CHAPTER II

LITERATURE REVIEW

2.1 Climate Change

Climate change is the long-term shift in Earth's climate patterns that influences conditions on local, regional, and global scales (NASA, 2024). According to BMKG (2025), climate change covers long-term changes for temperature & rainfall patterns, and other weather phenomenons on earth. These changes are identified through long-term pattern changes in temperature, pressure and humidity in the surrounding environment (Abbass et al., 2022). Climate change and other related environmental consequences are interconnected threats to the future of the planet (Piquet, E., 2022 as cited in Wang et al., 2023), leading to agriculture decline, heightened risks of economic losses, instability of extreme weather patterns, and severity of threatening disasters. These damages are also evident in Indonesia, where impacts of climate change can be seen through rising occurrences of abnormal weather and hydrometeorological disasters (Yuwono et al., 2024 as cited in Aeni & Anwar, 2024).

The global urgency of climate change has prompted many international initiatives targeted at reducing global warming, limiting carbon emissions, and shifting to renewable energy. In supporting global efforts towards climate change, Indonesia has also pledged their commitment to frameworks and policies, establishing Nationally Determined Contribution (NDC) targets under the Paris Agreement to the United Nations Framework Convention on Climate Change (UNFCCC) in 2015 with aims to reduce the country's carbon emissions to limit global temperature rise to no more than 1.5°C (IESR, 2025). In accordance with the Paris Agreement, Indonesia has also started integrating Long-Term Strategy (LTS) in the energy sector with the drafts of Rencana Umum Ketenagalistrikan Nasional [RUKN] and Rencana Umum Energi Nasional [REUN], as well as in the forestry sector with the Forestry and Other Land Use (FOLU) Net Sink 2030.

Other than integrating large-scale climate policies, local-scale initiatives are also equally important to gather community momentums towards active collaborations in decision making for climate actions across existing networks (Ballard & Theodor Bratosin, 2024). For instance, Indonesia applied the approach through its Education Standard, Curriculum, and Assessment Agency (BSKAP) by providing a guide for Climate Change Education (CCE) in Indonesia which uses the framework from Teixeira & Crawford consisting of four elements: impact, causes, adaptation, and mitigation. This guide is intended for education facilitators including leaders, educators, and other residents to foster students' autonomy in addressing environmental challenges, including climate change (Sekarwulan et al., 2024). A general understanding of climate change conditions must also be met to address these elements, as seen by the guide's introductory chapter of explaining what climate change is. Furthermore, to understand the applied framework on Indonesia's CCE sphere, it is essential to examine the current conditions of climate change, its impacts, causes, and adaptation and mitigation efforts surrounding it.

2.1.1 Climate Change Condition

Monitoring the progression of climate systems is an essential task to determine the current conditions of climate change. To do so, the Indicators of Global Climate Change (IGCC) were established as a bridge between the Intergovernmental Panel on Climate Change (IPCC) and the public. Its main function is to inform the latest scientific understanding of climate systems critical indicators where human influences are possible (Forster et al., 2025). These indicators include factors that are human induced such as greenhouse gas emissions, rising global temperatures, carbon emission budgets, and sea level increase. While those indicators are more frequently observed on a regional or global scale, local-scale observations on a daily basis also provide valuable insights into how climate change manifests and evolves within specific communities or environments, which are often overlooked by broader levels of observation. Such impact of local-scale observations for climate change yields richer and more diverse knowledge, different from the insights of scientific information on climate change (Reyes-García et al., 2016).

Applying local-scale observations in Indonesia, with its extensive geographical diversity, observations are accomplished differently according to the geographical conditions of an area. For example coastal areas tend to experience tidal floodings, causing local observations to focus on sea level changes. Forest areas, which experience frequent forest fires, emphasized temperature spikes to be monitored as it's a critical disaster indicator. Meanwhile, mountainous areas are prone to landslides, prompting observations to center around shifting rainfall patterns. Demonstrations of geographical diversity's role towards local-scale observations can also be seen in the capital of Indonesia, which is Jakarta.

Jakarta is a low, flat alluvial plain area with historically extensive swampy areas (Waworoentoe, W.J., 2025). The sprawl of urbanization in Jakarta has led to ecological problems such as low levels of clean drinking water, poor air quality, and frequent floodings (Kristiadi et al., 2022). These problems arise from human induced factors and natural factors. Human induced factors include lack of operations for environmental sustainability, inadequate waste and water management systems, the shrinking of green spaces, urban heat, and funding challenges, meanwhile natural factors include heavy rainfalls, seawater intrusions, and temperature rises (BAPPEDA, 2025).

