Teaching Approaches Using Graphing Calculator in the Classroom for the Hearing-Impaired Student

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The purpose of this study is to present teaching approaches using graphing calculator in the classroom for hearing-impaired student as a one of effective approaches. In the classroom for hearing- impaired student it is difficult enough to use spoken language as a means of communication owing to hearing impairment. The consequence of it leads to poor chance for them to negotiate with their teacher and the other students about mathematical meanings. Thus it is difficult for them to make sense of mathematics as many researches also show. As regards solving this state , we considered teaching approaches using graphing calculator. We focus on two approaches , step by step approach and visualization approach. It is considered that these approaches stimulate for hearing-impaired student to make sense of mathematics.

INTRODUCTION

It is said that it is difficult to promote student's conceptual understanding particularly in the classroom for the hearing-impaired student. However it is possible to enhance them to visualize and conceptualize important mathematical idea by selecting a problem as the basis of experiences with familiarity for them and using technology (Gardella and Glatzer, 1994).

In recent years we have been able to use technology such as graphing tool , spreadsheet tool and so on in the classroom. To develop effective approaches of teaching mathematics we have to consider the effects and problems of teaching approaches using technology. In particular it is important and expected to consider the use of technology in the classroom for the hearing-impaired student.

In this paper we present teaching approaches using graphing calculator in the classroom for the hearing-impaired student as a one of effective teaching

approaches. In the classroom for them it is difficult enough to use spoken language as a means of communication owing to hearing impairment. The consequence of it leads to poor chance for them to negotiate with their teacher and the other students about mathematical meanings. As regards solving this state , we considered teaching calculator using graphing calculator. Particularly we focus on two approaches, step by step approach and visualization approach, in the classroom for them.

Some Problems in the Classroom for the Hearing-Impaired Student

Difficulties for the Hearing-Impaired Student

Higher education for the hearing-impaired come to be expected in recent years. The other hand we have many problems necessary to solve the present state of education for them. One of them is how we support their subject learning.

Of course in education for them it is the most important problem how we support them to learn language to think and communicate. Because it is very hard for them to do owing to hearing impairment. We believe language learning is very important. On the other hand we also believe it is very important to support their subject learning. Because they needed subject learning in order to participate actively in many fields of modern society.

In the case of the hearing-impaired students it is difficult enough to use spoken language as a means of communication owing to hearing impairment. Although there are many different problems depended on individuals , we have to consider first of all what is meant by not enough using spoken language as a means of communication in terms of mathematics education.

We must pay attention to not enough using spoken language as a means of communication. As it is implicated by social constructivism mathematical knowledge is constructed by learners through social interaction. Therefore it is thought that not enough using spoken language as a means of communication influence the teaching and learning of mathematics in the classroom.

The fact is that we must support them on their fundamental understanding of mathematics when they enter our college. Mostly their understanding of mathematics as they enter college is not enough to learn it necessary to major in engineering (for example , calculus or linear algebra) . For that reason we support them so that they can understand secondary mathematics, occasionally elementary arithmetic.

In particular It seems that their relational understanding rather than instrumental one is not enough. As Skemp(1987) called relational understanding is knowing both what to do and why. In the other hand instrumental understanding is knowing how to do. We suppose that it is the reason why it is more easy to stimulate instrumental

understanding but it is more difficult to stimulate relational understanding.

For example Morimoto(1997) presented student's relational understanding on mathematical procedures and rules might not necessarily be enough for many freshman with hearing impaired at college of technology. For example although they could solve simultaneous quadratic inequalities but they couldn't answer correctly at the following problem;

Solve x with integer satisfying the following inequalities

$x^2-6x-7<0,\ 2x^2-5x-3>0$

56.9% of subjects (N=39) could solve simultaneous quadratic inequalities. But only 20.5% of subjects could answer correctly (Table I).

