Sustainable Intrinsic Values, and the Values Judgments Inference Framework for Environmental Education

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Abstract: The purpose of this research is to obtain results by formalizing the process of moving toward pro-environmental attitudes and behaviors—intended to realize the sustainable values we truly must preserve—into a "value judgment reasoning framework."

The methodology involves formalizing, for the purpose of environmental education, the process of students and the public making value judgments based on value principles regarding factual judgments experienced regarding the environment, using a value judgment reasoning framework.

As a result, this study explores the process of leading to duty- and responsible pro- behaviors, mediated by ethical values as normative motivations, through pro-environmental attitudes derived from environmental ethical value judgments, in order to realize these intrinsic sustainable values.

In terms of educational implications, environmental education should be a process of realizing abstract sustainable values into concrete eco-friendly behaviors. Above all, education that allows for the experience of sustainable values must take place within science education.

Keywords: Sustainable values, Pro-attitude, Pro-behavior, Normative behaviors' motivation, Environmental education

Ⅰ. Introduction

The Value-Attitude-Behavior (VAB) model is based on the concept that the influence of values on specific behaviors is mediated by attitudes toward those behaviors (Kim & Hall, 2021). Ecological, altruistic, and economic values are identified as factors of such values. We chose ecological values because they are sustainable values.

Attitudes serve as a mediator connecting values and behaviors. A recent survey in Korea targeting the MZ generation (those in their 20s and 30s) reported that normative motivation had the greatest influence on the intention to engage in eco-friendly behavior among gain motivation, normative motivation, and hedonic motivation (Khan et al., 2023). In particular, while it is the weakest in terms of intensity, it is the most important from a collective and social perspective. Associated with strong sustainability, its effects last a long time and persist longer than stronger pleasures and motivations.

Leopold's (2003) "Land Ethics" can be described as an ecological ethical attitude stemming from normative motivation. This acts as a powerful motivation for future environmental behaviors. In other words, the pro-attitude serves as a mediator connecting sustainable values with pr-behaviors. Above all, the study by Block and Keller (1998) stated that uniform environmental education that ignores the stages of behavioral change can yield only partial effects. For effective environmental education, it is necessary to comprehensively explore the entire stages of students' behavioral change.

In accordance with this necessity, the objective of this study is to formulate the process leading to environmental attitudes and behaviors that embody the sustainable values we truly need to preserve, using the value judgment inference framework.

Specific research questions for this purpose are:

First, what are the values we truly need to preserve?

Second, what is the normative and ethical pro-attitude that it is right to possess environmental and ethical values that realize such sustainable values?

Third, how does this pro-attitude lead to pro-behavior?

Fourth, what are the criteria for judging such pro-behavior?

Fifth, what are the educational implications?

II. Backgrounds

1. Epistemic values (intrinsic values) adding aesthetic value based on the understanding of scientific knowledge

The word "epistemic" originates from the Greek word "episteme," meaning knowledge. Thus, epistemic values promote the acquisition of knowledge and truth (Steel, 2010). In contrast, non-epistemic values do not contribute to knowledge acquisition. Ethical, political, and religious values typically fall within this category. Many argue that epistemic values serve to legitimize scientific knowledge. By contrast, non-epistemic values must be handled carefully to preserve the objectivity of science. Epistemic (cognitive) values are typically defined as values characteristic of good scientific theories (McMullin, 1983, p. 18), good reasons for accepting a theory (Longino, 2008, p.74), standard criteria for evaluating a theory (Kuhn, 1977, p.3, p.322), values that constitute the goal of science in the pursuit of knowledge or truth (Ronney, 2017), values embedded in scientific reasoning (Douglas, 2009), and values acceptable in science (Douglas, 2009).

In this study, epistemic values are divided into external values that expand knowledge, such as the accuracy of experience and explanatory power of theories, and internal values that demonstrate the internal robustness of scientific theories, such as simplicity, consistency, and symmetry. These internal values add aesthetic meaning to the understanding of knowledge, which is the focus of this study.

As elucidated by Reiss and Sprenger (2014, p. 7), values can influence science in four ways, namely (i) selecting a scientific research problem, (ii) collecting information, (iii) approving an appropriate answer to a problem or scientific hypothesis based on evidence, and (iv) disseminating and applying scientific findings. Most philosophers of science agree that the role of values in science is that epistemic values must be involved in (ii) and (iii), that is, the collection of evidence and the acceptance of scientific theories.

This epistemic or aesthetic value is necessary for facilitating the formation of scientific theories aimed at truth. It acts as a strategy for collecting data based on abstraction and idealization, and for guiding inferences in the reasoning process (Douglas, 2009; Elliott & Steel, 2017). After all, abstraction and idealization, when properly understood and utilized, are common tools of scientific thinking (Oh, 2016; Oh, & Han, 2022).

Which strategies should be used in scientific thinking to construct highly abstract theories?

The real world is too complex to create a theoretical model; therefore, to understand it, we must first simplify it to extract the important laws and then validate those laws based on observations and experiments. Finally, the basic principle of how we think in science is based on the concept that when you start out in mathematics or physics, it is always better to simplify things down to the bare essentials and then pursue complexity later. First, we creatively abstracted scientific laws and theories. It has a long history of Western scientific traditions that do not exist in the East. This implies eliminating unnecessary parts in advance. This is related to the aesthetic value of the theory, that is, its simplicity and symmetry. Philosophically, this is an epistemological issue.

Science continually generates models through idealization. However, these models are theoretical and should not be conflated with reality. The model delineates the real world within a framework dictated by specific assumptions. Assuming an idealized state entails temporarily overlooking unnecessary components. Idealization does not separate us from reality; instead, it facilitates our understanding of the essence of a phenomenon and the construction of a naturally simplistic model. Idealization strategies are grounded in reality and employ quasi-idealized states that serve as boundaries between reality and the ideal world to render idealized states achievable through extreme strategies. Philosophically, this is within the ontology domain (Oh, 2016).

Specifically, Mach refers to thought experiments as idealizations or abstractions of existing physical conditions (Miller, 1996).

Recently Magnani (2012, p. 30) concluded that “like experiments in science, good thought experiments are not evanescent and fuzzy, but clear, repeatable, and sharable, in so far as it can involve unambiguous constructive representations in various human agents.”

Idealization plays a crucial role in the context of discovery by constructing a physical (idealized) world about the real world from sensory information. This involves creating new models and laws, and formulating and formalizing them. Among other objectives, scientists aim to bridge the gap between the physical and real worlds.

