

# Innovation and extension of the active intrinsic value principle through the Galileo inertial discovery process for education

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**Abstract:** Aims of this study clarify the intrinsic value of Galileo's law of inertia, which holds significance in the history of science, and the process through which such law of inertia was formed, for educational purposes, and explores a possible conversion of this intrinsic value into an environmental ethical value. The research methodology is to establish a value schema and, through its application, to explore the changes in the active intrinsic value principle of Galileo's law of inertia based on the history of science. This study derived the following results: First, Galileo professed the value he assigned and discovered as a complete experience to support heliocentrism. Second, he realized his personal religious ideal, or in other words, the ideal of life as a whole. Third, the overall process is to feel a comprehensive and integral expansion of the self. Above all, it shows that the principle of active intrinsic value based on Galileo's experimental activities has changed and expanded throughout the history of science. One internalizes one's faith in accordance with the activity-centered value. Only when combined with aesthetic experience does education make one ethical. As general school education does not necessarily guarantee ethics, we must lead our values education toward ecocentric ethics education, which highlights beauty. It shows that these active intrinsic values also extend to ethical values.

**Keywords:** Galileo; law of inertia; intrinsic value based on activity; values education; ecocentric ethics education

## 1. Introduction

Peters states that the central features of education can be roughly organized as follows: First, as a condition of knowledge, the understanding of a broad and deep knowledge with intellectual discernment; second, as a criterion of value, the achievement of a desirable state of mind characterized by appropriate emotions and attitudes corresponding to it; and third, as a procedural requirement, this is done carefully in a way that does not infringe on the learner's consciousness and spontaneity (Hamm, 1991). There is a vast literature on the role of creativity, passion, aesthetics, and art in the lives and research of scientists, which corresponds to the second condition of value (Poincaré, 1946; Tauber, 1997; Wechsler, 1978). Scientists often refer to these characteristics as the motivating force that drives their research, calling their work beautiful and artistic. The recognition of the beauty inherent in the idea of science itself and in the process of discovering such scientific ideas inevitably draws scientists to that research.

Rather than instrumental values that form the basis for creating a sustainable society and nature, education that helps internally transfer intrinsic values should take

priority. The attitude toward life that values sustainability (the integrity, stability, and beauty of the natural ecosystem) naturally follows when such wisdom is cultivated (Lee and Oh, 2024). Such science education should be based on scientific experiments and be an education that expresses the dignity of the name.

“What exactly is science education, and what is the true purpose of science education?” is the most fundamental and ongoing question in science education and educational philosophy. Furthermore, “should we love and preserve nature?” is an important question in environmental education. What is commonly suggested here is that nature has an intrinsic value. John Dewey stated that the beauty of science is that it is reinterpreted continually by reorganizing experience. By clarifying the intrinsic value of the thought experiment process of Galileo, who holds significance in the history of science, this study addresses how to connect the former with the latter.

In deep ecology, self-realization and life-centered equality are adopted as the ultimate norms, and by this, all organisms and existences in the ecosystem have intrinsic value as interrelated parts (Han, 2006). In the process of transferring the meaning of scientific theory based on the active experimental process, epistemic values such as simplicity, consistency, and necessity are expressed as aesthetic values, epistemic values in the scientific theory and its formation process (Crease, 2004). This sometimes includes instrumental values that function as a means to satisfy human understanding interests or preferred experiences, but it is mainly dependent on human consciousness, but it is the aesthetic value of scientific theory as an intrinsic value in itself. The value expressed in this process is called active intrinsic value (Park, 2023). In other words, it is necessary to pay attention to active intrinsic value obtained through the experience of the active experimental process rather than the fixed and unchanging a priori intrinsic value that is traditionally unrelated to our experience.

Recent studies by Lee and Oh (2024) and the aesthetic aspect (Park, 2023) have studied active intrinsic values as (activity-centered) intrinsic values, but they did not cover the continuous history of science. It can be said that value research needs to explore continuous changes. Therefore, the purpose of this study is to clarify the intrinsic value inherent in all things during the formation process of Galileo’s law of inertia, and to explore the possibility of converting that intrinsic value into environmental ethical values.

Above all, most importantly, Galileo tackled a problem with Copernican heliocentrism. This study explores the scientific activity of clarifying and expanding the activity intrinsic value during Galileo’s discovery of the law of inertia, that is, his demonstration that justifies Earth is in motion even though we, the people on Earth, do not feel it, which is much more difficult to answer than the view that Earth is round empirically supported by Aristotle in ancient Greece. For The aims of this research purpose, the following concrete research questions were set.

