly Listed Company), P10 (Industry, Sustainable Business), P1 (NGO), P12 (SME), P11 (Higher Education)

Ref. No.	Exact quotation	Participant	Summary
EMP-01	"Another important area concerns the relationship between education and the labour market. Universities and colleges in Oman need stronger collaboration with industry, professional bodies, regulatory authorities and government institutions."	P2 (Higher Education)	Calls for stronger alignment between higher education and labour market needs.
EMP-02	"Graduates are not yet fully meeting the needs of the market, so this gap still needs to be addressed."	P9 (Industry, Publicly Listed Company)	Identifies a gap between graduate capabilities and labour market expectations.
EMP-03	"From the perspective of industry, we want graduates who arrive in the workplace already understanding these issues and, more importantly, who genuinely want to apply sustainable practices because they believe in them, not simply because they studied them as part of the syllabus."	P10 (Industry, Sustainable Business)	Industry expects graduates to apply sustainability authentically in the workplace.

Ref. No.	Exact quotation	Participant	Summary
EMP-04	"The challenge is where these graduates go afterwards and how they enter the workforce."	P1 (NGO)	Highlights the transition from graduation into employment as the key challenge.
EMP-05	"Once graduates have been prepared, we need organisations and institutions that are able to absorb them and provide appropriate career opportunities."	P1 (NGO)	Calls for greater employment opportunities for qualified graduates.
EMP-06	"There are still insufficient employment opportunities. At the same time, stronger links are needed between universities and industry so that graduates can receive mentoring from sustainability professionals and gain practical workplace experience."	P12 (SME)	Recommends stronger university–industry links to improve graduate employability.
EMP-07	"Students need more internships, guest lectures and practical learning opportunities."	P2 (Higher Education)	Recommends practical experiences to improve employability.
EMP-08	"Finally, I believe Oman would benefit from developing a national competency framework that clearly identifies the competencies required by employers."	P11 (Higher Education)	Suggests a national competency framework aligned with employer expectations.
EMP-09	"Universities could help by offering more career preparation, including guidance on career progression, workplace expectations, networking and internship preparation."	P12 (SME)	Recommends structured career preparation within higher education.

Ref. No.	Exact quotation	Participant	Summary
EMP-10	"Students should also understand how to approach internships strategically... They should be viewed as opportunities to build relationships, develop professional networks and demonstrate commitment."	P12 (SME)	Encourages students to maximise internships for career development.
EMP-11	"Another important recommendation is to prepare students more effectively for recruitment processes, including applications, interviews and the increasing use of AI-supported recruitment systems."	P12 (SME)	Calls for preparation for modern recruitment processes.
EMP-12	"Developing this mindset would significantly improve graduates' transition into employment."	P12 (SME)	Emphasises employability mindset as key to successful workforce transition.

CODE 13: Entrepreneurship

Definition: References describing entrepreneurial thinking, innovation, business creation and opportunity recognition as competencies supporting sustainable development.

Frequency: 5 references

Participants represented: P3 (Government-owned Industry), P8 (Higher Education), P9 (Industry, Publicly Listed Company), P12 (SME)

Ref. No.	Exact quotation	Participant	Summary
ENT-01	"In addition, we support innovators, including students, graduates, SMEs and start-ups."	P3 (Government-owned Industry)	Organisation supports entrepreneurs and start-up development.
ENT-02	"For example, Oman has made entrepreneurship a requirement across higher education programmes, so that all students must take an entrepreneurship course."	P8 (Higher Education)	Entrepreneurship has been embedded as a compulsory component of higher education.

Ref. No.	Exact quotation	Participant	Summary
ENT-03	"Sustainability also requires innovation and entrepreneurial thinking. These are two additional skills that we actively look for when recruiting graduates."	P9 (Industry, Publicly Listed Company)	Entrepreneurial thinking is identified as a key employability competency.
ENT-04	"If schools, colleges and universities can equip graduates with these three competencies—critical thinking and problem-solving, innovation and entrepreneurship, and AI literacy—they will be much better prepared to succeed in the labour market."	P9 (Industry, Publicly Listed Company)	Entrepreneurship is recognised as one of the three priority competencies for future graduates.
ENT-05	"One example that impressed me involved a university student who was mentoring one of our school programmes. Although her field of study was cybersecurity, she developed an innovative project using date seeds to create a sustainable building material. Her project eventually won the competition."	P12 (SME)	Illustrates entrepreneurial innovation applied to sustainability through a student project.

CODE 14: Environmental Sustainability

Definition: References describing environmental protection, climate action, biodiversity conservation, circular economy and sustainable management of natural resources.

