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# Mathematics Education as a Humanities Form of Education — A Brief Introduction to the History of the Philosophy of Mathematics Education[1]

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Mathematics holds a key position among many subjects of school education. Besides having an instrumental value, mathematics for the general public has been underestimated.

Thus, in this paper we examine how western educational theorists have emphasized the value of mathematics as humanities form of education. First of all, we discuss Platonism as a philosophical basis of the ancient Greek mathematics education. Next, we examine the thoughts of Froebel, who provided the theoretical basis for the public education since 19th century, and discuss the value of mathematics teaching in their humanistic educational thoughts. Also, we examine the humanistic value of mathematics education in Dewey's educational philosophy, which criticized the traditional western ethics and epistemology, and established instrumentalism.

In this paper, we recognize the humanistic values of mathematics education through the historical examination of the philosophies of mathematics education.

## I. INTRODUCTION

Mathematics holds a key position among the subject matters of school education. Besides having an instrumental value, mathematics for the general public has been underestimated. For the past fifty years, Korea has had neither enough systematic (and in-depth) examination nor discussion concerning the goals of mathematics education in order to establish the philosophy of mathematics education.

Thus, in this paper, we will discuss how mathematics education can contribute to a

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humanities education. For this, we will examine how western educational theorists have emphasized the value of mathematics as a humanities form of education.

Grant (1993) suggested that the history of mathematics, in relation to mathematics philosophy, had three-culture career. He said as follows:

> For most of Western cultural history, mathematics enjoyed a unique image, and a consequent prestige. Those perceptions were shaped, for centuries to come, by the achievement and outlook of ancient Greece, which saw in mathematics both a particular insight into the substance of "reality" and an unparalleled certainty of reasoning and conclusions. In the 6th and 17th centuries the founders of modern science fused with this classic legacy the further conviction of the enormous potential of mathematics for the description and control of the sensible world of our everyday experience. · · · In the last two centuries this pre-eminence of mathematics has been threatened by internal developments (non-Euclidean geometry, Goedel's "incompleteness" theorem) that have cast grave doubt on its claims to unshakable sureness and absolute truth. (Grant, 1993, p. 21)

In light of the above-mentioned history of mathematics, we will discuss Platonism as a philosophical basis of the traditional mathematics teaching. This has been concerned with teaching Euclid's "Elements" since ancient Greece. And we will discuss the relationship between mathematics and a humanities form of education in the context of traditional thought.

Next, we will examine the thoughts of Froebel who provided the theoretical basis for the public education since the 19th century and reflected the viewpoint of the early modern philosophy of mathematics. Further, we will discuss the value of mathematics teaching in their humanistic educational thoughts. Also, we will examine the humanistic value of mathematics education in Dewey's educational philosophy, which criticized the traditional western ethics and epistemology, and established instrumentalism.

## II. PLATO AND ANCIENT GREEK MATHEMATICS EDUCATION

Plato, having determined the aims, had proceeded to consider the scope of higher education. He had concluded the theory of numbers (or arithmetic), geometry, astronomy and the theory of music (or harmonies) as all preparatory to the highest of the sciences, namely, dialectic. Rusk (1979) summarized the Plato's educational theory as follows:

> The aim of higher education in Plato's philosophy of education is not a mere extension of knowledge; it is, in Plato's phrase the conversion of a soul from study of the sensible world to contemplation of real existence. Then, if I am right, certain professors of education must be wrong when they say that they can put knowledge into the soul which was not there before, like sight into blind eyes. Whereas, our argument shows that the power and capacity of learning exist in the soul already; and that just as the eyes was unable to turn from darkness to light without the whole body, so too the instrument of knowledge can only by the movement of the whole soul be turned from the world of becoming into that of being,

> and learn by degrees to endure the sight of being, and of the brightest and best of being, or in other words, of the good.
> Such is the aim of the higher education, the education of philosopher or ruler. Plato, having determined the aims, next proceeds to consider the scope of higher education. It concludes number or arithmetic, geometry, astronomy, theory of music or harmonies, all preparatory to the highest of the sciences, namely, dialectic. Thought mathematics to metaphysics' might be said to sum up Plato's scheme of higher education. (Rusk, 1979, p. 21)

As the theory of numbers is the first subject, so geometry is the second, these subjects had been selected for inclusion in the curriculum of the higher education. For the Plato's viewpoint of mathematics, Rusk commented as follows:

> As number is the first subject, so geometry is the second, selected for inclusion in the curriculum of the higher education. Its bearing on strategy is acknowledged, but what Plato is concerned about is whether it tends in any degree to make easier the vision of the idea of good. This, he believes, geometry does accomplish;
>
> 'geometry will draw the soul towards truth, and create the spirit of philosophy',
>
> consequently those who are to be the rulers of the ideal state must be directed to apply themselves to the study of geometry. (Rusk, 1979, p. 23)

The educational value of mathematics in ancient Greek education is written in Proclus's commentary as follows:

> The "Timaeus" calls mathematical knowledge the way of education, since it has the same relation to knowledge of all things, or first philosophy, as education has to virtue. Education prepares the sole for a complete (life through firmly grounded habits, and mathematics makes ready our understanding and our mental version for turning towards that upper world. Thus Socrates in the "Republic" rightly says that, when the "eye of soul" is blinded and corrupted by other concerns, mathematics alone can revive and awaken the soul again to a vision of being, can turn her from images to realities and from darkness to the light of intellect, can (in short) release her from the cave, where she is held prisoners by matter and by the concerns incidents to generation, so that she may aspire to the bodiless and partless being. (Steiner, 1988, p. 8)

Steiner summarized the role of books like the "Elements" in classical Greek education as follows:

> First, they can be used as a reference text for an introduction to hypothetic-deductive analysis as the specific method of dialectic philosophy.
> Second, according to their axiomatic organization of knowledge, they represent the best way of explaining that mathematical truth is eternal in nature and independent of empirical and sensual experiences, given that the basics concepts and axioms have been evidenced as possessing these properties.
> Third, insight into mathematical truth will best prepare the mind for understanding the world of ideas (comparing Truth, Beauty and Goodness), which is the utmost goal of higher education. (Steiner, 1988, p. 8)

## III. MATHEMATICS EDUCATION IN FROEBEL'S THEORY

In this section, in order to explain how mathematics education can contribute to humanities form of education, we will investigate which position mathematics occupies in Froebel (1887), in which he suggested the educational value of mathematics as follows:

> Education without mathematics (at least without a thorough knowledge of numbers, supplemented by occasional instruction in form and magnitude) is, therefore, weak, imperfect patchwork; it interposes insuperable limits to the normal culture and development of man. · · · for the mind and mathematics are as inseparable as the soul and religion. (Froebel, 1887, p. 208)

Froebel's educational theory is based on the concept of the "Divine Unity", which is relevant to the notion of 'The Absolute' of Fichte, Schelling and Hegel. He claims that from inanimate objects to human beings, all is subject to the eternal law, which is presided by god. So, the world itself is the representation of this law of the "Divine Unity" and education consists in leading man to a conscious and free representation of it.

The revealing process of the inner law of the "Divine Unity" can be attained through the awareness of the divinity, which resides in the self. And this process of self-consciousness is a dialectical movement of the two opposites, i.e., 'inner' and 'outer'. Froebel suggests that mathematics is the mediator between the inner and outer world, i.e., he suggests that since both human beings and nature are the representations of the "Divine Unity", mathematics is both the pure human spirits and the law of nature.

For the above-mentioned character of Mathematics, he said,

> As phenomenon of both the inner and outer world, mathematics belongs equally to man and natural. Mathematics, as proceeding from a priori laws of thought, as the visible expression of thought and its law, finds the phenomena, combinations, and forms logically deduced from these laws, again in the outer world independently established. (Froebel, 1987, p. 204)

Having such a role, mathematics becomes the main discipline in education. Though there are some criticisms on Froebel's educational thoughts on mathematics discussed in this paper, it can provide a typical answer to the question about how mathematics education contributes to the humanities form of education.

## IV. MATHEMATICS EDUCATION AND MORAL EDUCATION IN DEWEY'S EDUCATIONAL THEORY

While Dewey criticized the traditional western ethics and epistemology, he treated the problem of the separation of learning from activity, and hence from morals. And he suggested as follows:

> Both of these separations are overcome in an educational scheme where learning is the accomplishment of continuous activities or occupations that have a social aim and utilize the materials of typical social situations. For under such conditions, the school becomes itself a form of social life, a miniature community and one in close interaction with other modes of associated experience beyond school walls. All education that develops power to share effectively in social is moral. It forms a character, which not only does the particular deed socially necessary but one, which is interested in that continuous readjustment which is essential to growth. Interest in learning from all the contacts of life is the essential moral interest. (Dewey, 1916, p. 418)

What is learned (and employed) in an occupation having an aim, and involving cooperation with others is moral knowledge. For the relationship of learning and moral education, he said as follows:

> What is learned and employed in an occupation having an aim and involving cooperation with other is moral knowledge, whether consciously so regarded or not. For it builds up a social interest and confers the intelligence needed to make that interest effective in practice. Just because the studies of curriculum represent standard factors in social life, they are organs of initiation into social values. As mere school studies, their acquisition has only a technical worth. Acquired under conditions where their social significance is realized, they feed moral interest and develop moral insight. (Dewey, 1916, p. 414)

In this way, he denied the intrinsic value of mathematics education, which is separate to other subjects and human life. However, he maintained that mathematics education, 'having an aim and involving cooperation with other' is moral education.

## V. REMARK

We surveyed the brief history of the philosophy (focusing on Plato, Freobel and Dewey) of the mathematics education; the philosophies from ancient Greece to modern times. There must be good reason that mathematics has been the main subject of education since the ancient Greeks. It is necessary to research this reason more deeply and to try to realize that value of mathematics education in the present time.

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