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TO ENRICH THE SCHOOL MATHEMATICS IN PRIMARY OR SECONDARY SCHOOL

IKUTARO MORIKAWA
FACULTY OF EDUCATION YAMAGATA UNIVERSITY

INTRODUCTION

Once, I have inquired my students of the following things;

1) Where can we find isosceles triangles ?

2) What geometrical properties do they have ?

As for the question (1), each of them pointed out several concrete cases; While concerning (2), only about 30% of them could identify the correspondent properties to each case. Surely, they were familiar with abstract properties of isosceles triangles. But it seems that they did not have any chance to describe them with reference to their concrete properties or to observe many applicated cases.

Most of them have a image to isosceles triangles as a figure have same lengths to its side. So, they could not point out the following cases;

1> A figure is made of two bars to support a tree standing perpendicular to the ground.

2> A figure is made of two ropes of the same lengths to pull up a bar keeping its level.

3> A figure can separates the weights of things equally to its both sides.

4> A figure has the maximum area under some conditions; In ABC, points B and C are fixed. We move point A as AB+AC=constant(>BC).

It is notable that many students write as followings;

"It is difficult for us to find the isosceles triangles in our real daily lives because the concrete real cases of isosceles triangles are very rare in our ordinary lives."

In following section, I would like to argue that in mathematics education it will be the essentially significant steps toward the precise understanding of the properties in mathematics to have our students search for them in the concrete, real images of their surroundings.

SOME CASES EXAMINED IN MY LECTURE NAMED "MATHEMATICS EDUCATION"

I would like introduce some cases from my lecture. At last time of the lecture, I demanded every student to seek or to find a mathematical structure or mathematical model for concreat things in the real world. My expectation for this activity was that both doings such deciding a theme and finding mathematical structure of it was done by studentself. To the desire, most of them felt hard. So many reports were fillfulled by the things which were written in some books; i.e. reported mathematical properties were found by another reseachers, already. My this trial did not get fruitsfull results. So, in recent time, I reform this requiring as follow;

1> I introduced students some real cases. They selected one case from the list and visited adequate organizations to investigate what mathematical properties were used in its actual circumstances. After visiting, they investigate their mathematical structures.

2> Students decided a real case and visited some adequate organizations to reseach how use it in practice. After this reseaching, they seeked mathematical models or mathematical structure by theirself or by reading some books.

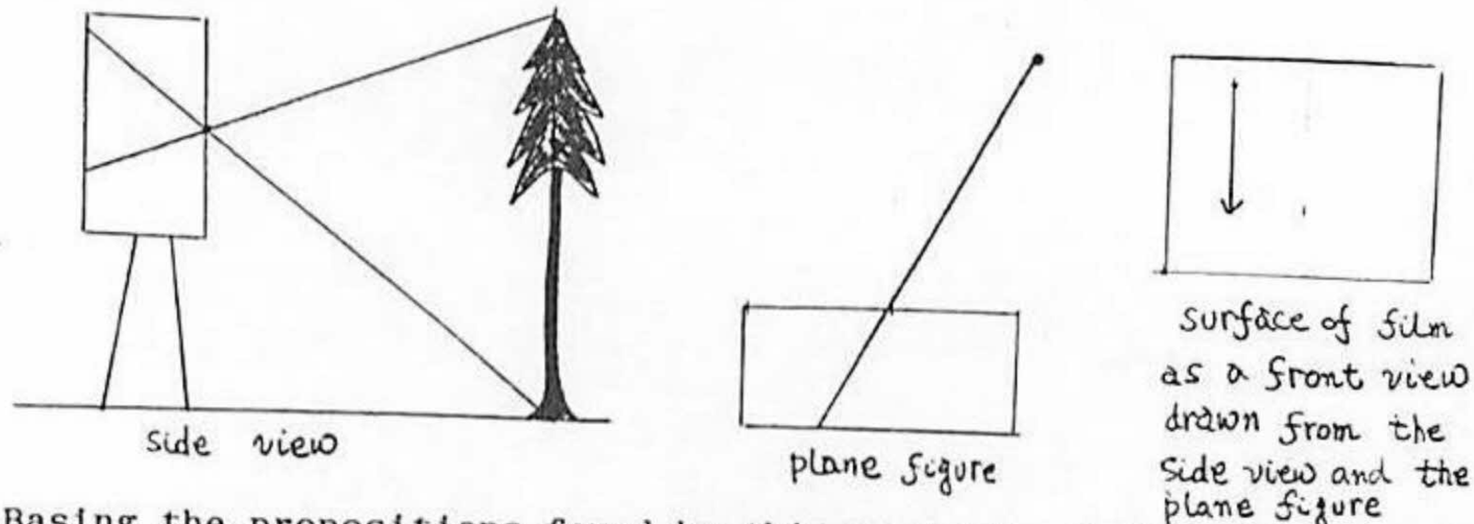
Now , I introduce some examples. At first, I would like to introduce my examples showed students as examples to this activity.