Frequency: 8 references

Participants represented: P2 (Higher Education), P4 (Government, UNESCO), P12 (SME), P1 (NGO), P10 (Industry, Sustainable Business)

Ref. No.	Exact quotation	Participant	Summary
ENV-01	"Recent examples include the expansion of renewable energy initiatives, particularly solar and wind projects, with the aim of increasing the share of renewable energy in electricity generation."	P2 (Higher Education)	Highlights renewable energy as evidence of environmental sustainability.
ENV-02	"These programmes address topics including climate change, environmental protection, cultural exchange, digital transformation, artificial intelligence and technology."	P4 (Government, UNESCO)	School initiatives address key environmental sustainability topics.
ENV-03	"My work is very practical and focuses on implementing circular economy initiatives by transforming waste into new products."	P12 (SME)	Describes practical implementation of circular economy principles.
ENV-04	"For example, we recently launched an educational programme that allows students to experience conservation research directly."	P1 (NGO)	Students gain direct experience in environmental conservation.
ENV-05	"Instead of simply reading about environmental issues, students work with realistic models, use scientific equipment, collect data and experience what it is like to become scientists for a day."	P1 (NGO)	Practical environmental education through conservation activities.
ENV-06	"In addition, students should spend more time outdoors. Particularly within my own field, direct contact with nature is essential for developing field research skills and building a genuine appreciation of biodiversity and environmental conservation."	P1 (NGO)	Emphasises biodiversity conservation and field-based environmental learning.

Ref. No.	Exact quotation	Participant	Summary
ENV-07	"Students should participate in projects linked to the SDGs, volunteer activities and current global themes such as climate change, digital transformation and education."	P4 (Government, UNESCO)	Recommends greater student engagement with climate-related projects.
ENV-08	"For example, when we talk about electric vehicles, people still need much more information and practical understanding before they are willing to change their behaviour and move away from diesel and petrol vehicles towards more sustainable alternatives."	P10 (Industry, Sustainable Business)	Uses sustainable transport as an example of environmental behaviour change.

CODE 15: Funding and Resources

Definition: References describing financial resources, investment, funding mechanisms and other material resources required to support effective ESD implementation.

Frequency: 3 references

Participants represented: P1 (NGO), P6 (Government), P11 (Higher Education)

Ref. No.	Exact quotation	Participant	Summary
FR-01	"One area that could be strengthened is the development of a more concrete action plan, supported by a clear implementation strategy and adequate financing."	P1 (NGO)	Calls for adequate financing to support effective implementation.
FR-02	"Importantly, this initiative was financed through a partnership with the private sector, specifically Ooredoo, demonstrating the value of cross-sector collaboration in supporting ESD."	P6 (Government)	Illustrates private-sector funding supporting an ESD initiative.

Ref. No.	Exact quotation	Participant	Summary
FR-03	"While this sounds straightforward, implementation requires considerable resources and close collaboration with both industry and government."	P11 (Higher Education)	Notes that implementing project-based learning requires substantial resources.

CODE 16: Green Jobs

Definition: References describing employment opportunities, workforce development and competencies associated with environmentally sustainable industries and occupations.

Frequency: 3 references

Participants represented: P9 (Industry, Publicly Listed Company), P12 (SME)

Ref. No.	Exact quotation	Participant	Summary
GJ-01	"Last year, we conducted a workshop on future jobs and future green jobs in collaboration with an international partner. The aim was to examine how Oman is developing the connections needed for future employment."	P9 (Industry, Publicly Listed Company)	Describes an initiative focused on future green jobs and workforce development.
GJ-02	"We observed this during the green jobs initiative last year. People in universities and colleges understand the concept of green jobs and how such jobs should be developed. However, these opportunities are not yet sufficiently available in the labour market."	P9 (Industry, Publicly Listed Company)	Highlights the gap between understanding green jobs and their availability in the labour market.
GJ-03	"As mentioned earlier, we now have many graduates interested in green careers, but there are still insufficient employment opportunities."	P12 (SME)	Notes growing graduate interest in green careers but limited employment opportunities.

CODE 17: Human Development

Definition: References describing human development as the overarching goal of education, emphasising the development of people's capabilities, opportunities and lifelong wellbeing.

Frequency: 1 reference

Participants represented: P12 (SME)

Ref. No.	Exact quotation	Participant	Summary
HD-01	"If I were to summarise today's discussion in one sentence, I would simply say that we need to place much greater emphasis on human development throughout the entire education system and across all stages of life."	P12 (SME)	Concludes that human development should become a central priority across education and lifelong learning.

CODE 18: Implementation and Monitoring

Definition: References describing the practical implementation, evaluation, monitoring and continuous improvement of sustainability-related policies, programmes and initiatives.

