

Development of Mathematics Education and Guidance to Improve the Educational Effect

1. Introduction

Mathematics education has made the transition from acquiring mathematical skill to utilizing mathematics for educational purposes. We need to acknowledge that certain things can be taught only by using mathematics. Mathematics for educational purposes utilizes necessary portions of mathematics. I will call this “mathematics for education”. This is the foundation of researching or specialized mathematics that are necessary for mathematicians although they are significantly different.

2. Objective of Mathematics Education

Mathematics is the universal intellectual property for people all over the world. It is the intellectual foundation of the modern civilization and doesn't belong to only a group of specialists. We must thoroughly recognize this concept in order to engage in mathematics education. The worldwide challenge in the 21st century is to “search for security and comfort”. Mathematics education is needed in order to resolve the challenge.

3. What is Mathematical Ability That Secures “Security and Comfort”?

Mathematical ability to ensure lifelong security is “ability to exchange information”, which is essential to the “search for security and comfort”. The universal ability in the 21st century world is the “ability to exchange information”. Mathematics education is required to develop this survival ability.

4. Perspectives to Develop the Ability of Information Exchange

In order to develop the “ability to exchange information” for the “search for security and comfort”, it is necessary to understand keywords such as “relationship”, “location”, “comparison” and “choice”. By building favorable relationship, verifying location, making comparisons or choices, we can build a safe society and develop an environment that promises lifelong security.

5. Mathematics Education from a Perspective of “Relationship”

We can find many examples of mathematics education by analyzing the relationship between human beings and all matters.

(1) Relationship between Human Beings and Roads

The road connects cities and serves as traffic routes, which creates issues of distance and time to travel. Describing location and direction of cities on two-dimensional plans or maps can become issues. Considering the traffic problems, we can also find tasks of mathematics education such as speed of automobiles, or transportation logistics.

(2) Relationship between Human Beings and Food

The amount of drink and food is an important issue according to the stages of human growth. Many types of substances exist in water, of which relationship creates issues of the thickness, mass and weight. The content of impurities becomes a safety issue not only for human beings but also for other animals and plants. The relationship between rain and temperature can create problems of crop yields, which also affects the worldwide population issue.

(3) Relationship between Human Beings, Technology and Society

The technological development made global regulations and agreements essential. For instance, we need advanced logical understanding and persuasion to secure relationships with patents or trademarks that claim the intellectual property right, or global treaties or international standard that ensure international economic activities. This becomes the foundation to build a global safe society. Each individual needs to make efforts to learn mathematics in order to secure lifelong safety and comfort.

We must make sure that our children learn basic mathematic activity between the age of three and six. This basic activity is the minimum requirement for survival, which includes counting, measuring, comparing and describing. One cannot become well off in the modern society without the ability of counting to ten. It is also important to understand units; many of which are essential elements that establish global relations.

6. Mathematics Education from a Perspective of “Location”

Our location becomes a reference point to find out other locations. Once the reference point is established, it is possible to find other locations and changes of various matters as time advances.

(1) Space and Location

It is necessary to acquire techniques to find out locations on straight lines or in two-dimensional space. After understanding the technique, it is important to acquire the skills of pointing out locations of actual matters and guessing/determining the directions. The space is in various shapes and changes significantly depending on where we look at it from.

(2) From Location to Coordinate and Vector

The origin of rectangular coordinates is a reference point that shows each location on two-dimension. A point on a coordinate shows the direction and distance from the origin, which eventually develops into the concept of position vector.

(3) Social Status, Value and Valuation of Individuals

If you are a student, your school work is evaluated. Evaluation is inevitable as long as we are engaged in social activities. The economical reward is established according to social status of each individual. Our position in terms of relationship with society is revealed in various ways.

The geographic location of your house can create an issue of flooding according to the water level of the river. How we relate to politics, religion or law affects our status and future security and comfort. How we relate to our children and parents affects our future. Our current position in society is addressed as our issues.

7. Mathematics Education from a Perspective of “Comparison”

We can find differences by comparing objects, humans, animals and shapes. We can acquire the ability to find commonality of various objects once we understand their differences.