2.1.2 Climate Change Causes

The cause of climate change is rooted in human activities, with anthropogenic activities reported to be the primary drivers of climate change (Mushed et al., 2022 as cited in Abbass et al., 2022). Nevertheless, natural processes also play a role in climate change (Karami, 2012 as cited in Abbass et al., 2022) these include volcanic eruptions, fluctuations in solar radiation, tectonic shifts, and orbital changes. However, its influence is too small in comparison to the rapid climate changes of today, which ultimately means that human activities are the rising causes of climate change (Turrentine, 2022).

Anthropogenic activities include fossil fuel overuse, large-scale deforestations, and other actions that contribute to the increase of greenhouse gases (GHG) in the atmosphere. It can also present itself through daily

activities, such as waste burning that produces a significant amount of GHG emissions, excessive use of private transportation which uses more non-renewable energy, and even in households carelessly using air conditioners, light sources, and cooking with liquefied petroleum gas (LPG). These activities collectively reflect society's dependence on fossil fuels, which is the main contributor to global GHG emissions.

Fossil fuels play a dominant role in global energy systems, such as in electricity, heating, and transportation. It includes coal, oil, and gas; which greatly contributed to technological, social, and economic development for most of human history (Ritchie & Rosado, 2022). The advantages of using fossil fuels lies in its abundance, accessibility, ease of transport, and efficiency in producing energy, despite being a limited resource. These advantages contributed to human developments, which made many bounded economies on various scales to be dependent on fossil fuels and other natural resources (Mayer, 2022). The continued reliance on fossil fuels remains evident, with four-fifths of global energy from coal, oil, and gas (Ritchie & Rosado, 2022).

Large-scale utilizations of fossil fuels managed to produce a total of over 37.8 billion metric tons of CO_2 emissions in 2024, with CO_2 emissions growth coming from China (0.4%) and India (5.3%) (IEA, 2025). According to 2022 data reported by Ritchie et al. (2020), Indonesia accounted for 0.89% of global CO_2 emissions with per capita GHG emissions reaching 6.5 tons. Major emission sources also included land-use change and forestry, electricity and heat, and manufacturing and construction. The accumulation of GHG is the primary driver for global warming, which subsequently leads to climate change. Global warming is the process that increases the earth's average temperature due to the excessive solar heat trapped in the atmosphere (Keniah, 2023). This phenomenon is also known as the greenhouse effect; although it's essential for sustaining life, its intensification disrupts the stability of earth's climate systems.

2.1.3   Climate Change Impact

As climate change is expected to worsen, it will continue to affect daily livelihoods through various crises, such as natural disasters, extreme weather, rising sea levels, ecosystem failures and other effects that create long-term changes across multiple sectors including agriculture, health, socio-economy, and most drastically, the environment. The effects of climate change range from large-scale events to more gradual occurrences, however these effects are not equally experienced especially among marginalized populations (Zahnow et al., 2025). The Intergovernmental Panel on Climate Change (IPCC) Sixth Assessment Report also stated that communities who contributed the least to climate change are disproportionately affected (Adil et al., 2025). Bhargawa and Bhargava (2023) key findings revealed that the 74 lowest income countries are the most heavily impacted by climate change, showcasing global disparities in vulnerability and adaptive capacity across the globe. This global inequality is mirrored in Indonesia, where dependence on natural resources and socio-economic fragility exacerbate vulnerabilities to climate change

Indonesia is among the countries at high risk of experiencing a climate crisis, this is due to 29.36% of the population working in agriculture, forestry, and fisheries which relies on the ecosystem's health (ABD, 2021 as cited in Sekarwulan, 2024). Those whose occupation relies on the ecosystem's health have received the lowest monthly wage compared to other sectors. Data reported by Alta et al. (2023) revealed the agriculture, forestry, and fishery sector workers only received Rp 1,396,579 of their monthly wages. The combination of low income and occupational dependence on ecosystems, made nearly one-third of Indonesia's population especially vulnerable to the impacts of climate change. This further solidifies the segmentation of its impacts in various levels of society.