First, since value research requires making correct value judgments, what is the value diagram of such a process?

Secondly, in the application part, above all, it is the solution to Aristotle’s argument that the Earth cannot move, especially the argument of the tower that the Earth cannot rotate. What kind of intrinsic value was changed and clarified through this process of supporting Galileo’s inertia? Next, does inertia have (practical) intrinsic value in the whole of nature as stability and beauty, and can such intrinsic value

eventually be expanded into ethical value? Finally, the biggest problem was the stability of the sun-centered solar system that Galileo tried hard to ignore. What intrinsic value principle did Newton propose to solve this problem?

Thirdly, what is the educational Implications?

## **2. Theoretical background**

In this chapter, we explore the theoretical background according to such intrinsic values, and in the next chapter, we establish a schema that can apply it as a research method.

The intrinsic value is a recognized value, and to say that an object is intrinsically valuable is to say that it has its own good. Furthermore, something instrumentally good has value in and of itself without depending on other external factors or judgments, not simply because of its use (DesJardins, 2013). In general, our experience regarding nature is aesthetic, and in this context, nature is considered to have value in and of itself, that is, intrinsic value, regardless of its use.

It is an intrinsically valuable experience, similar to the one gained when we view an artwork (Hargrove, 1989). One may argue that natural objects should be preserved because they have inherent value and are vivid and intriguing.

### **2.1. Intrinsic value**

Depending on whether judgment simply describes facts or signifies the speaker's active intentions, the former is called factual judgment and the latter is referred to as value judgment (Kim, 2007).

With factual judgment, we can determine whether "the rose is red" is true or not by investigating experimental facts. Meanwhile, with value judgment, we cannot determine whether "that rose (the object of evaluation) is pretty (the evaluative term)" using experimental facts. We need to use evaluative reasoning to examine the justification of such a value judgment. Ultimately, through ethical reflection, we identify the logic of value judgment, that is "evaluative reasoning".

Such values are categorized into instrumental and non-instrumental values. Non-instrumental values are used to distinguish between the entity of the object and the process of the formation of the entity. Traditionally, the values are divided into the intrinsic value, which emphasizes the entity of the object itself, and the activity-centered intrinsic value, which highlights the process of its formation, not just the entity of the object.

Furthermore, as it is difficult to educate someone directly from instrumental to intrinsic values in values education, the former are weakened and the latter are strengthened during the process as an intermediate step, where theoretical entities are formed among other values, to which we assign meaning.

The purpose of the traditional intrinsic value is extrinsic in nature. However, it is premised on Dewey's critique of educational theories that have growth as an end in itself for the intrinsic value. Dewey maintains that traditional metaphysics, which assumes a permanent and unchanging purpose, such as the idea, is not unlike modern metaphysics, which deems the order of nature as objectively determined (Dewey, 1940).

Typical attributes of active intrinsic value.

If, as the object of value judgment, a complete experience itself (emphasizing existence and the formation process of that existence, being active) has (intrinsic value attribute) that is completed with depth (from comparative to superlative, from finite to infinite), simplicity (from asymmetry to symmetry) and clarity (from diversity to a single prototype) rather than reduction to human usefulness, then the object of value judgment has activity-centered intrinsic value.

This study combines the traditional intrinsic value with the contemporary scientific perspective to view the process of our changing mind as we interact with nature as the intrinsic value of the process of activity. Thus, both the beginning and end of an experience must be considered.

## **2.2. Values clarification**

Proposed by Rathes et al. (1978), the process of values clarification is that of internalizing values by clarifying one's confused values and living consistently with the clarified values.

The process of values clarification comprises three steps: Choosing, respecting, and acting on the value (Jeong and Jo, 1993).

First, choosing the value involves carefully selecting a value among other alternatives.

Second, respecting the value involves professing one's chosen value.

Third, acting on the value involves professing something and putting it into action.

This research assigns or discovers the activity-centered intrinsic value through Galileo's thought experiment. By doing so, he resolves the tower argument through the ship experiment and professes Heliocentrism. Based on such value, he internalizes his faith. In other words, he dedicates himself to self-actualization while trying to understand God's intentions inherent in nature.