(1) Finding Differences Visually

Different shapes and movements is a matter of visual judgment. Comparison between a square and rectangle is to visually recognize the difference in vertical and horizontal lengths. The difference between males and females in appearance and emotion can be detected by their facial expressions and movements.

(2) Finding Differences Aurally

Each sound and voice has its own characteristics. The calling of white-eyes and sparrows sounds differently. If we look at an actual bird and hear it sing, we will be able to tell which bird is singing even if it is out of our sight.

We can also guess the movement of sound source by the state of sound, which can be high, low, loud or soft. The body sensory of Doppler Effect is one of the examples.

(3) Unifying different Objects

A task to find commonality in different objects begins with comparison. By accepting different cultures and exchanging information, we will discover and cultivate the characteristics of each culture, which will create a safe world as a result.

The ability to compare is the ability to survive, and also the fundamental ability to establish a safe world. The objective of mathematics education is to develop this fundamental ability of human beings.

We try to compare many types of similar objects based on the experience we have gained in our life. Comparing similar objects is an activity to find their differences. If they are found to be different after the examination, we will try to discover similarities. For instance, when we say, “There are four oranges”, we have, because of their similarity, characterized them as a group of four. Let’s say there are oranges in two boxes. If the conclusion of the examination is “Oranges are in the boxes”, no distinction was made. However, by using number, we can say, “There are three oranges in one box and seven in the other”. Thus, we have given them distinction and bring the examination to an end.

Is there uniformity in religions? Can we program democracy in robots? The mathematics education must be able to assist us when the time comes to consider these issues.

8. Mathematics Education from a Perspective of “Choice”

Mathematics is used to educate us. The health issue is stressed more when we age. It is desirable to have freedom of choice regardless of age.

(1) Choice and Probability

We have an issue to consider whether we will have an environment that will let us have freedom of choice when we age. When we choose our life, we question ourselves if it is achievable. Once chosen, we are responsible for our own choices. Choice is, in one sense, probability.

(2) Choices in Daily Life

People are constantly making choices everyday. “Should I take airplane or railroad when I travel?” “What time should I meet this person?” We are always forced to make decisions. We make decisions as we predict our future in daily life. Choice is also an issue of prediction.

(3) Choice to Acquire Security and Comfort

We can ensure the safety of our house against earthquakes and typhoons with good design structure and materials. It is also an economic issue because we need to work within a set budget. Many choices are made when building a house. It is necessary to exchange sufficient information between a party that orders a house and a party that designs/builds the house. After the former tells their favorable conveniences to the latter in a competent manner, he will design a plan that reflects the optimal conditions that meet the needs.

In order to design cities and towns and ensure the security, predictable measures before and after disasters need to be chosen by grappling with a budget.

Predicted risks and its countermeasures always depend on which choices to be made.

9. Lifelong Learning and Mathematics for Learning

People go to school for up to twenty years. If we lived up to eighty, the time to learn through experiences after we start working would be significantly longer. If lifelong learning of mathematics is “mathematics for learning”, we can assume that “mathematics for education” is the foundation of “mathematics for learning”.

If someone continues to learn something that interests him throughout his life, how knowledgeable will he become? Furthermore, if there are many other people like him in the world and they exchange information with each other, how much would their knowledge expand? If people continue to learn throughout their entire lives, they would become intelligent individuals who will be conscious about their health and have lifelong comfortable lives. I believe that countries where those intelligent individuals reside will have strong economic power and easily attain a safe society. Therefore, I conclude that each country should set an educational goal to make mathematics as lifelong learning. The ultimate goal of mathematics for education is lifelong learning.

If the entire nation is intelligent and healthy, for instance, cost of welfare can be drastically decreased. This is, needless to say, a very fortunate thing for everyone. Since children grow up in an environment where adults are always willing to learn, their learning habit will be formed naturally even if they don't go to school.

We must work steadily in order to establish lifelong learning so that we can attain such society. It can take a hundred years to achieve the goal. If, after a hundred years, such society is ever achieved, it will be the best country in the world.

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