As a principle of continuity in scientific theories of abstraction strategy, Bohr stated in 1920 that a new theory should not only explain atomic phenomena more precisely, but should also be applicable to phenomena in general and explain previous theories of physics in the same manner. This is known as the “**correspondence principle**.” The correspondence principle is relevant to theories beyond quantum theory. For example, the mathematical framework of relativity that describes the motion of objects at very high speeds yields accurate results at low speeds.

Newtonian physics is based on the nonrelativity of time (where the speed of light $c = \infty$),

which aligns with our everyday experiences. The correspondence principle that suggests that the speed of light can be considered an infinite number of infinitesimals, demonstrates the continuity of scientific change. New theories have been developed by extending intuition and visual images using the abstraction strategy of the correspondence limit. Additionally, the underdetermination of scientific theories implies that an infinite number of theories can explain any set of data. Although this cannot be avoided, theories that incorporate certain assumptions, such as the principle of relativity, tend to prevail. McMullin, a philosopher of realism, argued that the history of science shows an essential continuity in theoretical structure, demonstrating that the progression of theories is marked by an increase in abstraction (Miller, 1996, pp. 312–315).

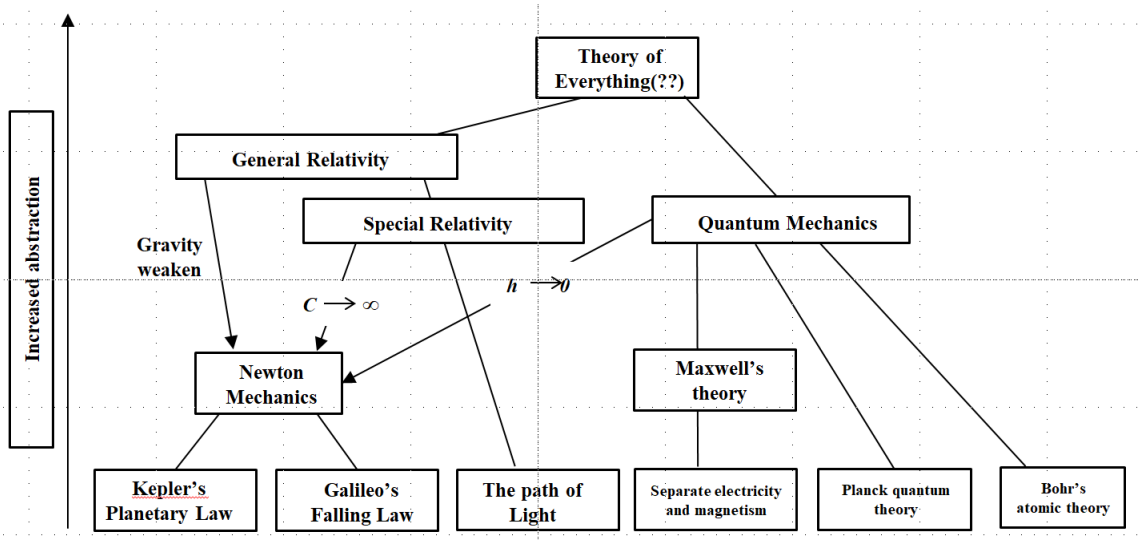

Fig. 1. Hierarchy of Physical Theories:

The upward arrows represent increasing abstraction, and the downward arrows represent the continuity of the theories, the correspondence principle

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The correspondence principle demonstrates the continuity of scientific laws, and idealization is related to this principle because it evolves from a previous concreteness to an idealized status. In contrast, abstraction is connected to the complementary principle as it directly enters the realm of mathematics rather than stemming from prior concreteness.

Bohr emphasized the importance of complementary concepts such as particles and waves. Bohr's classical quantum theory corresponds to classical Newtonian physics (as $h \rightarrow 0$), but after classical quantum theory evolved into modern quantum mechanics, the correspondence to

classical physics became limited. Thus, the complementarity principle suggests that concepts that appear opposed or contradictory should be acknowledged as intrinsic aspects of nature. Although it is possible to increase the level of abstraction from classical physics to modern quantum mechanics, the idealization that can be used to correspond to previous theories is limited.

2. Intrinsic (Inherent) and ethical values

Most importantly, science is often considered free of value. Most importantly, it is taught that science should exist beyond all values, asserting that only objective and verifiable knowledge has intrinsic worth. Science emphasizes instrumental value, suggesting that nature is valuable only when quantified mathematically, controlled by necessary variables, and utilized for human purposes.

In modern times, the natural sciences have allowed us to separate knowledge from value, replacing the pursuit of wisdom with the pleasure of endless consumption. As a result, the global ecosystem has collapsed; consequently, it is extensively recognized that something is fundamentally wrong.

Leopold (2003) drew on the scientific study of environments, particularly ecology, to develop eco-centrism and bring nature into an ethical realm. He sought to understand ecosystems as a whole, viewing the components of nature as intimately interconnected. Within the biotic community or the Earth's community, humans are perceived as ordinary members.

Callicott, a prominent American environmental ethicist, asserted that in environmental ethics, the ultimate value lies in the biological community, with the moral value of the individuals comprising it determined relative to the interests of the this community. This ecocentric position recognizes the intrinsic value of ecosystems and advocates for the protection of the entire ecosystem as a "land ethic" (Callicott, 1995, p. 58). Intrinsic value, which is the ultimate value, depends on how much it contributes to the integrity, stability, and beauty of a community.

Regarding the extent of intrinsic or inherent value, Naess asserted that "everything in an ecosystem has an equal right to self-actualization," extending from individuals to the entire ecosystem. He emphasized that self-realization and life are fundamentally one, which contrasts with the emphasis of natural science on monetary value. His argument expanded the concept of the self from an individual with an organic connection to nature to include animals, living things, and nature as a whole, extending beyond humanity (Naess, 1995, p. 3).

Therefore, it is necessary to emphasize that we are obliged to expand the scope of ethical value

judgment to nature-centered environmental ethics. This approach includes recognizing the aesthetic intrinsic value expressed through the understanding of scientific theories based on experiments, rather than adhering to the human-centered environmental ethics that gave rise to modern natural science. In doing so, we extend our ethical considerations to encompass the entire existence of nature.

A moral human actor capable of creating any natural entity or process judged to have intrinsic value should adopt a value ideology that respects all existence in the process of theory formation and experimentation. This includes demonstrating bio-empathy and affection for the Earth, its life forms, and all beings, including lesser ones, connected to it.