## **2.3. Aesthetic perspectives shown by the laws of physics: Intrinsic value judgment in scientific theory**

The word "epistemic" comes from the Greek word "epistemic", meaning knowledge (Steel, 2010). Thus, epistemic values are those that literally have the property of promoting the acquisition of knowledge or truth. Non-epistemic values, on the other hand, do not have the property of promoting the acquisition of knowledge. Ethical, political, and religious values typically fall into this category. Many argue that epistemic values serve as a legitimation of scientific knowledge. On the other hand, non-epistemic values must be handled with care so as not to harm the objectivity of science. Epistemic values are typically defined as follows: Values that are characteristics of good scientific theories (McMullin, 1983), good reasons for accepting a theory (Longino, 2008), standard criteria for evaluating a theory (Kuhn, 1977), values that are comprised of managing the goals of science in pursuit of knowledge or truth (Ronney, 2017), values included in scientific reasoning (Douglas, 2009), and values that can be accepted in science (Douglas, 2016).

In this research, rather than external values that expand knowledge, such as the accuracy of experience and the explanatory power of the theory, we mainly deal with scientific intrinsic values that show the internal solidity of scientific theories, such as the simplicity, consistency, and symmetry of the theory, and the aesthetic meaning according to the reflective understanding of scientific theories.

The two cases of ethics and philosophy of science are not unrelated. In science, the selection of a hypothesis presupposes an epistemic value, and the terms related to this value, such as ‘coherent’, ‘simple’, and ‘beautiful’, function similarly to ‘thick ethical concepts’ (Putnam, 2004).

Ultimately, it can be said that the epistemic values related to beauty are an important cause of ethical value judgments.

In general, symmetry refers to something that is in harmony and balance. Symmetry refers to the appearance of different parts consistently integrated into one. Therefore, beauty is closely related to symmetry. Hence, among other perceptual values, symmetry is a characteristic that shows the beauty of scientific theory through an understanding of the theory through its intrinsic properties.

### **Intrinsic robustness of scientific theory, a characteristic showing the beauty of the theory through its intrinsic properties**

Symmetry evokes great aesthetic emotions. Since ancient Greece, we have been interested in symmetrical objects in nature, including completely symmetrical spheres like planets and the Sun or symmetrical crystals in snow.

However, the symmetry discussed herein is that of the laws of physics themselves, not that of objects in nature. The way scientists feel about the laws of science is very akin to how we feel about the symmetry of objects, which is why it is called the symmetry of the laws of physics.

An object is defined as symmetrical if it looks the same as before even after conversion. In this sense, it makes no difference, or the result remains unchanged even if the laws of science or the methods by which they are applied are converted in some way (Feynman, 1965).

The simplest example of this symmetry of the laws of science is the translational symmetry of spatial motion, which means that the methods of applying the laws of science within the inertial system remain unchanged even though the whole experimental system is moved from one place to another at the same speed.

Simplicity and coherence are also closely related. The criteria of simplicity are closely related to coherence as it must be determined against the background of other theories (Hess, 1997). A theory is considered simpler and more elegant if it explains a wider range of phenomena with fewer logically possible premises.

The discovery of any signal faster than light would require a fundamental revision to mechanics, thermodynamics, atomic physics, cosmology, and other fields. The argument for light is deeply and strictly entrenched in the structure of theoretical descriptions about nature. This leads to an inevitable outcome (Kosso, 2009). Inevitability is a type of coherence. We may understand inevitability as something non-empirical, which is derived from connections in the theoretical system. More observations lead to more knowledge, but not necessarily a greater understanding (Kosso, 1992).

For example, one important difference exists between Bode's law and the principle of the absoluteness of light velocity. While many things come down to the combination of space and time, and mass-energy equivalence under the principle of the absoluteness of light velocity, there are few connections under Bode's law. Not only does it suggest the importance of coherence between theories in terms of epistemic values, but it also indicates the internal and aesthetic characteristics of a theory that can be gained through a greater understanding of theories.

Many philosophers, from Plato to Heidegger, stress that aesthetics goes beyond beauty and reveals what is true and good. The value that can be had during the activity-centered process of a transition to depth (from the comparative to the superlative and from the finite to the infinite) and to simplicity (from non-symmetry to symmetry) and clarity (from diversity to single origin) (Crease, 2003) with an experiment or activity-centered process itself resulting in the formation of scientific laws or theories is used as the principle of the intrinsic value of the activity-centered process.

A process has the activity-centered intrinsic value if it is not only irreducible to human utility but also contributes to the stability and beauty of the community of living beings (Han, 2006).

In the process of forming a law or theory, it is expressed when there is a transition from depth (from comparative to superlative, from finite to infinite), simplicity (from asymmetry to symmetry), and clarity (from diversity to a single prototype), which is an attribute of the active intrinsic value of scientific theory in this study.