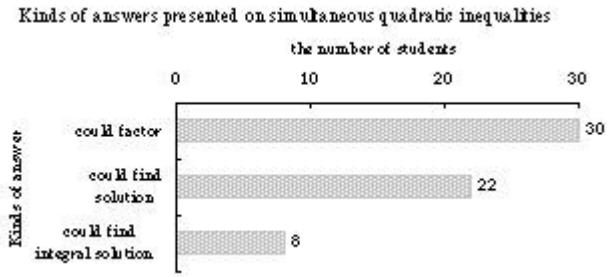


Table I

At this problem we can solve most correctly if we could remember the procedure of simultaneous quadratic inequalities. However this procedure involves some sub-procedures; students must factor quadratic expression, find a solution, select integral solution. It is not easy to remember and apply these more implicated procedures without knowing meanings of factoring, solution and integral solution. This result implicates that it is difficult for teacher to stimulate relational understanding with the hearing impaired student.

Special Needs for the Hearing-Impaired Student's Math Learning

As Sznajdere and Klosowski (1996) described that a major problem for hearing-impaired student's mathematical learning arises in the following way : Since the fundamental difficulty for deaf child is a weak speaking proficiency and incomplete acquisition of the language , the main purpose of the education process is the development of these functions. The school's activities are directed mainly towards this primary goal, and therefore children develop , as their main means of approaching learning , a style of memorizing rules , copying actions and remembering what to do.

It seems that they achieved learning goals at instrumental understanding level by this style. However it seems to be difficult to achieve learning goals at relational

understanding level as mentioned above.

Therefore one of special needs for the hearing-impaired student's mathematics learning is to promote their relational understanding. In teaching and learning for them we have to encourage them to know not only how to do but also both what to do and why.

In order to do so it is considered that there are some teaching approaches. As one of them , teaching approaches using graphing calculator enable us to support their mathematics understanding.

Teaching Approaches Using Graphing Calculator

Using Graphing Calculator

Curriculum and Evaluation STANDARDS for School Mathematics is announced by National Council of Teachers of Mathematics in 1989 (National Council of Teachers of Mathematics,1989). It presented changes in content and emphasis in school mathematics. For example , in the standard of *Patterns and Functions* of 5 - 8 grade and *algebra* of 9 - 12 grade , the focus of teaching and learning mathematics moves from symbol manipulation or drill and practice for memorize the procedure to use and exploration algebra. Of course symbol manipulation and drill and practice themselves are important. However it is not until they play important roles in use and exploration algebra that we realize that they are important. We must pay more attention to use and exploration so that student can appreciate mathematics power. In particular this is important for the teaching and learning mathematics for hearing-impaired student as mentioned above too.

It is expected that a teaching approach using graphing calculator is one which enable student to appreciate mathematics power. Using Graphing Calculator enhance students to visualize and conceptualize important mathematical ideas. We should focus on conceptualizing important mathematical ideas rather than symbol manipulation or drill and practice in teaching and learning mathematics.

At the following sections we will present two approaches using graphing calculator , step-by-step approach and visualization approach , in the classroom for the hearing-impaired student.

Step-by-Step Approach

It is necessary for achieving a aim of teaching to set up some objectives as small steps towards it. Particularly in the classroom for the hearing-impaired students it is necessary and important. Because it is difficult to negotiate about more complicated mathematical meaning owing to use spoken language as a means of communication.

It is important for more effective mathematics teaching how to set up small steps , but it is very difficult. For example , in the teaching and learning of function , students have to learn to manipulate symbols and describe and represent with tables and graphs. These procedures such as manipulating symbols and describing with tables and graphs are necessary for considering properties and relationships of function. However in order that it takes much time to learn these procedures , it is difficult enough to make a discussion about properties and relationships of function. As a result of it student come to satisfy with memorizing these procedures. After all it tends that mathematical procedures such as manipulating symbols and describing with tables and graphs are focused in teaching function rather than making sense of mathematical meanings.