<Ethical obligation value judgment principles>

Value principles associated with value judgments are termed approved principles. These principles also extend to environmental and ethical values.

3. Meaning of aesthetic understanding

If the intrinsic value can be successfully objectified, then the value of possessing it becomes an “is statement” and not an “ought statement.” That is, a valid inference procedure—the goodness of something in itself → intrinsic value → obligation toward it—can be followed from the fact of judgment to the value judgment. We considered the goodness of something to be a spiritual value derived from an understanding of the beauty of an object, which is an objective attribute of intrinsic value.

Based on John Dewey's (1980) empirical and psychological aesthetic experience, a subjective, psychological, and emotional aesthetic theory emphasizing feelings was developed (Girod et al. 2003, pp. 578–579). This study considered the intrinsic goodness of nature itself, as well as a key source of Callicott’s intrinsic value, which relies on human consciousness, and the content of Dewey’s four aesthetic values as a direction for desirable attitudes in environmental ethics. These relationships are listed in Table 3.

As organisms, we interact with nature; based on the principle of continuity, we experience aesthetics based on a noncognitive emotional understanding of beauty that leads to cognitive, natural-philosophical spiritual values. This principle ultimately leads to the moralization of ethical values and human obligations toward nature.

First, our ability to understand aesthetically implies that we have the power to transform an object

into something desirable (transformative). Second, our ability to understand aesthetically means we can unite and integrate it. Third, we understand aesthetically that an event is so dramatic that we cannot help but admit it psychologically and emotionally, ultimately deeming it an ontological object of high value. Fourth, value, as something cherished in and of itself, is "not simply about the satisfaction we feel from intuitive experience but rather about the stability of the world, a type of stability derived from completed experience" (Dewey, 1916, p. 249).

Table 1 Intrinsic value (inherent value) based on aesthetic understanding of nature

Understanding emotional aesthetics (John Dewey,1980; Girod, et al. 2003, pp. 578-579)	rational mental values (Hartmann, 2017)	Intrinsic values (Inherent values)	Environment ethical values (Leopold, 2003: Callicott, 1989, p.108)	
First (1): The power to transform an object into something desirable (transformative) (Girod, et al. 2003, pp. 578-579)	Symmetry	It implies human obligations toward the object of value judgment as a function of intrinsic value (inherent value).	The power to transform desirable environmentally friendly attitudes and behaviors	
Second(2): The power to unite and integrate (Crease, 2003, pp. 13-14)	Coherence Symmetry	Coherence, Symmetry	Through the beauty of dramatic transitions	(integrity)
Third(3): Something so dramatic and dazzling that it is emotionally admirable (Crease, 2003, pp. 13-14)		Emotional, dramatic transition (increasing intrinsic value and increasing the demand for obligatory behavior)		(beauty)
Fourth(4): A kind of stability of the community of life obtained from completed experience (Dewey, 1916, p.249).	Simplicity	Simplicity	Through the beauty of dramatic transitions	(stability)

As shown in <Table 1>, understanding of the beauty of an object was 3. Specifically, the degree of intrinsic value associated with emotional dazzling was important.

1. The inherent value functions well, and moral individuals who emotionally perceive it as beautiful imply a human duty toward it, which can influence environmentally friendly and responsible attitudes.

This extends Leopold's environmental ethical values. According to Dewey's continuity principle (Figure 2), an emotional understanding of beauty implies that the cognitive aesthetic values of coherence and symmetry that unite and integrate the content of inherent value, become ethical objects that should be treated with nobility. Furthermore, based on this understanding of

beauty, the simplicity of scientific theory, which refers to the simplicity of meaning and abstraction, extends into the Universe's stability. This implies the stability of the entire ecosystem; thus, all objects can be considered ethical objects of equality (Table 3)

3. Above all, this study emphasizes a dramatic understanding of emotional beauty as a medium that connects facts and ought. Conclusively, Individual aesthetic value is ultimately human socialization.

4. Judgments of obligation for realization of values based on the correlation between values and obligations.

Moral human agents who create natural entities and processes confirmed to possess intrinsic value based on the processes of theory formulation and experimentation have a desirable value ideology. They have a duty to respect all living things around us, not only the Earth, but also the living beings that inhabit it, connected to all beings, even insignificant ones. They also love Earth and the living beings that inhabit it, and they have a duty to respect all things in our world, empathizing life (Principles of ethical duty value judgment).

The value principles linked to value judgments can be considered principles that have been approved. These principles also extend to environmental ethics.

According to Jonas, the renowned philosopher, the concept of responsibility can be broadly divided into two categories; one is responsibility as the cause for actions already performed, and the other is responsibility for actions to be performed in the future. The former is a causal responsibility, which is a prerequisite for causally connected power. Therefore, this refers to a legal rather than moral responsibility. Conversely, the latter, is "ontological responsibility," a duty that stems from human power and threats nature. It does not refer to responsibility for actions and their consequences but to responsibility for situations that raise a claim to action. In this case, because the natural world exists outside of humans—yet clearly lies within the realm of human power—responsibility for it must be assumed.

Ecological responsibility is not causal. While causal responsibility may be a prerequisite for moral responsibility, it is not a moral responsibility. Ecological responsibility is an ontological responsibility and a specialized form of moral responsibility. As all the living things are interdependent, the reality of each living thing's existence and the expectation of its continued coexistence are essential requirements (Jonas, 1984).

Ecological responsibility is not causal responsibility—which holds individuals accountable for

actions and their consequences—but ontological responsibility, which assumes responsibility for situations that raise claims to action. It refers to human obligations regarding what must be done in the future. Ecological responsibility is understood in the context of the critical questions pertaining to “for,” “to,” and “why”.

According to ecocentrism, nonhuman entities in the natural world possess intrinsic value, and responsibility is the ecological responsibility for nature and toward nature, grounded in moral reasoning.

According to anthropocentrism, only humans can be moral subjects and objects of ethical obligations; thus, responsibility implies ecological responsibility for ourselves and toward ourselves, grounded in pragmatic (or moral) reasoning.

The correlation between value and duty is the view of those who argue that value is somehow explained by duty or is reduced to duty. This argument applies to environmental ethics as well. In teleology, establishing a correlation between value and duty is easy because duty is defined as a function of the intrinsic value. Moore’s teleology (1903, p. 25) can be modified to adopt the principle, “If an action maximizes the degree of intrinsic value (inherent value) existing in nature, then the action is obligatory” (Han, 2006, p. 51).