Frequency: 10 references

Participants represented: P1 (NGO), P5 (Industry, Global Organisation), P2 (Higher Education), P7 (Higher Education), P9 (Industry, Publicly Listed Company), P4 (Government, UNESCO), P6 (Government)

Ref. No.	Exact quotation	Participant	Summary
IM-01	"One area that could be strengthened is the development of a more concrete action plan, supported by a clear implementation strategy and adequate financing. This would help ensure that implementation is coordinated and that progress can be monitored more effectively."	P1 (NGO)	Calls for coordinated implementation and more effective monitoring of progress.
IM-02	"More importantly, I have observed these principles being transformed into concrete action plans, measurable targets and practical implementation measures."	P5 (Industry, Global Organisation)	Highlights implementation through action plans and measurable targets.

Ref. No.	Exact quotation	Participant	Summary
IM-03	"Overall, I believe the Omani education system is aligned with the country's long-term priorities at the policy and strategic level. However, the real challenge now is implementation."	P2 (Higher Education)	Distinguishes policy alignment from implementation challenges.
IM-04	"How do we translate Oman Vision 2040 and the SDGs into everyday teaching practice?"	P2 (Higher Education)	Emphasises translating policy into educational practice.
IM-05	"However, what we now need is implementation. At the preparation level, we are there. We are now working on how to implement these initiatives effectively and see the results."	P7 (Higher Education)	Focus shifts from preparation to implementation and measurable outcomes.
IM-06	"There is still no complete consensus, and there remains a clear gap between intention and what is actually happening on the ground."	P9 (Industry, Publicly Listed Company)	Identifies an implementation gap between intentions and practice.
IM-07	"This is why I say that the intention is there, but there is still a significant gap between intention and reality."	P9 (Industry, Publicly Listed Company)	Reinforces the gap between policy intentions and real-world implementation.
IM-08	"Although I believe our curriculum is already strong, we need to improve the way it is implemented by creating more practical projects and initiatives beyond the classroom."	P4 (Government, UNESCO)	Calls for stronger implementation of an already strong curriculum.
IM-09	"At present, we are developing a practical toolkit that will help schools promote sustainable development throughout the school environment."	P6 (Government)	Describes implementation support through a practical toolkit.
IM-10	"This work is currently in its final stages."	P6 (Government)	Reports progress in implementing the national toolkit.

CODE 19: Inclusion and Equity

Definition: References describing equitable access, participation, fairness and inclusive educational opportunities regardless of individual or social differences.

Frequency: 2 references

Participants represented: P6 (Government), P12 (SME)

Ref. No.	Exact quotation	Participant	Summary
IE-01	"In other words, achieving SDG 4 is not viewed solely as the responsibility of the Ministry of Education, but rather as a collaborative national effort."	P6 (Government)	Emphasises inclusive participation in educational governance by recognising that responsibility for achieving SDG 4 is shared across all relevant stakeholders.
IE-02	"Students should not be excluded simply because they did not achieve the highest examination grades."	P12 (SME)	Advocates equitable educational and career opportunities regardless of academic performance.

CODE 20: Industry–Academia Collaboration

Definition: References describing partnerships between higher education institutions and industry to enhance teaching, research, employability and practical learning.

Frequency: 11 references

Participants represented: P2 (Higher Education), P5 (Industry, Global Organisation), P12 (SME), P11 (Higher Education), P10 (Industry, Sustainable Business)

Ref. No.	Exact quotation	Participant	Summary
IAC-01	"Another important area concerns the relationship between education and the labour market. Universities and colleges in Oman need stronger collaboration with industry, professional bodies, regulatory authorities and government institutions."	P2 (Higher Education)	Calls for stronger collaboration between higher education and external stakeholders, particularly industry.

Ref. No.	Exact quotation	Participant	Summary
IAC-02	"This is an area where partnerships with the private sector could provide universities with opportunities to develop programmes that people are currently often sent abroad to attend."	P5 (Industry, Global Organisation)	Recommends university–private sector partnerships to develop professional programmes in Oman.
IAC-03	"There are still insufficient employment opportunities. At the same time, stronger links are needed between universities and industry so that graduates can receive mentoring from sustainability professionals and gain practical workplace experience."	P12 (SME)	Advocates closer university–industry collaboration through mentoring and workplace experience.
IAC-04	"Greater collaboration between universities and industry would benefit everyone. Students would gain valuable experience and professional networks, while employers would have better opportunities to identify suitable graduates."	P12 (SME)	Highlights mutual benefits of university–industry collaboration.
IAC-05	"Students need more internships, guest lectures and practical learning opportunities."	P2 (Higher Education)	Recommends collaboration with industry to expand practical learning opportunities.
IAC-06	"Finally, I would strongly encourage greater collaboration between faculty members and students on sustainability research, as well as stronger research partnerships between different higher education institutions and industry."	P2 (Higher Education)	Calls for collaborative sustainability research between universities and industry.