According to Adil et al. (2025) climate change has led to an increase in both frequency and severity of natural disasters. Climate change contributes to "transforming unusually extreme events into continued threats", with damages felt most severe in disproportionate communities due to limited recovery

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support from inequality, poverty, and marginalization. (Adil et al., 2025).
Indonesia frequently experiences hydrometeorological disasters, which are
events caused by water phenomenons and extreme weathers (Sekarwulan et
al., 2024), such as forest fires, droughts, landslides, and floodings. The
aftermath of such disasters includes infrastructure damages, such as houses,
education institutes, healthcare facilities, transportations; and also human
casualties such as displacements, injuries, and death. In 2024 alone, Indonesia
experienced natural disasters that affected more than 8 million people, injuring
11.531 and causing 540 deaths, while 80.304 houses were damaged and
1.238.108 were submerged (PDSI Pusdatinkom BNPB, 2024), resulting in
economic losses of approximately Rp 281.9 trillion (SIAP SIAGA, 2025).

Beyond environmental consequences, climate change extends into
other vital sectors, such as human health, economic stability, and social well-
being. Indonesia has recorded rising rates of climate-related diseases in 2021
such as diarrhea, pneumonia, tuberculosis, and dengue throughout multiple
regions including Kalimantan, Nusa Tenggaran, Bali, Maluku, and Papua.
Losses due to these diseases are projected to cost 1.86% of the national GDP
or roughly Rp 357 trillion in 2021-2050 (UNICEF, 2023 as cited in Sulistiadi
et al., 2024). Economically, climate change has disrupted agricultural
productivity, damaged infrastructure, and increased recovery costs of disasters;
which threatens national food security and leads to a decline in household's
food purchasing power due to increasing prices. These disruptions also extend
into the social sphere, where climate change is recognized to be a stress factor
for mental health, increasing the risk of affective and anxiety disorders, as well
as Post Traumatic Stress Disorders (PTSD) due to extreme weather events
(Walinski et al., 2023). Altogether, these impacts of climate change is not only
an environmental issue, but is a multidimensional crisis that undermines
Indonesia's health, economic stability, and social resilience.

2.1.4 Climate Change Mitigation

Mitigation of climate change refers to efforts at reducing or preventing
the accumulation of greenhouse gas (GHG) emissions from human activities

(United Nations Development Programme [UNDP], 2024). Mitigation actions are crucial in defending against climate change, it's to ensure the reduction of prolonged climate change impacts in the global population's livelihoods. Mitigation strategies vary in their scales and approaches. According to Simarmata and Indrawati (2022), mitigation can be categorized into structural mitigation and non-structural mitigation. Structural mitigation refers to reservations of carbon sinks, such as forests, oceans, and soils; and the construction of embankments, such as river canals, and dams/reservoirs. Meanwhile, non-structural mitigation refers to "mapping the disaster-prone areas, constructing rules and policies, forming working groups, training and education for the community, and building a network among stakeholders" (Simarmata & Indrawati, 2022, p. 1).

At the global scale, such initiatives are shown through international policy agreements and collaborative actions undertaken by governments, which is categorized under non-structural mitigation. These policies promote the shift to environmentally sustainable policies and strategies including mechanisms such as budget reallocations, tax incentives for renewable energy development, and other fiscal instruments supporting low-carbon transitions (Wurarah & Mulyanto, 2024). In Indonesia, such actions are reflected through participation in the 21st Conference of the Parties (COP21) to the United Nations Framework Convention on Climate Change (UNFCCC), which gathered 195 countries that adopted The Paris Agreement on 12 December 2015. The Paris Agreement is a framework adopted by countries to limit global warming to 1.5°C by the end of this century through reducing their GHG emissions. This agreement works with a five-year cycle of increasingly ambitious climate actions, and submitting it through Nationally Determined Contributions (NDCs) reports (UNFCCC, 2025). Indonesia's first submitted NDC pledged to reducing unconditionally GHG emissions by 29% against 2030 Business-as-Usual (BAU) scenario, and reducing conditionally GHG emissions up to 41% below the BAU level through international assistance (Wijaya, 2017). BAU scenario refers to the development of GHG emissions in

the atmosphere with no further efforts made to reduce emissions (German Council on Foreign Relations, n.d.).

While large scale actions such as policy integrations are beneficial to climate change mitigation, small scale actions taken by local communities can reduce vulnerabilities against the unpredictability of climate changes due to traditional knowledge that's been developed for an extensive amount of time. The implementation of climate change mitigation in certain areas can be achieved through local wisdom, which refers to the systems of traditional knowledge passed down through generations that house the order of social life, politics, culture, economy, and the environment (Simarmata & Indrawati, 2022).. Such examples of this can be seen in Buleleng Bali, more specifically in Tigawasa village where its local people, called Bali Aga Society, passes down the culture of customary forest that is only used for traditional events, ultimately preserving the forest ecology (Candraningsih, 2018 as cited in Simarmata & Indrawati, 2022).