This study, incorporating this utilitarian perspective into its teleology, adopted the principle of the correlation between value and duty: “If a human action can increase the degree of intrinsic value (inherent value) existing in nature, then that action is an ecological responsibility that is obligatory on our part as moral beings toward nature.”

Based on Leopold’s land ethics, Callicott’s ecological environmental ethics can be organized into the following argument, where the variable x represents all the members of the community of life (Han, 2006, p. 170) (revised by the author).

<Obligation behaviors of realization of intrinsic values based on the correlation between value and obligation>

If x is a member of the community of life, then x has an inherent value. Some x is a member of the community of life.

Thus,

Some x has intrinsic value.

.....

Therefore,

Some x has intrinsic value, and the moral agents in the position to bring them into existence are required to have an ethical obligation to respect x by accepting the intuition that the community of life is the community of life and that the community of life is equality and secure.

"If human action can increase the degree of intrinsic value (inherent value) existing in nature, then that action is required as an ecological responsibility that is obligatory on our part as moral beings toward nature and for nature."

Most importantly, the degree of inherent value is linked to obligation, and the degree of demand is determined by the correlation between value and obligation, which implies that value implies obligation.

Rolsten III (1994) fundamentally believed that facts and evaluations occur simultaneously. Science is constructed through experience with the self; however, what is described through this experience is not limited to facts. These values were ultimately formulated through these experiences. In other words, the facts are imbued with value. In other words, they can move from judgmental facts to value judgments through the inference process of "the goodness of something in itself → intrinsic value → obligation to it." Our study divided judgmental facts into two stages: value judgments based on the principle of value, and duty judgments based on the correlation between these values and obligations.

II. Methodology:

Construction of values judgments inference framework

1. Fundamental general framework of values judgments inference

"Value is the quality of an object under evaluation, serving as the criterion against which its merit is judged; when it is appropriately perceived by the evaluator, it signifies its worth (worthiness, goodness, or desirability)" (Lacey, 2017, p.12).

Reasoning, or inference, is the process of thinking that transitions from a given fact-judgment to a new value-judgment. Although fact and value judgments are logically distinct, they are

inevitably combined in actual intellectual activities. People often make value judgments about a fact based on some underlying value-judgment about that fact. These value-judgments are termed "value–value-dependent judgments" (Elliot, 2017), where a factual judgment is embedded with value. Value judgments are made at the top of value experiences (Hessen, 1959).

A universal value principle is a characteristic of any goal-directed endeavor. By extension, the field of evaluative thought encompasses worldviews (Hessen, 1959).

<Principle of General Value Judgments**, Foundations of value judgment**>.

if a natural entity or process x belongs to class F (the objects to be judgment).

Thus, x possesses a value V (a value term or value judgment term)

<**Factual judgment**> A specific x (the object to be evaluated) is F (the characteristic)

……

<Value judgement>Thus, any x (the object of judgment) possesses a V (value term)

In the value diagram (Fig. 2), F contains a nonvalue predicate as a characteristic, INS contains an instrumental value, and IHV contains the value-judgment terms of inherent, intrinsic, and intrinsic values. In certain instances, there may be some or complete overlap.

When presented with a fact-judgment and assigned the task to make a value-judgment, a universal value principle must link the two judgments.

Callicott (1989) suggests the prioritization of the development of intrinsic value as an intermediate step from instrumental value rather than emphasizing a priori intrinsic value, which aligns with value objectivism. This approach is preferred owing to the direct challenge of teaching intrinsic values. The intrinsic value, which is a priori and objective, acknowledges the clear separation of observer and observed, in contrast to Cartesian dualism, which does not conflict with modern quantum theory, where the observer and observed are indistinguishable.

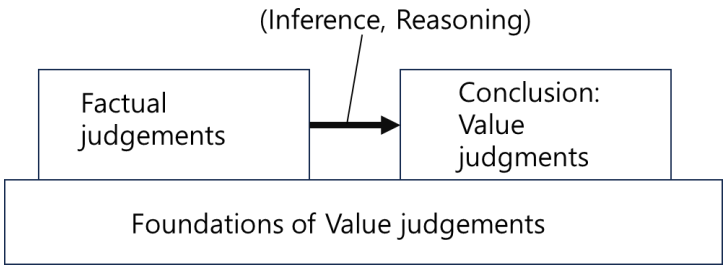


Fig. 2. A unit structure of the Value Judgement inference

Hence, in this study, instrumental value judgments, Callicott's static inherent value judgments, and the dynamic transitions occurring in the process of actual scientific experimentation are collectively termed "active intrinsic values."

Instrumental value as the framework of value judgment inference 1

When adopting the principle of value as the grand axiom (Rosen, 1978, p. 13), we employ the following value schema (adapted from Han, 2006, p. 50) (author's modification):

If some natural entity x and some x (object of judgment **categories**) of its experiential processes have properties (characteristics) that are reducible to human interest, then some x has INS (value-judgment) <instrumental value principle>.

The presence of a particular tree species growing in the mountains and the outcome of its growth process (x, object of judgment), which we primarily utilize to construct houses and produce firewood or paper (F, characteristic), are crucial for our survival <specific fact-judgment: an experience assessed as mostly true, but not a constructed experience>.

.....

Thus,

the presence of a specific species of tree growing in the mountains and the outcome of its growth process (x, the object of judgment) hold an INS for us (**special instrumental value-judgment**)

It is challenging to comprehend how any natural entity or process (x) possessing instrumental rather than INS is compelled to be respected by a moral agent in the positions of their creation,

irrespective of whether they lack biophilia or bioempathy (**ethical value judgment**).

Instrumental values are transient and diminish in impact because they pertain to immediate survival. This differs from sustainability values, which have lasting and enduring effects over time.

Ultimately, instrumental value is not a solid foundation for ethical value judgment. In environmental education, instrumental value inertia (Nam, et al., 2025) refers to excessive blind trust or obsession with INSs, which can lead to a situation where the means overwhelm the ends, or the ends are forgotten.

Nevertheless, it can be contended that the intrinsic value, which is important in this study, can be expanded to encompass ethical value judgments as follows.

Callicott was a leading proponent of non-instrumental values within environmental ethics. While acknowledging the importance of the value discourse in environmental ethics, he underscored the necessity for an environmental ethic that "must be formulated in a manner that acknowledges values beyond the instrumental for natural beings other than humans" (Callicott, 1989, p. 70).