Ref. No.	Exact quotation	Participant	Summary
IAC-07	"As academics, we cannot develop authentic project-based learning in isolation. We need industry partners to explain the competencies and expectations they have for graduates."	P11 (Higher Education)	Industry input is needed to make learning authentic and relevant.
IAC-08	"Without those partnerships, project-based learning risks relying only on generic international case studies rather than addressing local challenges that are directly relevant to our students."	P11 (Higher Education)	Explains why industry partnerships are essential for contextualised learning.
IAC-09	"The same applies to assessment. Redesigning assessment requires collaboration with industry."	P11 (Higher Education)	Industry collaboration is necessary for authentic assessment.
IAC-10	"This reinforces the importance of stronger collaboration between higher education and industry so that both sectors can jointly develop the competencies required in the workplace."	P10 (Industry, Sustainable Business)	Encourages joint development of workplace competencies by universities and industry.
IAC-11	"What we need most is continued support from industry. Universities cannot achieve this transformation alone."	P11 (Higher Education)	Emphasises the ongoing need for industry support in transforming higher education.

CODE 21: Innovation

Definition: References describing creativity, innovation and the development of new ideas, products, services or approaches that contribute to sustainable development.

Frequency: 6 references

Participants represented: P3 (Government-owned Industry), P9 (Industry, Publicly Listed Company), P12 (SME)

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Ref. No.	Exact quotation	Participant	Summary
INN-01	"I also believe there is considerable scope for further innovation to support the achievement of the SDGs."	P3 (Government-owned Industry)	Identifies innovation as an important driver of sustainable development.
INN-02	"In addition, we support innovators, including students, graduates, SMEs and start-ups."	P3 (Government-owned Industry)	Describes organisational support for innovators and entrepreneurship.
INN-03	"Sustainability also requires innovation and entrepreneurial thinking. These are two additional skills that we actively look for when recruiting graduates."	P9 (Industry, Publicly Listed Company)	Innovation is identified as a key employability competency.
INN-04	"Many of the activities we discussed earlier, such as hackathons and idea-generation competitions, are designed specifically to develop critical thinking, problem-solving, innovation and the ability to move beyond conventional approaches."	P9 (Industry, Publicly Listed Company)	Hackathons and competitions are used to foster innovation.
INN-05	"One example that impressed me involved a university student who was mentoring one of our school programmes. Although her field of study was cybersecurity, she developed an innovative project using date seeds to create a sustainable building material."	P12 (SME)	Presents an example of student innovation addressing sustainability.
INN-06	"When I asked her how she had developed the idea, she explained that she had attended an IB school, where students are consistently encouraged to innovate and think creatively."	P12 (SME)	Highlights an educational approach that promotes innovation and creativity.

CODE 22: International Collaboration

Definition: References describing partnerships, knowledge exchange and collaborative initiatives involving international organisations, institutions and global networks.

Frequency: 6 references

Participants represented: P4 (Government, UNESCO), P6 (Government), P9 (Industry, Publicly Listed Company)

Ref. No.	Exact quotation	Participant	Summary
IC-01	"We work with students on numerous programmes related to sustainable development, including international collaborations with schools and organisations from countries such as Croatia, Denmark, the United Kingdom, Poland, the United States, Qatar, Palestine and several others."	P4 (Government, UNESCO)	Describes international educational partnerships supporting sustainable development.
IC-02	"Another example is Oman's participation in the UNESCO Global Network of Learning Cities. Currently, Muscat, Sur and Nizwa are members of this international network."	P6 (Government)	Highlights Oman's participation in an international UNESCO network promoting lifelong learning.
IC-03	"We have also worked closely with UNESCO on reviewing how these sustainability concepts are reflected within the curriculum and educational practice."	P6 (Government)	Describes collaboration with UNESCO on curriculum development.
IC-04	"The SDGs are explicitly mentioned in our curriculum, and Oman is among the countries participating in UNESCO's monitoring process."	P6 (Government)	Refers to Oman's participation in UNESCO's international monitoring process.
IC-05	"We have also organised workshops with international experts to support curriculum developers, assessment specialists, school leaders and teachers."	P6 (Government)	International experts contribute to capacity building for ESD implementation.

Ref. No.	Exact quotation	Participant	Summary
IC-06	"Last year, we conducted a workshop on future jobs and future green jobs in collaboration with an international partner."	P9 (Industry, Publicly Listed Company)	International collaboration supports green jobs and workforce development.

CODE 23: Multidisciplinary Learning

Definition: References describing learning that integrates knowledge, perspectives and competencies from multiple academic disciplines to address complex sustainability challenges.