Examples> -- from the geometrical cases

1> What pictures are taken on the film of a camera ?

To analyze this, I employed two methods. One was used the vectors in space; We see a ray as a line and surface of film as plane. We get the point as meet of a line and the plane by solving two equations which represented these figures.

Another is done by drawing a front view from a plane figure and a side view. These plane figure and side view are taken from a model which show a seen to take a photograph.



Basing the propositions found by this analysis, I introduced some theorems related to Desarque in the projective geometry.

2> What properties are exist in a stream running down on the inclined plane or in a mountain trail from a point on its skirt to the top ?

We can see this problem as seek the shortest route which connect the two given points in space along the surface of the ground. To get an answer, we use the theorem of three perpendicilar lines in the space and draw the segments on a map as following; We set a point A on a contour. We draw the tangent AT_A and its perpendicular line AP_A at A. Then, we set a point B near A, on next contour of the abovementioned contour. We draw tangent BT_B and its perpendicular line BP_B at B. If AP_A and BP_B meet at C in the region decided by two contours which pass A or B respectively, we get bent line ACB as an approximated solution.

After learning this subject, I introduce the thorems in classical differential geometry by using the geometrical meanings of partial differentiation.

In next, I would like to show my list to make students investigate mathematical sturcture of a case which was selected from the list.

Examples] -- cases about traffic or road or railway --

1> How policeman can guess the speed of the car which did traffic accident ?

2> What curves were adopted in the curved parts of the road or the railway ?

3> What curved surface is used on a mirror which are set at the corner of a road?

4> How methods are used to guess the numbers of automobiles passing through a road in its planning days ?

(Of course, more problems were prepared to this activity.)

Following examples are set themes by students. They visited some organizations or read some books to research their mathematical structure. I introduce three examples.

1> Relation of speeds of an eletric locomotive and diameters of wire to send electric current to trolly of it.

A student visited the office to build the Yamagata Shinkansen which would be accomplished in 1992 and heard the relation of speeds of an electric locomotive and diameters of wires. A railway official taught him the equation which was deduced by Dr. Fujii (Tokyo univ.). The student solved the differential equatoins and get a solution that for Yamagata shinkansen a diameter of wire would be more 10mm.

2> Example of usage of semi logarithm graph

A student visited the office to research the level of underground water stream. She was taught following things from reseacher.

*1 set a several wells to observe the level of underground water stream.

*2 at a well A, reseacher pumped out large amounts of water. By this doing, level of water stream is falled at every well. Then, level water stream return to the first condition with lapse of time.

*3 reseacher observe periodically the level of water stream at every well after pumping out.

*4 reseacher protted the data, level of water and distance of a observed well from the well A, or times and level of water at each well, on semi logarithm graph. Yes, relation of these factors were represented as exponential function in definite interval.

3> Mesuring the length of rolled tape

Student assumed each rollment of tape as a circle. He calculated the length of rolled tape by using formula of $\sum k^2$ and a datum get from his experiment. After this activity, he telephoned factory to know precise amounts of length of it. By his report, precise length is 178m and his obtaind length is 188m. Its relative error is about 6%.

BACK GROUNDS OF MY PRACTICES

According the consequences of IEA reports, level of mathematics learn ing of children of Japan is very high. One of reasons is that social status of teacher, even in primary school, is high. Then, the abilities of the teachers is generaly high. Second reason is that total amounts of times of mathematics teaching is large. But,in other hand, many children especially higher graders, dislike to learn mathmatics. For many pupils, study of mathematics is the all that they can or can not solve each given problem. Mathematics as explain some structures of each concrete case is not conceived except some case as calculate at purchase, measure length or weight. School of Japan have another problems. From the difficulties of these, not few teachers lost vital mind to instruct and are leaving from the school. Many reseachers have investigated of these causes. I think the following things as causes of these phenomenum.