During the formulation of his theory on the value of nature, he distinguished between non-instrumental and intrinsic values. According to him, if the value of a natural entity or process is "independent of the objective of evaluating the human mind," it possesses "intrinsic value," whereas if it is "not independent of the evaluated mind," but retains primary instrumental value along with secondary "value for its own sake," it possesses inherent value (Callicott, 1989, p. 161).

Intrinsic value is occasionally employed interchangeably with non-instrumental value. Second, intrinsic value is posited to possess objectivity detached from the concerns of the valuer (Han, 2006, p.36). Epistemic value obligations do not constitute a distinct class of obligations; instead, they align with various forms of practical obligations, including moral, non-calculative, and aesthetic obligations (Lee, 2019).

2. the framework of the environmental ethical value judgments inference realizing the intrinsic value

Inference framework of intrinsic value

If x, a nonhuman natural entity, is F (reducible to human interest but dependent on human goods), then x has inherent value (IHV, cultural value, aesthetic value, etc.) (principles of inherent value).

Some natural landscapes of nonhuman natural beings are not only reducible to our interest in them but are also dependent on our more meaningful good (factual judgment).

.....

Thus, some natural landscapes, such as those of nonhuman natural beings, have inherent values (cultural value, aesthetic value, etc.) (specialized inherent value judgment).

Let us now consider an everyday example. Imagine that we take a bus to the Science Center to see the sundial Angbuilgu on display. Our objective was to explore sundial's principles at the science museum. In this scenario, we can assert that this pursuit possesses inherent value, embodying a fundamental principle of science linked to intellectual curiosity, rather than immediate gain. Furthermore, we can acknowledge its instrumental function as it serves the purpose of a sundial, albeit with diminished practicality in contemporary times. Moreover, the bus ride to the science center serves as a means to this end, representing a distinct instrumental value. This facilitated our journey in achieving the goal of visiting a science museum. Thus, instrumental value is essential as a means to an end, which in this case, is an inherent value. However, if my goal is to go to the courthouse, then the bus to the science center becomes useless. In this situation, the means (or instrumental value) do not seem to matter as much because the important "means" that were necessary to achieve the original goal suddenly became useless.

Upon further reflection, we discerned that instrumental and intrinsic values are intertwined and mutually influential. Without instrumental value, inherent value would remain beyond reach and without inherent value, and instrumental value would lack importance. Hence, the conclusion is not that either inherent or instrumental values hold greater importance, but rather that both values interact and complement each other, culminating in a true value. Hence, from my perspective, establishing value objectivism without considering instrumental value proves challenging. Therefore, by concentrating on cultivating inherent value in education, we can realistically embrace the unique value theory within the contemporary sustainable development discourse, which cannot overlook economic considerations. Our objective is to transform an object with an existing instrumental value into one with an intrinsic value independent of instrumental considerations. However, achieving this transition through education alone is difficult. Therefore, it is prudent to focus on fostering intrinsic value when considering this intermediary step.

3. Extending aesthetic experience to ethical values and obligations

Leopold (2003) drew upon the scientific study of the environment or ecology to formulate ecocentrism by integrating questions about nature into the ethical domain. He aimed to perceive ecosystems as cohesive wholes, viewing the components of nature as intricately interconnected. Within biotic and terrestrial communities, humans are regarded as mere participants alongside other members. The ethical evaluation of individuals is contingent on their contributions to the integrity, stability, and beauty of the living community. In the realm of environmental ethics, Callicott contends that paramount value lies within the biological community, with the moral worth of its constituent individuals assessed in relation to the interests of the community as a whole. Consequently, he advocates for an ecocentric stance that acknowledges the "intrinsic value of ecosystems" and promotes the preservation of entire ecosystems through a "land ethic" (Callicott, 1995, p. 58). He describes the affection for nature as "biophilia" or "bioempathy." The appreciation of nature for its own sake by individuals possessing this bio-emotion is called inherent value (Callicott, 1989, p. 147).

As intrinsic value judgments extend to ethical value judgments, the factual judgments underlying them stem from the phenomena of experience rather than mere descriptions.

If intrinsic values hold independent of the outcomes resulting from their active application, a question arises regarding the exact meaning of these values and how they can be imparted through education.

Primarily, when Platonic ideals—that constitute the foundation of Western thought—transcend the realms of the good, true, and the beautiful, beyond nature and experience, they are perceived as transcendent. Consequently, this issue pertains to a lesser extent to what we experience and how we operate in reality.

In this research**,** we employ the term **activity inherent value** to denote the value experienced as desirable through the experimental process of refining a scientific theory, distinct from the inherent value that is inherent in the theory itself.

Foundation of judgments: Principle of general value

The principle of general values, which is evaluative thinking, is a characteristic of any goal-oriented effort. Value-evaluative reason strives toward the goal of goodness. If we expand beyond

the individual level to universality, the field of evaluative thinking can be considered a worldview field (Hessen, 1959). This is the generality and objectivity of values from a cultural perspective. We have the vital certainty that we are related to something noble, something great beyond the subjective.

From an educational perspective, those who want to make value judgments should state their viewpoints (the universal value principle); thus, if a teacher asks students to make a value judgment, the teacher should present as many universal value principles as possible.

As a fact judgment is based on the foundation for assessing activity intrinsic value, it is crucial to recognize that an activity-centered intrinsic value is shaped through human endeavors. Hence, it is not the value itself that is internalized but rather the activity that actively manifests and legitimizes it. This prioritization of "practical activity" reshapes the notion of intrinsic values from being immutable and absolute to values that continuously evolve with shifts in society and tradition. Traditional discussions on intrinsic values acknowledge the fact that the outcomes of activities are linked to certain forms of knowledge (Bernstein, 1997, p. 89). Nonetheless, it is crucial to recognize that the prevailing perspective on activity-centered intrinsic value is not static, but rather dynamic, constituting a source of meaningful change in our lives.

Instead of merely describing an actual fact as the completion of a process, fact-judgment (fact-assertion) encapsulates reality judged through active experience, incorporating both judgment and constitutive experiences.

At the stage of completing an experience or scientific experiment and recognizing the intrinsic values therein, all activities undertaken within the experience as well as its components, steps, and modalities, acquire new significance. In this context, the acknowledgment of intrinsic value arises from the discovery of fresh meanings and values acquired through experiential processes (Kwak, et al., 2022, pp. 36–37). This distinct feature of the intrinsic value experienced during the culmination of a process sets it apart from pure intrinsic value; hence, it is termed activity-centered intrinsic value.