Frequency: 7 references

Participants represented: P2 (Higher Education), P7 (Higher Education), P3 (Government-owned Industry), P8 (Higher Education), P10 (Industry, Sustainable Business), P11 (Higher Education)

Ref. No.	Exact quotation	Participant	Summary
MD-01	"Sustainability should not be treated only as a separate subject or solely as an environmental topic. Instead, it should be embedded across disciplines, including accounting, auditing, finance, management, engineering, information technology and business ethics."	P2 (Higher Education)	Advocates multidisciplinary integration of sustainability across academic disciplines.
MD-02	"This means that sustainability is no longer reflected only in institutional policies but is increasingly being embedded within the curriculum across different specialisations."	P7 (Higher Education)	Sustainability is expanding across multiple disciplines.
MD-03	"Students need to learn how to adapt to change. They also need to become more multidisciplinary, understanding how different fields connect rather than remaining within the boundaries of a single discipline."	P3 (Government-owned Industry)	Calls for multidisciplinary thinking as a graduate competency.

Ref. No.	Exact quotation	Participant	Summary
MD-04	"In addition, all disciplines and fields of study should be grounded in the principles of sustainable development."	P8 (Higher Education)	Recommends embedding sustainability throughout all disciplines.
MD-05	"From the perspective of industry, we are increasingly looking for graduates with multiple competencies rather than narrow specialisations."	P10 (Industry, Sustainable Business)	Industry values graduates with broad, multidisciplinary capabilities.
MD-06	"Today's students are becoming increasingly multidisciplinary, but this transformation takes time."	P11 (Higher Education)	Notes progress towards multidisciplinary graduates.
MD-07	"What we now need is a stronger emphasis on multidisciplinary learning, lifelong learning and developing graduates with a growth mindset."	P3 (Government-owned Industry)	Identifies multidisciplinary learning as a future priority.

CODE 24: Values and Attitudes

Definition: References describing beliefs, values, ethics, responsibility, behaviours and mindsets that encourage sustainable thinking and action.

Frequency: 10 references

Participants represented: P3 (Government-owned Industry), P9 (Industry, Publicly Listed Company), P10 (Industry, Sustainable Business), P4 (Government, UNESCO)

Ref. No.	Exact quotation	Participant	Summary
VA-01	"People need to recognise its value for investment, business competitiveness and today's global economy. Sustainability is no longer simply about protecting the environment—it has become an economic asset."	P3 (Government-owned Industry)	Emphasises a value-based shift in how sustainability is perceived.

Ref. No.	Exact quotation	Participant	Summary
VA-02	"The concept of sustainability at university level is not yet fully mature. In many cases, it remains part of the curriculum as a box-ticking exercise, rather than becoming a behaviour or something people adopt in their daily lives."	P9 (Industry, Publicly Listed Company)	Argues that sustainability should become part of everyday attitudes and behaviour.
VA-03	"That value is responsibility."	P10 (Industry, Sustainable Business)	Identifies responsibility as a core value for sustainable development.
VA-04	"Students need to develop a genuine sense of responsibility for their workplace, their environment and the resources they use."	P10 (Industry, Sustainable Business)	Recommends fostering responsibility towards resources and the environment.
VA-05	"Building on the previous comments, I believe one additional element is essential: belief."	P4 (Government, UNESCO)	Introduces belief as a foundation for sustainable behaviour.
VA-06	"When children genuinely believe in these values from an early age, they become part of their lifestyle. Sustainability should become part of their everyday behaviour, their future careers and the way they think."	P4 (Government, UNESCO)	Explains how values become embedded in behaviour and lifestyle.
VA-07	"For me, belief may not be a competency in the traditional sense, but it is certainly one of the foundations upon which all other competencies are built."	P4 (Government, UNESCO)	Positions belief as the basis for developing sustainability competencies.
VA-08	"I think it is also important to recognise that the SDGs and sustainable behaviour are closely aligned with the values already present within our culture and religious beliefs."	P3 (Government-owned Industry)	Connects sustainability with cultural and religious values.

Ref. No.	Exact quotation	Participant	Summary
VA-09	"I believe schools and higher education institutions should make these connections much more explicit so that sustainability is experienced as something natural rather than something additional."	P3 (Government-owned Industry)	Recommends embedding sustainability within existing value systems.
VA-10	"When sustainability becomes connected to people's existing beliefs, culture and values, it becomes much easier for them to embrace it as part of everyday life."	P3 (Government-owned Industry)	Highlights the role of values in shaping sustainable behaviour.

CODE 25: Adaptability

Definition: References describing flexibility, resilience and the ability to respond effectively to changing social, technological, environmental and professional contexts.