### **3. Methodology of research**

When an ethical or value principle is assumed as the premise underlying a certain justification (Rosen, 1978), we can have the following value schema (Han, 2006): It is evaluative reasoning represented as a conditional proposition [Modus ponens].

When we are given a fact-judgment and are asked to make a value-judgment about it, a universal value principle that connects the two judgments must be presented. In other words, we present factual grounds (factual judgments that support the value judgment) and normative grounds (criteria or value principles) that can justify our thoughts about something, which is a value judgment. Arguing a value judgment by presenting such grounds is called evaluative reasoning.

The universal or general value-principle, which is an evaluative reasoning, is a characteristic of a goal-oriented effort. This evaluative reasoning is a reasoning that strives for the good as a goal. If it is expanded beyond the individual level to universality, the field of evaluative reasoning can be called the worldview field (Hessen, 1959).

It is the generality and objectivity of values in cultural terms. We have a living certainty that we are related to something noble, great, and great beyond the subjective. In terms of education, those who want to make value judgments should clearly state their perspectives (universal value-principles), and if teachers ask students to make value judgments, such teachers should present possible universal value-principles (Jeong and Jo, 1993). It can be said to be a universal and common value principle, but it is possible for teachers or students' value principles to change as they newly expand to possible universality. This content is important in our research.

## **Value schema**

If some natural existence or the  $x$  (objects of value judgment, theoretical entities, and the process of completing the theory) of the cognitive process is  $F$  (predicate of judgment), then some  $x$  has  $V$ . <Universal principle of value judgment>.

Any  $x$  is  $F$ . [Special factual judgment].

Therefore, any  $x$  has  $V$ . [Special value judgment].

Usually, the object of evaluation is inserted into  $x$  in the value schema, the predicate of evaluation into  $F$ , and either instrumental or intrinsic value into  $INS$ . Nonetheless, when the process (experience) is emphasized, the activity-centered intrinsic value is used as the intrinsic value.

In this research. In extension, when emphasizing the process (experience), it is called an active (or activity-centered) intrinsic value. In practice, this factual claim is combined with the value claim. However, the attribute of intrinsic value means the worldview of scientific theory, so it has changed and appeared and appeared again according to the history of science, but it is the basis of Western scientific thought.

However, the properties of the principle of intrinsic value change and reappear in the history of science because they mean the worldview of scientific theory, and they form the flow of Western scientific thought in particular. We explore the changes in the characteristics of these intrinsic values. These intrinsic values are expressed as the aesthetic value of the theory in contrast to the extrinsic value, which is an instrumental value, and this is expanded to an ethical value. However, in the study, these values are weighted differently depending on the history of science applied in the next chapter.

## **4. Application: Changing values owing to the transition to Heliocentrism**

Authors deals with the process of formalizing Galileo's law of inertia, which treats experiments as important in the history of science (Oh, 2016), because it considers that the inherent value expressed in the experimental process is involved. Above all, it is because the value principle according to the change in the world view of the history of science is revolutionary or expanded within the same world view.

### **4.1. Focus on the stability of the universe by the hierarchy of places:**

#### **Aristotle's Geocentrism**

(Aristotle) While the planets are in constant circular motion and composed of a fifth element called aether in the heavens, objects on Earth consist of four elements that have the tendency to maintain order by going to their original place and stopping (maintaining the stability of the geocentric universe). In other words, it focuses on the tendency of objects to stop on Earth.

The stability of the geocentric system means that it has the overall hierarchy in which other planets maintain their original positions around stationary Earth.

[Aristotle's Teleological Explanation, Why?]

If the metaphysical truth that all things under the spherical surface of the moon are composed of four qualitatively different elements is correct, and all things have different elements and densities, then the complete process of movement toward their own natural place, proper place (Trusted, 1991) (objects of value judgment); is not a

reduction to human usefulness, but rather a complete experience itself (being and the process of forming that being) centered on activity, a transition to depth (from comparative to superlative, simplicity (from asymmetry to symmetry) and clarity (from diversity to one archetype) (attributes of value), the process has an activity intrinsic value (a teleological active value judgment principle that gives meaning as a metaphysical principle).

The more you reach your own proper position, the more harmonious, beautiful, and beautiful the world becomes. In other words, it can be said to be completed as a circle with symmetry. In ancient Greece, going to infinity was reluctant because it was a safety issue.