According to Dewey's argument (Kook, 2022), traditional intrinsic values exist before the object of valuation. This pertains to Plato's ideal world rather than the tangible realm. In contrast, active intrinsic values diverge in that they are not objectively present in the world, but are experienced through experimentation.

Traditional valuation theory tends to isolate desires and interests from the contextual milieus. However, Dewey's theory of value commences with propositions concerning the wants and

interests that emerge in specific circumstances. Empirically grounded propositions about needs and interests serve as the basis of valuation as they can be substantiated through experience (Kook, 2022, p. 111). When a valuation proposition addresses a lack, need, or conflict necessitating a choice, it stems from physical propositions based on empirical observations as they originate from desires and interests. Nonetheless, what sets valuation propositions apart from physical ones is their consideration of the means–ends relationship.

In our research, we concluded that propositions formulated during experimental activities, encompassing both the ends and means derived from the needs and interests underlying values, materialized as empirical experiences—judgmental facts throughout the experiment. These assertions serve as the foundation for subsequent value judgments.

To align with the objectives of our study, we have adapted the teaching strategy of analysis of values outlined in the book entitled "Values Education: Rationale, Strategies and Procedures" by Metcalf(1971). The following modifications were implemented to tailor this approach to a scientific experimental activity that holds importance within the context of the history of science, rather than being solely directed at students:

The process commences with exploration, where the value concern is identified and elucidated. When faced with a problem pertaining to a valued aspect, the necessity and interest in resolving it act as motivating factors for engaging in experimental activities. These experiments were conducted to accomplish objectives that have importance.

The empirical data collection and reasoning phase of scientific experimentation involves gathering facts and making claims. The experiment began with a physical premise and implicitly embedded values within it. Throughout the experiment, which was conducted using various experimental tools to reach the desired goal, these values gradually became more systematized as the experiences were reorganized in the process of transition.

Valuations (fact-claims) and value judgments (value-claims) are extended to include ethical values. The outcome is an experiential event described as a fact claim that is subsequently affirmed by value claims. While fact-claims contribute to provisional value assessment, value determination is not solely dependent on factual evidence. The value principle undergoes scrutiny and adjustments based on the factual judgment collected to assess whether the implied value principle in the provisional assessment is acceptable or not. Only then is the final value judgment made, as historical scientific experiments encapsulate the prevailing worldviews or value

principles of that time.

Indeed, this process is not absolute, but dynamic, evolving as values become increasingly defined based on scientific experimentation. The transition from desirable intrinsic values to noble and valuable ethical values necessitates practical activities.

In practice, value ideologies are implicit and difficult to manifest; they are expressed in the direction and qualitative nature of value experience as they undergo refinement.

Among other considerations, the principle of active inherent value comprises two premises that underline the ethical implications of an environmental crisis.

a) **The first premise** concerns aesthetic scientific evidence derived from active experience. However, this experience alone does not dictate our course of action; we require an additional premise.
b) **The second premise** is normative, necessitating a judgment about what is valuable and ethically appropriate (Moore, & Nelson, 2013). The combination of both premises, rather than just one or the other, constitutes the active inherent value principle.

Our proposed active inherent value principle encompasses a second premise, namely the following ethical principle.

We underscore what Callicott (1989) identified as the unifying principle of ecocentric environmental ethics–the acknowledgment of the inherent value of natural entities.

An action is deemed appropriate when it upholds the integrity, stability, and beauty of the biotic community; if it undermines these qualities, it is considered inappropriate (p. 108).

Hence, we structure the principle of **active inherent value** bolstered by two supplementary premises and experiential elements (Oh, 2016, Oh, 2024):

Framework of value judgments inference 2

This research broadly consists of the value judgment inference framework classified into third phases. The first phase consists of a stage where a value judgment is made on a given fact based on value principles. The second phase, based on the correlation between these values and obligations, requires behaviors based on the judgment of human obligation toward nature, the

objects of judgment. and third phase is judgments of Social System's Pro-environmental behaviors choices

The First Phase,

Value judgments for factual judgments toward realization of these values (Fig.2)

<Foundation of judgments>

If the empirical formulations and theories of science, alongside their entire developmental process **(the object of value judgment),** are observed to manifest experientially a transition toward properties like depth, simplicity, clarity, and inevitability **(direction of value experience and characteristics of the aesthetic value of scientific theories), and** these experiential properties are not only beyond mere human utility but also contribute to the preciousness, stability, and beauty of the biotic community **(Leopold's characteristic of environmental ethical inherent value),**

then, the theory and the entirety of one's experiential process **(the object of judgment)** possess environmental ethical values **toward the realization of** their active inherent values (environmental ethical value as an extension of Callicott's inherent value).

<Factual Judgments>

(And) any individual scientific theory and its formation process (object of value judgment) have an inner beauty that experiences a transition (from comparative to superlative, from simplicity (asymmetry to symmetry) and clarity (from diversity to a single archetype)) (Crease, 2003, pp. 13–14) that is not related to usefulness <any special judgment-fact is required>. The type and attitude of the behavior of a moral being who has experienced this individualistic intrinsic value (extending the object) is formed in the direction of life that contributes to the integrity, stability and beauty of the entire life community that includes such individual object <any special judgment-fact based environmental attitude>.

<Value Judgments>

<special environmental ethical value judgment>

(Thus),

it is ethically appropriate that not only the empirical formula and theory of a certain science based

on the value ideal at that time (value ideal), but also the type and attitude of the behavior of a moral being (extending the object)—who experienced the aesthetic intrinsic value in the process of forming the completion (including the object of the special value judgment and the type of action and attitude)—have the environmental ethical value of the entire living being beyond the individual active intrinsic value.

Regarding value experiences, the principle of active intrinsic value as examined in Callicott's ecocentric environmental ethics extends to the following ethical values; given that the principle of active intrinsic value encompasses an ethical dimension, it is further extended to include ethical value by adding the following ethical obligation conditions:
Ultimately, the question of value validity expands to include ethical and moral issues by using factual and value judgments. This concept has expanded to moral ontological issues.

Maloney, Ward, & Braucht (1975) suggested that the relationship between humanity and the environment is a very important issue and that ecological behavior is crucial for improving environmental problems. Therefore, it is necessary to pay attention to the eco-friendly attitude that forms the basis of such ecological behavior. Eco-friendly attitude is defined as the beliefs, emotions, and behavioral intentions that an individual holds regarding environment-related activities or topics (Qader & Zainuddin, 2011), or refers to a psychological tendency that expresses the degree of liking or disliking of the natural environment (Milfont & Duckitt, 2010). Environmental intention or environmental attitude serves as a mediating variable connecting sustainable values and eco-friendly behavior.