2.1.5 Climate Change Adaptation

Besides mitigation, adaptation also plays an important role in addressing climate change. According to the United Nations Development Programme (UNDP, 2024), adaptation is achieved through actions that reduce vulnerabilities and risks associated with the current or expected impacts of climate change, such as extreme weather, sea-level increase, or food and water insecurity. Adaptation aims to prepare communities for these impacts through adjustments of existing social, environmental, and infrastructure systems. The Intergovernmental Panel on Climate Change (IPCC) Sixth Assessment Report (IPCC, 2022) classifies adaptation actions into four categories: infrastructural, institutional, behavioural, and nature-based options.

Analysis of Climate…, Sherline Widjaja, Universitas Multimedia Nusantara

Type of adaptation responses by global region

Percentages reflect the number of articles mentioning each
type of adaptation over the total number of articles for that region

— Technological/Infrastructural
— Institutional
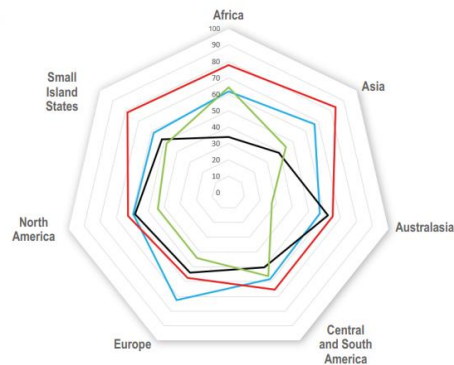— Behavioural/Cultural
— Nature-based

Figure 16.5 | Type of adaptation responses by global region. Percentages reflect the number of articles mentioning each type of adaptation over the total number of articles for that region. Radar does not total 100% per region since publications frequently report multiple types of adaptation; for example, construction of drainage systems (infrastructural), changing food storage practices by households (behavioural), and planting of tree cover in flood-prone areas (nature-based) in response to flood risk to agricultural crops. Data updated and adapted from Berrang-Ford et al. (2021a), based on 1682 scientific publications reporting on adaptation-related responses in human systems.

Figure 2.1 *IPCC AR6 WGII infographic for types of adaptation responses*
Source: (IPCC, 2022)

Infrastructural adaptation involves constructing or modifying systems that reduce climate change impacts, such as drainage systems, dams, sea walls, and flood barriers. Institutional adaptation refers to reforms within governance including policy instruments, financial resources, and decision-making procedures, that enhance resilience to climate change impacts. Behavioral adaptation focuses on changes in human behaviours and lifestyle patterns to strengthen communities' capacity in facing impacts of climate change. Lastly, nature-based options are solutions that integrate nature into cities, landscapes, and seascapes through locally adapted, resource-efficient, and systemic interventions (Climate ADAPT, n.d.).

Indonesia implements a combination of those four adaptation categories at a national, regional, and local level. An example of an institutional approach is the National Action Plan for Climate Change Adaptation (RAN-API), which "identifies priority adaptation programs and provides a policy mechanism that can be modified to become more climate-resilient" (BAPPENAS, 2019, p.12). Meanwhile regionally, climate change adaptation activities are focused on infrastructure to support basic services such as water, food resources, and agriculture (Simanjuntak & Mufida, 2023). These activities can cover creating irrigation systems for agriculture, creating

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food banks for food security, or constructing drainage systems or proper clean water channels to increase resilience against climate change impacts.

Other than infrastructural or institutional approaches, behavioural adaptations also play an important role in shaping communities to better prepare themselves against climate change impacts. This can be achieved through Climate Change Education (CCE) which equips communities with the power to make their own decisions based on learned knowledge of climate change impacts, causes, and conditions around their environment. Education therefore becomes a key role in fostering adaptive behaviours, strengthening sustainable resilience towards climate change impacts in daily livelihoods.

2.2 Education

Education is commonly associated with the processes of teaching and learning, transmitting of knowledge and wisdom, and empowering individuals to experiment and actively engage with real-world problems. According to Naka et al. (2025), education is defined as a discipline of school-oriented environment methods for teaching and learning, as opposed to non-formal or informal socializations. Meanwhile, John Dewey, a leading educational philosopher, defined education as a necessity to help people navigate problems in the world around them and society while equipping them with the adaptability to implement the changes that arises as a result of that thinking (Banks, 2014; Barrett et al., 2013; Benjamin & Vaught, 2018; DeJaeghere, 2018; Kelley & Knowles, 2016; Slot, 2018, as cited in Woenardi et al., 2022). Similarly, Ki Hajar Dewantara, a key figure in Indonesia known as the Father of Indonesian Education, explained education to be an effort in accelerating the growth of character, mind, and body (Faaizah, 2023). In conclusion, education can be understood as a process to prepare individuals with the knowledge, values, capabilities, and adaptability needed to navigate through real-life problems surrounding their world and society.