In the case of it , by using graphing calculator , teacher can set up more usefully small steps. It is supposed that using graphing calculator influences how teacher set up small steps. For example in the teaching of the relationship between $y = ax^2 + bx + c$ and $y = a(x-p)^2 + q$, teacher often handle transformation from $y = ax^2 + bx + c$ to $y = a(x-p)^2 + q$ with the procedure of factoring in the traditional way with paper and pencil. Teaching these transformation is one of small steps. On the other hand in the way with graphing calculator putting $y = a(x-p)^2 + q$ on $y = ax^2 + bx + c$ is one of small steps. Of course it is not impossible with paper and pencil. However it is possible to more easily handle graph in the way with graphing calculator than with paper and pencil.

Thus using graphing calculator enable teacher to set up small steps different from ones in the way with paper and pencils. These approach using graphing calculator influence the objectives , the contents of the teaching and learning of mathematics in the classroom for the hearing-impaired student.

Visualization Approach

It seems to be difficult for the hearing-impaired student to interpret a graph. In fact the hearing -impaired student who enter in college interpret a graph in different incorrect way. Nakamura & Morimoto (1998) studied student's interpretations towards different graphs (Hart,1980). Many students interpreted incorrectly graphs (Figure I).

Only 49.6% of 39 students (at average of 3 problems) interpret a graph correctly (see Table IIÝmethod for student to interpret graph may not necessarily be correct. This result means that it is difficult for them to interpret and explain mathematical relationships represented. As Watts (1979) also indicated , these failure so often due to the fact that insufficient language had been used to clothe the concepts developed when making graphs.

Although they have handled different graph since they was elementary school students , it seems to be difficult to effectively use graphs.

(a) (b) (c)

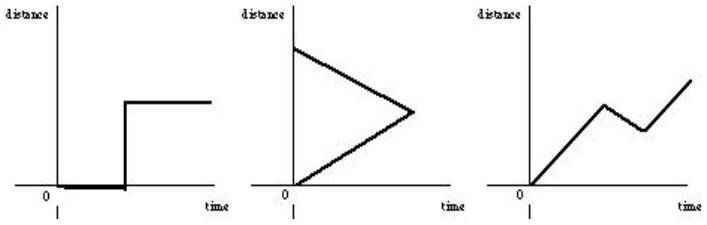
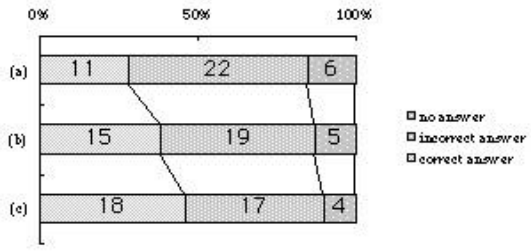


Figure I

Graphs used in problems of interpretation towards ones

Table II

Student's interpretation towards graphs



Needless to say , it is important to be able to translate from one representation to another representation. It is necessary for exploring mathematical relationships to use different representations. We can think and communicate an mathematical idea with different representation. In order for student to be able to translate between representations and use them, students should have more opportunities to use different representation.

It is supposed using graphing calculator enabled the hearing-impaired student to visualize and conceptualize an important mathematical idea as Gardella and Glatzer (1994) also suggested. For example in the teaching and learning of function students learn some concepts on function. In the way with graphing calculator teacher can make opportunities to discuss why each concepts on function is needed before they can describe and represent with graph.

Using graphing calculator enable teacher to make more opportunities in order to discuss on mathematical meaning with different representations in the classroom. These approach using graphing calculator also influence the objectives , the contents of the teaching and learning of mathematics in the classroom for the hearing-impaired student.

Summarize

In this paper we presented teaching approaches using graphing calculator in the classroom for the hearing-impaired student as a one of effective teaching approaches. These approaches should be continually considered through practice in classroom for the hearing-impaired student.

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