A terrestrial apple is made up of mostly flesh and water. [Specific factual judgment].

Therefore, the apple falls toward the ground, where the place of its intrinsic water content is. [Specific teleological intrinsic value judgment].

The celestial Moon and planets are made of aether, the fifth element. [Specific factual judgment].

Therefore, the celestial Moon and planets made of aether are in constant circular motion in their intrinsic aether position in the heavens. [Specific teleological intrinsic value judgment].

This teleological value judgment cannot make inevitable predictions based on facts from accurate experiments in the past; however, it is replaced by science based on the causal value judgment of Galileo and Newton.

#### **4.2. Heliocentrism, which states that Earth is in motion, required a new stability (Oh, 2016)**

Instead of Stability by Stationary Earth under Geocentrism (Teleological Explanation).

The problem arises with the previous teleological, organismic explanation that there is some sort of hierarchy between places with Earth at the center. Heliocentrism highlights that there is no special place and Earth is in motion, and therefore, it is problematic to say there is a hierarchy between places with Earth at the center.

Galileo was a strict Platonist, who wanted to mathematically explore the principles of an object's motion to understand God's intentions, not reasons for the stability of the new universe (solar system). Ultimately, owing to stability in Heliocentrism, we should wait for Newton.

[Galileo's Kinematic Explanation, How?] Expanding the intrinsic value of nature by reorganizing data.

The law of vertical motion on the ground, the acceleration of falling.

If all things on the ground are made of the same material (substance) made of atoms, then the process of discovering the law of falling, which has the same acceleration regardless of mass, is a complete experience itself (existence and the process of forming that existence) (as an object of value judgment, a claim of fact), and rather than reducing it to human usefulness, the process of transition has an intrinsic value centered on activity, with depth (from comparative to superlative, from finite to infinite), simplicity (from asymmetry to symmetry) and clarity (from diversity



to a single circle) (Crease, 2003). <The principle of intrinsic value as a metaphysical principle of a mathematical quantitative world based on atomism>.

Galileo's law of falling is directed to the superlative, with a single acceleration, as a single circle, and as a symmetry as a rule that appears anywhere on the ground. However, due to the influence of Aristotle in Greece, it has a universe limited to circular inertia.

The souls are removed from all matter other than humans, and it is made of the same particles called atoms. [Factual judgment].

Therefore, if there is no air resistance, all objects made of atoms fall at the same acceleration (single origin) regardless of mass. [Intrinsic value judgment].

[Focus on how an object moves rather than why].

Aristotle's natural motion is cited as the reason for motion.

Formalization and Expansion of the Law of Inertia from the Ground to the Horizontal Direction:

The aesthetic intrinsic values of inertia, such as eternity and symmetry, are continuously expanded by reorganizing experience. The process is to realize the activity-centered intrinsic value. Furthermore, it is to realize the purpose of our life as a whole.

Step 1: Assigning meaning to nature as an abstraction strategy.

(Galileo) If the frictional forces that prevent horizontal motion on Earth were removed, all objects have the properties to continue to move as they do in the heavens.

[Assigning the meaning of the purpose of continuity to nature based on metaphysical principles].

Step 2: Idealization and thought experiment.

From the world of common-sense experience (Aristotle's world) to an idealized world.

If all things on earth are made of the same material (substance) made of atoms, then the process of discovering the law of fall of all objects with the same acceleration regardless of their mass,

rather than reducing it to human usefulness, as a complete experience itself (existence and the process of forming that existence), with depth (from comparative to superlative, from finite to infinite), simplicity (from asymmetry to symmetry), and clarity (from diversity to one archetype) (Crease, 2003).

That transition process has intrinsic value centered on activity (Extended Active Intrinsic Value Principle).

The thought experiment that makes this contact surface increasingly smooth is empirically possible. [Factual judgment].

Therefore, it is possible that all objects have the inertia that keeps them in motion on an idealized surface. [New intrinsic value judgment].

Step 3: Predictive experiment about a possible real-world phenomenon (hypothesis-deduction).

From (idealized world) to (empirical world). (Expanding the intrinsic value by reorganizing experience).

Experimental prediction:

If it is true that all objects moving on a horizontal plane have frictional forces on the plane as the only cause of the object's motion, and if the contact surface becomes

increasingly smoother, the object's movement distance and movement time become longer, and eventually the object continues to move with infinite movement distance and movement time, the discovery process of inertia (the object of value judgment).