The functions of education according to Vanderstraeten (2021) is to facilitate the ongoing reproduction of communication systems of modern society. John Dewey also agrees with education as an integral function of society, outlining its roles as (1) A means of cultural transmission, (2) Reducing inequality and

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disparity, (3) Social mobility and change, (4) An instrument of socialization, (5) Development of new knowledge, (6) Education and individual development, and (7) Development of new social patterns (G.B, 2019). The tangible impact of these functions are apparent in the decrease of adult illiteracy in the last half of the 20th century, as numbers of school enrollments increased among children and youths (Gelpi, 2025). Education has therefore shaped society into a more informed and capable population. Over time, diverse educational approaches and methodologies emerged to enhance its capacity in shaping the younger generations, aligning education to evolving global and local challenges that are and will be relevant for their productive age.

Education as a means of transmissioning knowledge, skills, and values is also influenced by its teaching methods, namely pedagogy. Pedagogy in teachings can be defined as the interactions between educators with students, their environment, and the learning tasks (Murphy, 2008. p. 35 as cited in Shah & Campus, 2021). Different pedagogical models have been developed throughout history to respond to the evolving needs of learners in society. Traditional pedagogy consisted of a teacher-focused approach where "learners passively receive information from teachers" (Bremner et al., 2022), but now many educational institutions are experimenting with student-focused approaches, such as inquiry-based learning. Inquiry-driven learning capitalizes on students' interests driven by their questions and innate curiosity, it roots itself in constructivism, which means constructing their own knowledge and meanings from personal experiences (SEAMEO INNOTECH, 2022). While teacher-focused pedagogy has been vastly used, it doesn't hide the fact that the needs of learners are now shifting to adapt with the digital age that has transformed how information is processed inside individuals or groups.

Education type differentiation then surfaced due to the perception of unmet conditions of society from educational systems; it surged the differing learning arrangements consisting of formal, informal, and non-formal learning (Johnson & Majewska, 2022).
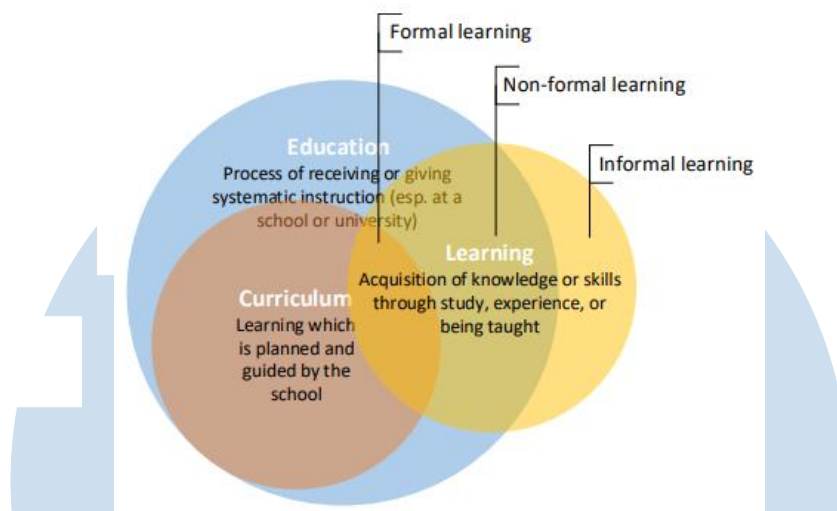
Figure 2.2 Definitions of Education, Learning, and Curriculum

Source: (Johnson & Majewska, 2022)

Due to society's perception of unmet conditions from educational systems, it surged the differing learning arrangements consisting of formal education, informal education, and non-formal education. Formal learning focuses on an "institutionalized, chronologically graded and hierarchically structured… system, spanning lower primary school and the upper reaches of the university" (Coombs & Ahmed, 1974, p.8, as cited in Johnson & Majewska, 2022). Formal learning is gained from schools, universities, and other educational institutions that's grounded in a hierarchical system which results in certification and recognition. Informal learning refers to the education a person can gain from daily experiences and exposure to the environment (Coombs & Ahmed, 1974, p.3, as cited in Johnson & Majewska, 2022). Lastly, non-formal learning is known to be more flexible than formal and informal learning, often filling in the need to meet diverse educational or learning needs with the knowledge, skills, and values to increase quality of life (Fauziah et al., 2021).