Frequency: 4 references

Participants represented: P3 (Government-owned Industry), P10 (Industry, Sustainable Business)

Ref. No.	Exact quotation	Participant	Summary
AD-01	"Students need to learn how to adapt to change."	P3 (Government-owned Industry)	Identifies adaptability as a key graduate competency.
AD-02	"In today's world, if you cannot adapt, if you cannot think beyond what you have been taught, and if you cannot continue teaching yourself, it becomes very difficult to succeed."	P3 (Government-owned Industry)	Emphasises continuous adaptation and self-directed learning in a changing world.
AD-03	"Graduates therefore need broader capabilities and greater adaptability."	P10 (Industry, Sustainable Business)	Industry highlights adaptability as an important employability attribute.
AD-04	"Knowledge is increasingly available through AI. The real challenge is helping learners generate new knowledge, communicate effectively, collaborate across disciplines and transform knowledge into meaningful action."	P3 (Government-owned Industry)	Explains that rapid technological change requires graduates to adapt beyond knowledge acquisition.

CODE 26: Collaboration and Teamwork

Definition: References describing teamwork, interpersonal communication, collaborative learning and working effectively with others to achieve shared goals.

Frequency: 4 references

Participants represented: P3 (Government-owned Industry), P13 (Student)

Ref. No.	Exact quotation	Participant	Summary
COL-01	"Another important competency is the ability to work collaboratively. Students need experience working in teams through collaborative projects and group assignments."	P3 (Government-owned Industry)	Identifies teamwork and collaborative working as essential graduate competencies.
COL-02	"These competencies are closely related to critical thinking, but they also include how people present themselves, how they engage with others and how they interact with the world around them. These interpersonal competencies are equally important."	P3 (Government-owned Industry)	Highlights interpersonal communication and collaboration skills.
COL-03	"Working with classmates, especially through group projects, allows us to explore perspectives that are not found in textbooks. Different students think differently, and those discussions help us develop a broader understanding."	P13 (Student)	Explains how teamwork and peer collaboration enhance learning.
COL-04	"The real challenge is helping learners generate new knowledge, communicate effectively, collaborate across disciplines and transform knowledge into meaningful action."	P3 (Government-owned Industry)	Emphasises communication and collaborative working across disciplines.

CODE 27: Community Engagement

Definition: References describing partnerships with communities, volunteering, civic participation and educational activities that contribute to societal wellbeing and sustainable development.

Frequency: 8 references

Participants represented: P4 (Government, UNESCO), P1 (NGO)

Ref. No.	Exact quotation	Participant	Summary
CE-01	"I have seen teachers who have made a remarkable impact not only within their schools but also throughout the surrounding community and even within students' families."	P4 (Government, UNESCO)	Highlights the wider community impact of sustainability education.
CE-02	"One recommendation I would make is to include more volunteer work within school programmes."	P4 (Government, UNESCO)	Recommends volunteering as part of education.
CE-03	"Volunteer activities help students develop responsibility towards their communities and their surrounding environment."	P4 (Government, UNESCO)	Explains how volunteering develops civic responsibility.
CE-04	"I also appreciate the way some international curricula include compulsory community service as part of students' overall educational achievement."	P4 (Government, UNESCO)	Advocates community service as a component of education.
CE-05	"Students should participate in projects linked to the SDGs, volunteer activities and current global themes such as climate change, digital transformation and education."	P4 (Government, UNESCO)	Encourages participation in community-based sustainability initiatives.
CE-06	"Making these themes part of everyday school life would benefit both school students and those in higher education."	P4 (Government, UNESCO)	Promotes embedding community-oriented sustainability activities into education.
CE-07	"For example, we recently launched an educational programme that allows students to experience conservation research directly."	P1 (NGO)	Describes a community-based educational outreach programme.

Ref. No.	Exact quotation	Participant	Summary
CE-08	"Experiences such as these strengthen students' understanding of sustainable development far more effectively than classroom instruction alone."	P1 (NGO)	Community engagement through authentic experiences strengthens learning.

CODE 28: Problem Solving

Definition: References describing the identification, analysis and resolution of real-world problems through critical, practical and evidence-informed approaches.

Frequency: 6 references

Participants represented: P9 (Industry, Publicly Listed Company), P13 (Student), P1 (NGO), P11 (Higher Education)

Ref. No.	Exact quotation	Participant	Summary
PS-01	"Graduates need to understand market needs and be able to propose practical solutions to real-world problems."	P9 (Industry, Publicly Listed Company)	Identifies problem solving as a key employability competency.
PS-02	"Many of the activities we discussed earlier, such as hackathons and idea-generation competitions, are designed specifically to develop critical thinking, problem-solving, innovation and the ability to move beyond conventional approaches."	P9 (Industry, Publicly Listed Company)	Explains how educational activities develop problem-solving skills.
PS-03	"That experience helped me understand sustainability as something practical rather than purely theoretical."	P13 (Student)	Demonstrates learning through solving a real sustainability problem.
PS-04	"Instead, we were required to develop a sustainable solution to a real problem."	P13 (Student)	Describes authentic problem-solving through assessment.