Specifically, the transition process has active intrinsic value. (The extended active intrinsic value principle that gives and discovers the meaning of the transition from finite space to infinite space, from finite time to eternal time, from the diversity of physical laws to one law of inertia, from the asymmetry to the symmetry of the physical law of circular inertia) (attributes of value).

Such processes have active intrinsic value. (Extended Active Intrinsic Value Principle)

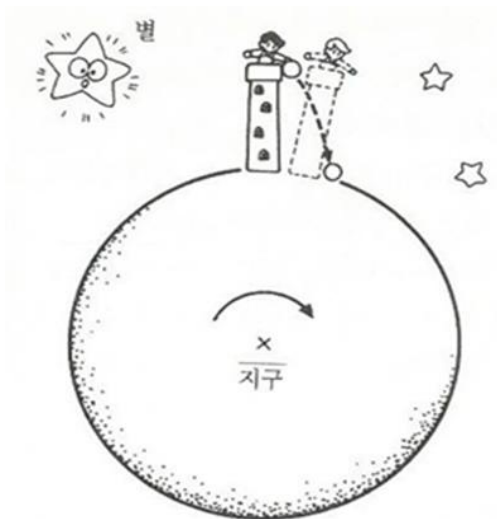
Experimental results: Albeit approximate, it falls right under the mast. (Factual judgment)

Conclusions: Therefore, the hypothesis that a moving object in a horizontal plane, such as Earth's surface, continues to be in motion without applying any force to cause the motion is correct.

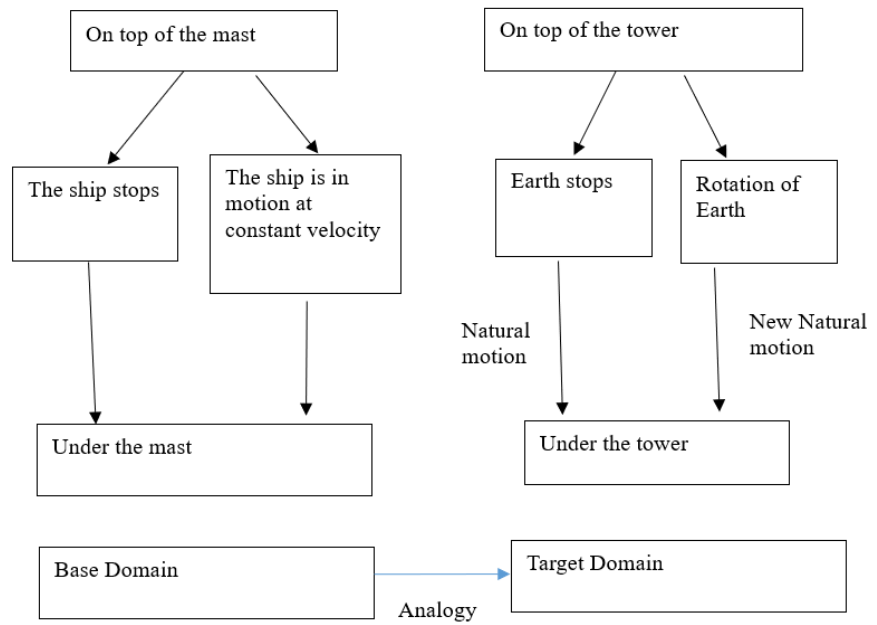
(Clarifying a new intrinsic value as a justification of meaning).

For Aristotle, there are two natural motions. While celestial bodies are in continuous circular motion in the heavens, made up of the fifth element, objects move in a straight line in an up and down motion depending on their composition and density on Earth, made up of four elements. However, Galileo added natural motion on Earth via circular inertia, where horizontal components on Earth's surface follow the rounded shape of its surface in a circular orbit, in accordance with God's will, that is, his metaphysical truth that circular motion in the heavens also occurs on Earth (Trusted, 1991). This circular inertia was used to support Copernican heliocentrism that Earth's rotation could not be felt on Earth.

According to **Figures 1 and 2**, an object free falling from a tower on Earth has the linear velocity of Earth's rotation, and therefore, the observer on Earth cannot distinguish its motion in terms of what velocity Earth's rotation has. More notably, even if the Earth rotates, we cannot know it. The process is explained with an analogy to the motion of a ship.