2.2.1 Junior and Senior Secondary Education

The differentiation of education is also visible in Indonesia, as it's carried out as one of its main responsibility to the people, which is to "enlighten the life of the nation" (*mencerdaskan kehidupan bangsa*) as stated in Indonesia's fourth paragraph of the Preamble to the 1945 Constitution of the

Republic of Indonesia (*Pembukaan UUD 1945 alinea ke-4*). Non-formal and informal education are not as widespread as formal education in Indonesia due to lack of policy support, infrastructure, and resources that limits their capacity to carry out quality level education consistently. The Indonesian education follows a formal hierarchical structure that's carried out for approximately 12 years of compulsory schooling before entering higher education, including six years elementary (Sekolah Dasar [SD]), 3 years of junior secondary (*Sekolah Menengah Pertama* [SMP]), and three years of senior secondary, with diversification of senior vocational education (*Sekolah Menengah Kejuruan* [SMK]) and regular senior secondary education (*Sekolah Menengah Atas* [SMA]) (Borenovic Dilas et al., 2019).

Each level of Indonesia's education system is equipped with different sets of outlined competencies which students are expected to have by passing a certain level. These competencies are sourced from the nation's curriculum for formal education called the Merdeka Curriculum, which was in effect starting from 2022. The creation of the Merdeka Curriculum stems from the need of a flexible and less-material heavy learning process from previous curriculum evaluations. The arrangement of the Merdeka Curriculum was based on several principles, which were competency and character development, flexibility, and focusing on essential content for learning. Its goal is "to create meaningful and effective learning that strengthens faith, devotion to God Almighty, and noble character, while fostering students' creativity, emotional intelligence, and initiative as lifelong learners embodying the values of Pancasila." (Wahyudin et al., 2024, p. 14).

Figure 2.3 The Merdeka Curriculum Logo

Source: (Wahyudin et al., 2024)

In the Merdeka Curriculum, six dimension profiles were also created from the urgency and manifestations of knowledge and skills for Indonesian students. These profiles consist of: (1) Have faith, fear God Almighty, and have noble morals, (2) collaborations, (3) critical reasoning, (4) global diversity, (5) independent, and (6) creativeness. These dimensions are the one of the backbones of guiding compulsory schooling starting from SD until SMA/SMK. Other than principles and students' dimension profiles, there are four other characteristics that make up the Merdeka Curriculum: (1) utilizing initial, progression, and final assessments to understand the development process and learning needs of students, (2) using the understanding of participants needs and positions to make learning adjustments, (3) prioritize learning progressions of students rather than the coverage and completeness of the curriculum content delivery, and lastly (4) To be based on students' reflection on learning progression which is done through collaboration with other students. From its principles, profiles, and characteristics, the Merdeka Curriculum showcased high flexibility in accommodating educators to efficiently empower and educate students of their own capabilities and ability.

2.2.1.1 Current Curriculum Structure

Flexibility is one of the prioritizations for the current Merdeka Curriculum. According to Wahyudin et al. (2024), flexibility is tied to two things, which are how far can the curriculum adapt to the background of students' abilities, and how far can the curriculum be designed to help students reach maximum learning output. To support this, the Merdeka Curriculum implemented a structured learning system consisting of intracurricular, co-curricular, and extra-curricular.

1) **Intracurricular**

In intracurricular courses, achievable competencies are based on phases instead of yearly changes. This is to give more time for students to learn and deepen their understanding of the competencies they need to achieve.

2) Co-curricular

Co-curricular courses are carried out through projects meant to strengthen the six dimension profiles of Indonesian students mentioned before, which acts as its competencies. Co-curricular projects aim to support intracurricular activities through students' character and competency developments.

3) Extra-curricular

Extra-curricular refers to all activities carried outside of regular class hours. Through this structure, students are given the opportunity to develop their abilities, as well as identifying and cultivating their talents outside of the academic learning routine.