Ref. No.	Exact quotation	Participant	Summary
PS-05	"Students should be encouraged to identify problems themselves, investigate them and develop their own solutions."	P1 (NGO)	Recommends inquiry-based problem solving within education.
PS-06	"Our students are capable of solving complex problems, but those problems need to reflect their own context."	P11 (Higher Education)	Advocates contextualised problem solving using local challenges.

CODE 29: Progress towards Sustainable Development

Definition: References describing perceived achievements, improvements and national progress in advancing sustainable development and ESD.

Frequency: 9 references

Participants represented: P1 (NGO), P2 (Higher Education), P3 (Government-owned Industry), P4 (Government, UNESCO), P5 (Industry, Global Organisation), P6 (Government), P7 (Higher Education)

Ref. No.	Exact quotation	Participant	Summary
PSD-01	"Oman is currently moving in the direction of sustainable development."	P1 (NGO)	States that Oman is progressing towards sustainable development.
PSD-02	"I agree with the previous speaker. Oman is moving in the direction of sustainable development."	P2 (Higher Education)	Confirms national progress towards sustainable development.
PSD-03	"I would also like to add that I believe Oman is moving in the direction of sustainable development."	P3 (Government-owned Industry)	Views Oman as progressing towards sustainability through national initiatives.
PSD-04	"Based on this experience, I believe Oman is making significant progress towards sustainable development and has achieved strong results in several areas."	P4 (Government, UNESCO)	Describes substantial national progress based on educational initiatives.

Ref. No.	Exact quotation	Participant	Summary
PSD-05	"Sustainable development is an ongoing journey rather than a final destination. Based on my international experience, I believe Oman has been progressing steadily in this direction for many years."	P5 (Industry, Global Organisation)	Frames sustainable development as continuous long-term progress.
PSD-06	"Overall, I believe Oman is making substantial progress in embedding ESD within the education system and using education as a foundation for achieving the broader SDGs."	P6 (Government)	Highlights educational progress supporting the SDGs.
PSD-07	"Overall, we are pleased with the progress that has been made. We believe the preparation phase has been successful, and the next step is to focus on implementation so that these initiatives produce measurable results."	P7 (Higher Education)	Recognises institutional progress while emphasising implementation.
PSD-08	"If we compare higher education today with the situation two or three years ago, we can clearly see significant progress."	P2 (Higher Education)	Identifies progress in higher education's contribution to sustainability.
PSD-09	"I believe this shows that higher education is moving in the right direction in preparing graduates for the future."	P2 (Higher Education)	Concludes that higher education is progressing towards sustainability goals.

CODE 30: Renewable Energy Transition

Definition: References describing the transition towards renewable energy systems, sustainable technologies and related behavioural, educational and policy changes.

Frequency: 4 references

Participants represented: P2 (Higher Education), P9 (Industry, Publicly Listed Company), P10 (Industry, Sustainable Business)

Ref. No.	Exact quotation	Participant	Summary
RET-01	"Recent examples include the expansion of renewable energy initiatives, particularly solar and wind projects, with the aim of increasing the share of renewable energy in electricity generation."	P2 (Higher Education)	Highlights national investment in renewable energy generation.
RET-02	"For example, when we study the transition from conventional fuel-powered vehicles to electric vehicles, we are really examining consumer behaviour."	P9 (Industry, Publicly Listed Company)	Discusses the transition from conventional vehicles to electric vehicles.
RET-03	"Consumer behaviour requires a great deal of education. People need to understand why they should behave sustainably and why they should shift from conventional vehicles to electric vehicles."	P9 (Industry, Publicly Listed Company)	Explains the educational role in supporting the transition to electric vehicles.
RET-04	"For example, when we talk about electric vehicles, people still need much more information and practical understanding before they are willing to change their behaviour and move away from diesel and petrol vehicles towards more sustainable alternatives."	P10 (Industry, Sustainable Business)	Emphasises education and awareness to support the energy transition.

CODE 31: Strategic Planning

Definition: References describing long-term planning, strategic alignment, policy direction and institutional or national frameworks supporting sustainable development.