**Figure 1.** Counterargument to the tower argument.



**Figure 2.** Galileo’s principle of relativity: Space (place) is relative, and there is no special place.

### 4.3. Newton modifying and expanding Galileo’s circular inertia

Using an idealization strategy in which all forces, not just gravity and friction, acting on any object are eliminated, Galileo’s circular inertia to support the Earth’s motion was expressed as linear inertia. In other words, Newton’s first law, the law of inertia, can be said to be a theoretical world that extends the idealized world. The process of discovering the property that all objects with mass have the common essence of inertia is rather than reducing it to human utility, the process of transitioning from a complete experience itself (existence and the process of forming that existence) to depth (from finite to infinite linear inertia), simplicity (from asymmetry to symmetry, the same in any direction) and clarity (from diversity to one circular inertia) has an active intrinsic value (The newly expanded active intrinsic value principle).

In fact, there is a problem with Galileo’s circular inertia owing to his obsession with circular motion. However, we on the surface of Earth may observe the inertial system that is in motion at approximately constant velocity if we adopt a shorter timeframe. In other words, the principle of inertia generalizes from a stationary state in Geocentrism to a constant velocity in Heliocentrism. For the law of force and acceleration, Newton’s second law, there must be an external force acting on an object. Once this external force is removed, of course, only inertia remains. Newton’s first law, the law of inertia, is not a part of the second law. Instead, inertia is inherent in all objects with a mass. Therefore, the first and second laws are independent from each other.

In addition, objects moving at a constant velocity in a straight line require a force to change their velocity, a force that was not in Galileo’s ideal world. In other words, the distinction between the ideal world and our empirical world was erased, and the world was integrated with mathematics, which was Pythagoras’s and Plato’s ideal.

In particular, the principle of inertia directly demonstrates the homogeneity of space and the uniformity of time, which are shown in Heliocentrism where the Earth

is in motion, instead of Geocentrism where it is stationary, and it means that the principles or laws of nature are established in any part of time or space at any time and anywhere.

#### **4.4. Einstein expanding Galileo-Newton's principle of relativity to the entire universe**

The process of discovering that the laws of physics apply equally to observers in any inertial frame moving at a constant speed in a straight line is not reduced to human utility, but to a complete experience itself (existence and the process of forming that existence).

The transition process to depth (from comparative to superlative, the same phenomenon in an inertial frame), simplicity (from asymmetry to symmetry, the same physical laws apply in an inertial frame), and clarity (from diversity to one archetype, the same physical laws apply in an inertial frame) (Crease, 2003) has an intrinsic value centered on activity. (New expanded intrinsic value judgment).

Approximately, the same laws of physics are established for all planets, regardless of their motion. It is the perfect Newtonian completion of Copernican Heliocentrism, which states that there is no special planet in the solar system, including Earth. Einstein expanded on it and stated that there is not only no special place but also no center in the universe.

Instead of Aristotle's Geocentrism, where there is a hierarchy of places with Earth at the center, Galileo-Newton's principle of relativity states that in Heliocentrism, there is no special place as places are generalized, and therefore, natural phenomena are observed equally and natural laws apply equally anywhere.

This principle of inertia extends straight from Galileo to Newton to Einstein.

### **5. Values education shifting from (activity-oriented) intrinsic value judgment to ethical value judgment**

If the thought experiment process of the formation of inertia of an object sliding on a horizontal plane is completed in an idealized state where many influencing factors are eliminated, from the normally finite distance over which the object moves to an infinite distance, from various distances to a single infinite circle, it has an active intrinsic value (Principle of general active Intrinsic Value).

Certain non-human natural inertia and its formation process transfer to the stability and beauty of the community of living beings in the solar system, which cannot be reducible to human interests (Special factual judgment).

Thus, inertia, a natural existence, and its formation process have the activity-centered intrinsic value (Special activity intrinsic value judgment).

If the inertia and its formation process that may be inherent in an object cannot be reduced to human understanding interests, and only contribute to the integration or completeness, stability, and beauty that express the health of the human mind and independent living community (F, Leopold Ethical Value Characteristics), (then) inertia and its formation process have ethical value by expanding the intrinsic value <universal and ethical value principle> (Callicott, 1989) (Shifting to the value judgment of ethical obligations, and acting on the intrinsic value as the process of clarifying a single intrinsic value).

Therefore, the intrinsic value produced by activity centrism is eventually extended to environmental ethical values.

It would be possible to remove spatial anthropocentrism, or the belief that humans are spatially at the center of Earth and the universe based on instrumental anthropocentrism, rather than the intrinsic value.

Copernican Heliocentrism, which placed the Sun at the spatial center of the universe, was no longer questioned instead of the geocentric astronomical view of the universe, which humans undoubtedly believed to be objectively true before the modern period. Moreover, the contemporary theory of relativity states that there is no special place in the universe.