2.2.2 Junior and Senior Secondary Education

Junior secondary education, or is often called *Sekolah Menengah Pertama* (SMP) is the upper level of elementary education where students will be enrolled for three years throughout three different grades. In the merdeka curriculum, SMP's achievable competencies are in phase D, where from evaluations of previous curricula, SMP's are targeted to strengthen their technological competencies including systemized and computational thinking abilities through the mandatory informatics subjects. Through the implementation of the Merdeka Curriculum, SMP's were able to score higher literacy and numerical skills compared to the previous curriculum (Wahyudin et al., 2024). According to the Regulations of the Minister of Education, Culture, Research, and Technology of the Republic of Indonesia Number 12 of 2024 concerning The Curriculum for Early Childhood Education, Primary Education, and Secondary Education, the mandatory subjects of all grades inside junior high school education are: Religious and Good Character Education, Pancasila Education, Bahasa Indonesia, Mathematics, Science Education, Social Education, English, Physical Sports and Health Education, Informatics, and lastly Arts, Culture and Crafts. SMP prepares its students with enough competencies to advance to another education level, which is senior secondary education.

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Meanwhile for senior high school education, or is often called *Sekolah Menengah Atas* (SMA) and *Sekolah Menengah Kejuruan* (SMK), is the upper level of junior high school education where students will be enrolled for three years throughout three different grades. In this level, students may pick between two high secondary education, SMA prepares students for higher education, meanwhile SMK prepares students to jump into the work industry (Sun Life Indonesia, 2024). Students' literacy over technology, financials, environmental awareness, and other learning according to interests, talents, and aspirations are strengthened in SMA/SMK. School subjects available in SMA are more or less the same with SMP, but there are more opportunities for students to deepen their understandings of previous subjects, such as science education, in which students can now separately learn physics, chemistry, and biology, and social education, which is separated into sociology, economy, history, and geography.

2.2.3 Climate Change Education

Indonesia has adopted climate change related policies inside education. Education serves as an important bridge in connecting climate change knowledge and translating them to achievable climate actions. It equips people with the understanding of climate crises while also empowering them with the knowledge, skills, values, and attitudes to become agents of change towards climate change (UNESCO, n.d.). In late 2024, Indonesian Education Standard, Curriculum, and Assessment Agency (BSKAP) released a guide for Climate Change Education (CCE) in all levels of formal education called the "Climate Change Education Implementation Guide for Educational Units and Stakeholders" (Pendidikan Perubahan Iklim: Panduan Implementasi Untuk Satuan Pendidikan dan Pemangku Kepentingan Pengarah) in late 2024, it detailed strategies teachers could adopt for CCE depending on their educational content priorities and local context of the area (Sekarwulan et al., 2024).

Figure 2.4 Cover of Climate Change Education Implementation
Guide for Educational Units and Stakeholders
Source: (Sekarwulan et al., 2024)

2.2.4 Interactive Learning

To keep up with the development of learner needs, educators and other educational higher ups in various institutions has seen the need of a new approach towards learning that increases students engagement and curiosity whilst still maintaining the core aim of education which is to equip individuals with the knowledge, skills, values, and attitudes to make informed decisions for future challenges or real-world problems. One such way that's been developed recently over the years is interactive learning. Interactive learning is defined as a process of creating new insights from the combination of newly acquired and previously obtained knowledge through "the engagement of the intellectual and psychomotor efforts" (Lukita et al., 2017). In order to create a successful interactive learning environment, the principles of interactive learning must be met, which are: (1) simultaneous interactions, where all students work at the same time, (2) equal participation, in which all students are given equal time to complete a task, (3) positive interaction, indicating that every student has a part to play for a completion of a task, and finally (4) individual responsibility, meaning each students has their own task to work on (Blyznyuk & Kachak, 2024). Interactive learning can be applied to almost

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every learning opportunity with benefits including heightened activity engagement for students, motivation growth among students, and empowering the development of critical thinking and problem solving skills.

Interactive learning is usually accomplished through the support of its tools, which is commonly called interactive learning media or interactive media. Such media can be categorized into three types: (1) Used as an element of classroom learning, such as interactive videos, (2) Used as an independent learning material, such as learning kits and (3) Used as the only medium in learning, such as educational games (Kustyarini et al., 2020). Examples of such media in Indonesia can be seen through Wirnata & Nirwansyah (2022) research on an interactive Bahasa Indonesia learning module tested in Padang, West Sumatra. To test the effectiveness of the learning module, a comparative was done with the learning process while using the learning module and not using the learning module. The results of the tests validated the module, where it was concluded appropriate and beneficial to the learning process of SDN 03 Alai Padang students.

2.3 Knowledge Partnership Platform Australia-Indonesia (KONEKSI)

Knowledge Partnership Platform Australia-Indonesia (KONEKSI) is a collaborative program grounded in the knowledge and innovation sector that supports the partnerships between Australian and Indonesia organisations. The program is operated and managed by Cowater International and backed by the Governments of Australia and Indonesia, its goal is to address the socio-economic challenges through knowledge-based solutions for inclusive and sustainable policies and technologies.