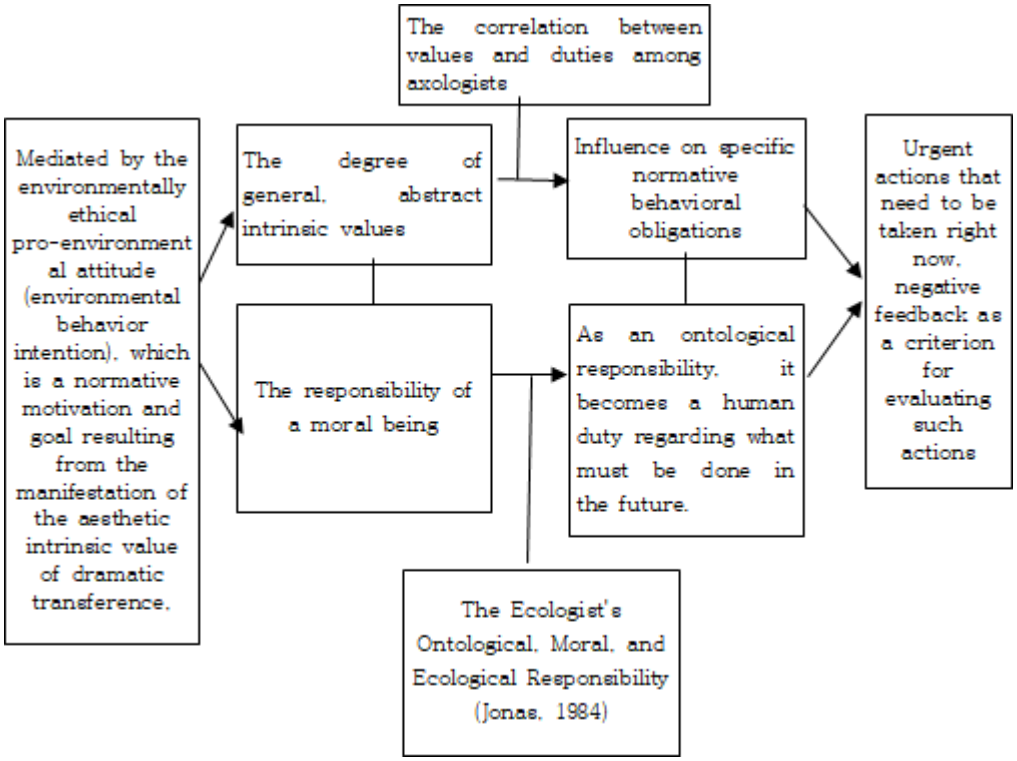
The Second Phase,

Obligation judgment on value judgment objects based on the correlation between value and duty (Fig.3)

In Figure 3, generally speaking, according to the correlation between values and duties for axologists, the degree of value influences behaviors as a concrete duty. The intrinsic values manifested in the Nature, demonstrates a strong degree of emotional values. Therefore, it influences the duty of practical action, demanding immediate pro-behaviors beyond mere attitude.

The ecological responsibility of an ecologist is based on the fact that, practically speaking, everything in this world is interconnected; thus, a moral being bears an ontological responsibility

toward nature to preserve it. As a result, one engages in pro-behaviors out of an immediate duty to preserve nature.



Fig, 3. Correlation between Value and Obligation regarding Intrinsic Value, and Ontological Responsibility

In the correlation between value and duty—based on the axiologist's view that values contain obligations—and environmental behavior as a duty to realize intrinsic values, and in the ecologist's view that all beings in this world are interconnected, thus entailing ontological responsibility for future events, moral beings possessing an ethical attitude are strongly called upon to engage in pro-environmental behavior as an immediate duty and responsibility. In fact, a recent survey conducted in Korea targeting the MZ generation (those in their 20s and 30s) reports that normative motivation had the greatest influence on the intention to engage in eco-friendly behavior among gain motivation, normative motivation, and hedonic motivation (Khan et al. 2023). The study by Van Riper & Kyle (2014) applied the Value-Belief-Norm (VBN) model to visitors of national parks along the southern coast of California. The results showed that normative and ecological values had a positive influence on Pro-behavior.

Therefore,

a moral agent, positioned to influence any natural entity or process judged to possess intrinsic value, adopts the desirable value ideology of being obligated to respect all that surrounds us with a sense of affection or bio-empathy for the Earth and its inhabitants. This includes the life forms existing therein, in recognition of their interconnectedness, even extending to the seemingly insignificant shadows. Moreover, by comprehending our responsibilities toward the future, we ensure our survival in this world **(ethical obligation judgment).**

The appreciation of the beauty and wonder inherent in the world compels us to take action. In the hypothetical scenario of transitioning from an old scientific theory to a new one, in which the world is dazzled by its simplicity, symmetry, and consistency, how should we respond? If we hold reverence for a world governed by these laws, it becomes imperative to nurture and safeguard it diligently. Moreover, by comprehending our responsibilities toward the future, we ensure our survival in this world (Moore, & Nelson, 2013).

The ideal value is the basis of a worldview and can be said to be deeply embedded metaphysically. The value system can also be said to have resulted from this phenomenon. For example, in the strong determinism of Newtonian mechanics, value is placed on the clarity that only one result should produce, rather than various results. However, in the weak determinism of probability theory in evolutionary theory and quantum mechanics, it can be said that weight is placed on the stability that produces various results rather than this type of clarity. In other words, in the experience of completion, value is loaded differently, depending on the ideal value. This can be considered as a produced judgment. Therefore, as shown in Figure 3, the ideal value was used as the basis for environmental behavior. This judgment and aesthetic value are then combined to create a unique principle of value. The loaded aesthetic value is expressed through the clarification of the completion process. In this study, this is referred to as the individualistic, active, and unique value principles. This is because environmental theories cannot be developed using actual facts alone.