It all comes down to an ecocentric worldview as the only alternative to an instrumental, anthropocentric worldview. Ecocentrism places the intrinsic value of the ecosystem itself at the center of all values as the totality of a complementarily intertwined web of relationships between all kinds of life, not humans as an individual species.

To discuss the environment from an ecological philosophical horizon, it inevitably gives rise to the ethical question of respecting and preserving its living beings, that is, nature.

Expanding the activity-centered intrinsic value to ethical obligations: Evaluative reasoning should be identified with value judgment about environmental ethics. Inertia inherent in nature, including all of us, means that we cannot ignore it.

Hence, as nature as a whole has aesthetic inertia as the intrinsic value, we, as moral agents, have the environmental ethical value that we should treat and preserve nature with care.

## **6. Discussion and interpretation**

With the creative characteristics of Galileo's laws of mechanics and the clarification and expansion of the intrinsic value of the law of inertia.

The formation process of Galileo's laws of mechanics can be said to be the process of clarification and expansion of active intrinsic value. Through the evolution process of this principle of intrinsic value, we obtain the following results.

Through Galileo's thought experiment and actual experiment of inertia, as a recent study on the aesthetic aspect (Park, 2023), as (activity-centered) intrinsic value, through continuous reorganization of experience.

First, as a complete experience, it showed the clarification and expansion of the value he chose by progressing to support the theory of the other-centered theory.

Second, through the process of clarification of this value, it is the realization of Galileo's personal religious ideal, that is, the ideal of his entire life.

Third, above all, this entire process allows us to feel the expansion of a comprehensive and integrated self. According to such values, we internalize our religious life. In other words, we strive for self-realization while understanding God's intentions in nature.

Creative Characteristic of Galileo's Laws of Mechanics and Clarification and Expansion of the Intrinsic Value of the Law of Inertia.

## **7. Conclusions and implications for education**

### **7.1. Conclusions**

First, the reason Aristotle was not able to use his imagination to make the same leap as Newton's or Galileo's mechanics is not because he "disregarded the facts" as critics in the 17th century claimed. Rather, it is more about his desire to be extremely faithful to the facts. For example, Aristotle did not recognize that some aspects of common sense should be discounted to create a complete theory of motion (abstraction and idealization), which is an important reason Aristotelian physics did not develop further into modern science (Gottlieb, 2000).

Second, compared to Kepler's celestial mechanics, Galileo needed reasoning to remove frictional forces to consider frictionless motion on Earth. In particular, the intrinsic value of inertia continues to be expanded and clarified through the reorganization of experience. Through the completion of individual steps and the whole process, we develop the activity-oriented intrinsic value. Galileo's aesthetic goal (Park, 2023) was to support Heliocentrism by reorganizing one complete experience, and he had a religious experience of finding God's intentions for the universe, which was the goal of life as a whole. In other words, it was to realize the value of life as a whole.

As a limitation with realizing this value, he could not propose the law of universal gravitation required to explain the causality of a new stability in the solar system, and we had to wait for Newton. For Galileo, it was difficult to fully realize his ideal. For us, overcoming these limitations becomes learning and experience.

### **7.2. Implications for education**

Only when combined with experience about beauty can education make one moral. General school education does not necessarily guarantee ethics (Fischer, 2007); however, we must lead our values education from human-centric instrumental values education to ecocentric ethics education.

As an implication of physical education, it can be said that education that helps us internally transfer our own values rather than instrumental values that are the basis for creating a sustainable society and nature should be given priority. In the present, physics education should focus on living a life that values sustainability (the integrity, stability, and beauty of the natural ecosystem) rather than justifying knowledge, and knowledge will naturally follow when such a mindset is cultivated. Above all, it is emphasized again that environmental education, which cannot be ignored in the present age, should be implemented in physics education. It is emphasized that such physics education should be implemented based on scientific experiments and that it should be a physics education that expresses its dignity

Value education, which is the foundation for creating a sustainable society and nature, should prioritize education that helps intrinsic values to be internally transferred rather than instrumental values. The attitude of living a life that values sustainability naturally follows when such a feeling is cultivated. In particular, the possibility of environmental education through value education in science education was explored. In addition, value education in elementary science education is more

important than anything else. This is because secondary education is an education that prioritizes knowledge education over values. Our understanding and appreciation of the beauty and wonder of the world urge us to act. If the world is beautiful and awe-inspiring as it is, we cannot treat it carelessly in this world.

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