Figure 2.5 KONEKSI Logo

Source: (KONEKSI, n.d.)

KONEKSI realizes these goals through a variety of initiatives focused on the knowledge and innovation sector, such as collaborative research funding grants with the focuses of fostering new and existing partnerships to conduct exploratory research, maintaining high research standards with wide-spread application, as well as developing proof of concept, prototypes, and follow up research. Other initiatives also follow the same previously mentioned principles, such as technical assistance to address capacity gaps, knowledge dissemination and management, as well as networking and coalition building to promote solutions from KONEKSI partners (KONEKSI, n.d.).

Supporting the continuation of the KONEKSI Environment and Climate Change (ECC) Extension Support 2025-2026 grant program, a research titled "Scaling Up Policy or Technology Impact for Environment and Climate Change (ECC) in Indonesia", is now underway by a research team led by Aditya Satyagraha, S. Sn., M. Ds.. The goal of this research is to continue the GENERAKSI 2023-2024 project by expanding its implementation into an inclusive learning kit, and carrying out Training-of-Trainers (ToT) across 5 provinces including North Sumatra, Jakarta, Yogyakarta, Nusa Tenggara Timur, and North Sulawesi. The implementation of this research also involves other parties such as PREDIKT, Universitas Multimedia Nusantara (UMN), and other related parties.

2.3.1 Collaboration with PREDIKT

PREDIKT is a social enterprise aiming to educate parents and children regarding disaster preparedness through entertaining and interactive alternatives. PREDIKT missions are to: (1) creating educational materials regarding disaster preparedness that are easy to understand, child-friendly, reliable, and fun, for all ages, anytime and anywhere, (2) establish partnerships with private sector, government institutions, academics, UN agencies, non-governmental organizations, the Red Cross, as well as various networks and consortia, (3) developing effective campaigns and learning experiences through various media and mediums, and (4) conduct studies on disasters impacts on children (PREDIKT, n.d.).
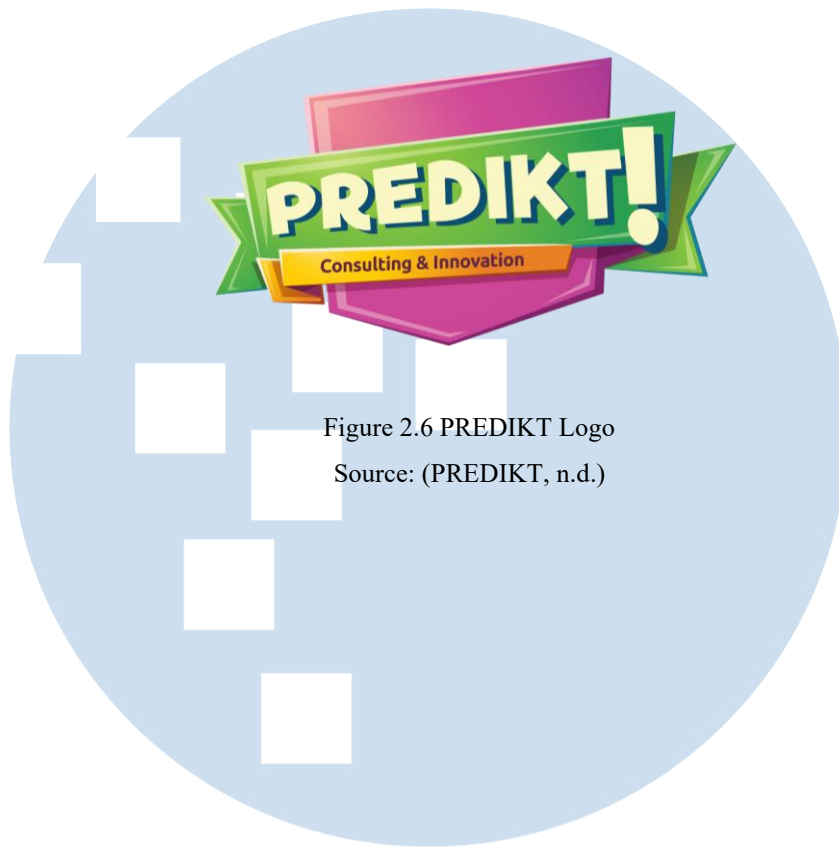
Figure 2.6 PREDIKT Logo

Source: (PREDIKT, n.d.)

Analysis of Climate…, Sherline Widjaja, Universitas Multimedia Nusantara