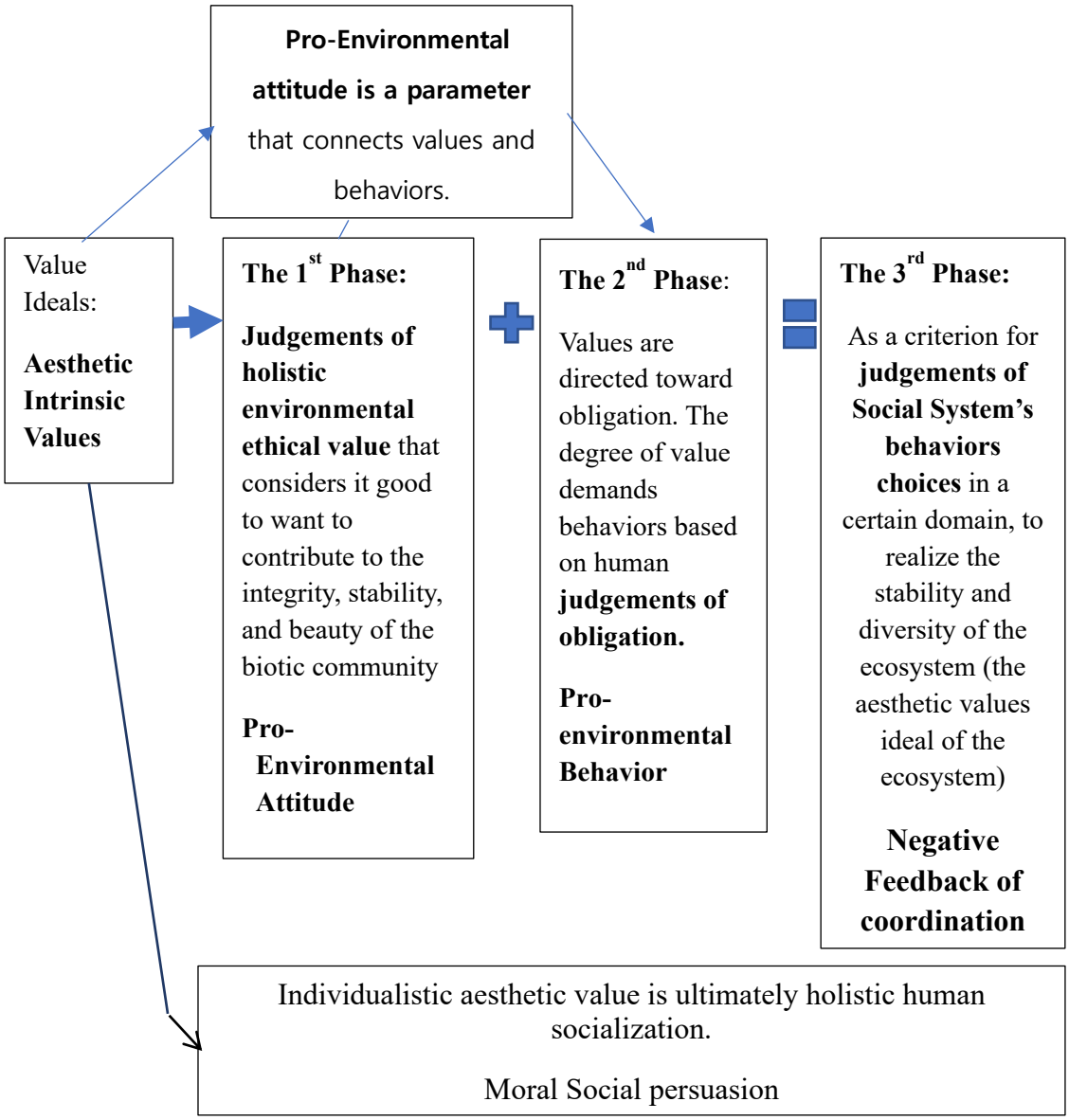


Fig. 4. Aesthetic values are an extension of ethics for human socialization, and feedbacks **of coordination** is the standard for judging behavior based on **Framework of value judgments inference 3**

It cannot be guaranteed that only the unique values loaded on public and individualistic facts will induce human attitude changes toward the natural environment. Therefore, diachronic and holistic environmental ethics are required. Only by expanding the natural environment into the domain of normative environmental ethics can induce human attitude changes toward it. It is not a statement of facts but an attitude toward facts.

The overall inference process for the value judgments inference framework 3 is shown in Fig. 2. The “Value inference framework 1” is difficult to expand to the overall environmental ethical value because it includes all the values, and the “Value inference framework 2” is difficult to translate into environmentally friendly behavior because it includes fixed and passive intrinsic values. Conversely, the “Value inference framework 3” that we proposed includes dynamic and active aesthetic values; thus, it goes beyond environmentally friendly attitudes and leads to behavior. If we fully understand our future ontological obligations, we can survive in this world.

The Third Phase

judgments of Social System’s Pro-environmental **behaviors choices (Fig.4)**

According to Dryzek (1987), the list of evaluation criteria for social choice structures now consists of five items: negative feedback, integrated regulation, robustness, flexibility, and elasticity. However, robustness and flexibility are interchangeable, while elasticity is secondary. Therefore, only negative feedback and integrated regulation are necessary conditions for ecological rationality. Unless there is a fundamental imbalance requiring elasticity, adding robustness and flexibility to these two becomes a sufficient condition.

Therefore, in this research, "**negative feedback of coordination**" can be considered one of the criteria for judging obligatory behavior in the important social choice structure of obligation-driven behaviors.

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V. Discussion and conclusion

Based on the formulation of a value judgment inference framework that reconstructs the Value-Attitude-Behavior (VAB) flow, this study yields the following results.

First, sustainable values can be defined as the aesthetic intrinsic value of scientific theories and the natural environment to which they are applied, rather than temporary gratification values. Such aesthetic intrinsic values, unlike temporary instrumental values, can be considered sustainable values.

Second, Leopold's Land Ethics involves realizing and extending these intrinsic values into a form of normative ethical value. Consequently, a desirable pro-environmental attitude imbued with

these normative and ecological motives leads to subsequent obligatory and responsible pro-environmental behavior. Conversely, motives for profit and hedonic desires struggle to sustain sustainability. In other words, this environmental attitude serves as a mediating variable connecting sustainable values and environmental behavior.

Third, ultimately, there is a need to reinforce the environment with aesthetic intrinsic values as sustainable values. This is because they directly and strongly influence ethical environmental attitudes, particularly environmental behavior. Fourth, the core of this study is that these intrinsic values are not fixed and unchanging a priori intrinsic values, but rather active intrinsic values that manifest as dramatic transferences during the application of theory.

Therefore, this study argues that environmental education should be conducted within the science curriculum. This is because these active intrinsic values are realized during the experimental process of science classroom instruction.

A limitation of this study is that, as it focused on the formulation of value judgment reasoning schemas, it was not grounded in actual data from scientific experiments suitable for practical education. Therefore, follow-up research is necessary.

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