Frequency: 7 references

Participants represented: P1 (NGO), P2 (Higher Education), P3 (Government-owned Industry), P8 (Higher Education), P11 (Higher Education)

Ref. No.	Exact quotation	Participant	Summary
SP-01	"One area that could be strengthened is the development of a more concrete action plan, supported by a clear implementation strategy and adequate financing."	P1 (NGO)	Recommends a stronger strategic framework supported by implementation planning and resources.
SP-02	"Recent examples include the expansion of renewable energy initiatives, particularly solar and wind projects, with the aim of increasing the share of renewable energy in electricity generation. These initiatives are aligned with Oman Vision 2040."	P2 (Higher Education)	Links renewable energy initiatives to the national strategic vision.
SP-03	"Oman Vision 2040 was developed in alignment with the SDGs, making them an integral part of the national vision."	P3 (Government-owned Industry)	Highlights the strategic alignment of Oman Vision 2040 with the SDGs.
SP-04	"Therefore, I believe that Oman already has a clear strategic direction."	P3 (Government-owned Industry)	Affirms that the country has a defined long-term strategic direction.
SP-05	"Institutions are required to align themselves with Oman Vision 2040, which is very clear in relation to the sustainable development agenda."	P8 (Higher Education)	Explains how institutional planning aligns with national strategy.
SP-06	"Overall, I believe the Omani education system is aligned with the country's long-term priorities at the policy and strategic level."	P2 (Higher Education)	Notes strategic alignment between education and national development priorities.
SP-07	"First, the SDGs should be embedded more explicitly within institutional policies and strategic documents."	P11 (Higher Education)	Recommends strengthening institutional strategic planning through explicit integration of the SDGs.

CODE 32: Systems Thinking

Definition: References describing the ability to understand the interconnectedness of social, environmental, economic and educational systems, recognising relationships, complexity and the wider consequences of decisions rather than viewing issues in isolation.

Frequency: 3 references

Participants represented: P2 (Higher Education), P3 (Government-owned Industry), P8 (Higher Education)

Ref. No.	Exact quotation	Participant	Summary
ST-01	"Sustainability should not be treated only as a separate subject or solely as an environmental topic. Instead, it should be embedded across disciplines, including accounting, auditing, finance, management, engineering, information technology and business ethics."	P2 (Higher Education)	Advocates a holistic, cross-disciplinary understanding of sustainability rather than treating it as an isolated topic.
ST-02	"Students need to learn how to adapt to change. They also need to become more multidisciplinary, understanding how different fields connect rather than remaining within the boundaries of a single discipline."	P3 (Government-owned Industry)	Emphasises understanding relationships between disciplines, reflecting systems thinking.
ST-03	"In addition, all disciplines and fields of study should be grounded in the principles of sustainable development."	P8 (Higher Education)	Supports integrating sustainability throughout the education system rather than treating it as an isolated subject.

CODE 33: Areas for Improvement

Definition: References identifying gaps, challenges, recommendations and opportunities for strengthening ESD implementation, educational practice and sustainable development initiatives.

Frequency: 9 references

Participants represented: P1 (NGO), P3 (Government-owned Industry), P2 (Higher Education), P7 (Higher Education), P8 (Higher Education), P9 (Industry, Publicly Listed Company), P12 (SME), P6 (Government)

Ref. No.	Exact quotation	Participant	Summary
AI-01	"One area that could be strengthened is the development of a more concrete action plan, supported by a clear implementation strategy and adequate financing."	P1 (NGO)	Recommends strengthening planning, implementation and funding.
AI-02	"Nevertheless, there is still room for improvement, particularly in increasing public awareness of existing initiatives and strengthening collaboration among different organisations."	P3 (Government-owned Industry)	Identifies awareness and collaboration as key areas requiring improvement.
AI-03	"One important area requiring further improvement is curriculum integration."	P2 (Higher Education)	Identifies curriculum integration as an educational priority.
AI-04	"Overall, I believe the Omani education system is aligned with the country's long-term priorities at the policy and strategic level. However, the real challenge now is implementation."	P2 (Higher Education)	Highlights the gap between policy and implementation.
AI-05	"However, what we now need is implementation. At the preparation level, we are there. We are now working on how to implement these initiatives effectively and see the results."	P7 (Higher Education)	States that implementation is the next major priority.
AI-06	"At present, education generally introduces topics related to sustainable development, but I believe these are still treated quite superficially."	P8 (Higher Education)	Suggests sustainability needs deeper integration into education.
AI-07	"There is still no complete consensus, and there remains a clear gap between intention and what is actually happening on the ground."	P9 (Industry, Publicly Listed Company)	Identifies a gap between policy intentions and practical implementation.

Ref. No.	Exact quotation	Participant	Summary
AI-08	"We have awareness campaigns and educational initiatives, but the greatest gap remains practical implementation."	P12 (SME)	Identifies implementation as the principal weakness.
AI-09	"No curriculum is ever perfect. Our curriculum is strong, but it should continue to be improved and enhanced."	P6 (Government)	Advocates continuous improvement of the curriculum.