1> Administration and concentration to many social system are increasing year by year. This is occured in education, also.

In education, power of the Ministry of Education and some organizations attached of it are strong. For example, the Ministry of education has authorities to determe the syllabus and to examinate all textbooks which were used primary or secondary school. In Japan, for many teachers and pupils textbooks are very important subject matters Then, the Ministry of Education has very strong influences even to methods of the teaching mathematics.

2> Competition in the social are gradually strong, also.

In the education, competition to enter some famous schools were keen. On the other hand, more pupils were omitted from this competition and lost his /hers aims of life. Increasing the numbers of this "lost" pupils are promoted by the losting of variety or complexity in the social.

3> The other hand, to keep growth of economy or to develop new higher technology, social demanding for sending out many tallented men/women to social are sended to the school. While this demanding are increasing more and more, confusions occured in the school are more and more deep and wide.

CONCLUSIONS

As abovementioned things, I think, the system of the school has been destroying in its essential parts. To recover the functions of the school, I think, it is very important that every teacher has the ability to construct the contents of his/her instruction by his/her original found things. By leraning these contents, pupils leran mathematics vitaly. And, they may conceive that the functions of mathematics in real world is very high. Adding these things, pupils may obtain following abilities;

1> Knowing and reserching the properties of a concrete case from many view points.

By these consciousness, we expect pupils to know many wisdoms using in our ordinary lives or to conceive essential properties of our culture.

I pointed out three examples which were seen in Yamagata city on a day.

*1 Require the heights of the snow on the roof to concerve each constructed one from the weight of snow.

*2 Require the methods to reseach the region being able to receive waves which are dispached from a satellite branch of the television broadcast. Yamagata city is surrounded by hills. So, the waves from broadcast have many obstacles. Then, it is important to determine the place of despaching the waves.

*3 Require the angles or directions of tank to warm the water in it by Sun beams, effectively.

2> Definitions or propsitions can be found by pupils from these deduced things. So, pupils may recognise some properties related to them naturally and conceive the importances of these properties.

3> We can give the neccesity of proof to these deduced propositions being true or false; i.e. we can easy do problem whether the deduced things satisfy only in these treated cases or are general ones being able to applicate another cases.

If the idea of direction or angle is get from the movement of a ship on a sea, we can ask this concept being able or not to applicate another movements of some ones on the ground. From these seeking, we get general concept of angle by drawing two lines on a paper or by changing direction of movable ones at a coner.

4> If deduced thing is a general property, we require pupils to seek another applicated cases of it.

Doing these seeking, pupils can grow their consciousness of this.

5> In some cases, we get more general results by changing some conditions of deduced things. In the obsevation of the shadows of solids by parallel rays, we get some results by changing the direction of ray.

For 6th graders; We change the direction of rays, in the condition that rays move parallel to the plane. We require pupils what figure or part of solid is transformed on the screen as shadow. From this research, we get the concept of cutted face by plane which is perpendiciular to direction of rays.

For 11th graders; we change the direction of ray arbitary. By using properties with respect to parallel lines, we get concept of linear transformation.

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初等・中等教育における数学教材を豊かにするために

森川　幾太郎　（山形大学）

教育学部の教員養成として行っている授業での試みを紹介する。

あるとき、学生に、２等辺３角形に関する性質をあげさせ、それらの性質を使っている実際の場面を指摘させた。しかし、実際の例をあげることができた学生は僅かであった。

数学としての、一般的な性質についてはよく知っていても、それらの具体場面での使い方を知らない、という学生は大変多い。これでは、卒業後教育現場で彼らが授業を行うにしても豊かな内容をもった授業ができないと思われる。そこで、私の授業「数学科教育法」の中で、いくつかの事象についてその数学的構造を解析させる活動を学生に行わせている。

この活動は、課題の設定およびその数学的特質の発見の両方の事柄を学生が行うことを期待したが、これは学生には困難であった。そこで、最近では、

1> 私の方で課題を設定して、それらについてある機関を訪問させ、そこで使われて様子とか使われている数学的内容を聞き取る

とか、

2> 学生自身が題材を設定し、それについての調査を、研究機関を訪問と本を読むことで行う、という方式にきりかえている。この小論では、学生のレポートした事柄の紹介とこの活動の意味について述べた。