

## Application of Distance Education for Mathematics of Junior High School

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Recently a new type of educational method through the internet, distance education, has been developed with technology development. To find out any complement between distance education and traditional in-class education, a series of study with junior high school mathematics were conducted. Both distance education and in-class education have merits and shortcomings. Some advantages with distance education shown from the study can be used for complement to in-class education depending on the contents and subjects. Distance education in mathematics education can be a good turning point for future education.

*Keywords and phrases:* Complement, Distance education, In-class education, Mathematics learning.

### I. INTRODUCTION

Human's creative activity is needed more than ever as the world has been connected by the internet and has no boundary by the location and as the required knowledge and information to keep up with the rest of the world is overflowing. These recent dramatic changes make things impossible in the past all possible now with technology advancement by simply getting connected to the internet. A lot of work such as internet-banking and purchasing without going to real stores can be done through the internet thanks to the state-of-art technology in networking and internet communication. The recent technology development has also been utilized at school education and educational method. Introduction of computers, satellite and cable communications, and various projectors to school education has in-class and group education changed into more opened and individualized education (Carroll 1993; Fosnot 1984; Moore & Cozine 2001a; 2001b; Spector 1995).

The 7th Korea national curriculum for public education, continuous education, and

student-oriented education is mainly focused on the education of characteristics and capability of individuals, instead of cramming system of education. Therefore, many educational institutions have developed various educational methods and programs such as distance learning and cyber-education using the internet and cable for people who need education at their convenient time and locations. Education at home through computers at their convenient time is one of good examples of distance learning and cyber-education regardless of time and location of both teachers and students. This kind of educational method has been used for a long time in overseas.

Domestically many hospitals and universities have recently started similar educational programs. Several web-sites are available for distance education of mathematics. Even though some research has been done in the area of distance education, few research has been done on the efficiency, benefit, and the compensation of both educational methods, especially with mathematics education. Therefore, it is important to compare mathematics education by *distance education* (DE) with that by *in-class education* (CE) and to find complements of both methods.

The purpose of this paper is to study the advantages of distance education in mathematics learning, to compare effects of both in-class education and distance education, and to find out what method is better for maximizing problem-solving capability in mathematics. Furthermore, the possibility of compensation between two methods for learning junior high school mathematics is another goal of this paper.

## II. BACKGROUND

It is necessary to know commonalities of both methods, in-class education and distance education. In-class education has been a main program to educate the society until now. It has introduced, explained, transferred, and taught many things covering all topics from the past to present. It has narrowed gaps between generations, locations, social levels, and genders, and contributed a lot in changes of the societies. However, it has been done only according to intentions and plans of educators. In the past, education covered limited materials that were transferred in a rigid form of knowledge. Traditionally school education, in-class education, has been designed only for groups with certain ages without considering individual characteristics and been limited by location. It has also been a symbol of social level, advancement tool in society, indication of group with same interests. It has shown many shortcomings since it was created. A lot of efforts are needed to modify it in a short time. It may not be easy to make changes of it.

With technology development, a new activity has been tried for improvement and

convenience in education. It is not surprising that society has also been influenced by surroundings such as technology development. Educational system cannot be an exception. Changes in educational system with technology advancement include no limit in recipients, by time and location, in educational methods, and on availability of various educational materials.

Nowadays education is rather an information-like character than a knowledge-like character, especially with technology development. The contents of the future education will be informational, respectively with several remarks. Educational Materials can be shared with all including students, parents, educators and citizens. The materials can be stored in public places modified more by accessible people for improvement, instead remaining the sole property of educators. Educational material can be shared with all people regardless of their culture, time to get, and their countries. Future education may not be one direction, transfer of knowledge traditionally done from educators to students.

The information will be handled and taken by people who need it according to their purpose. The material may be also a matter of recipients, not a matter of educators. Future education will be done for individual's needs and preferences such as one's interest, ability, and level of their education. To meet future needs, current educational system itself needs changes in terms of delivering methods, materials, and school system. It seems to be possible that technology development could meet demands on future educational system. One in the area of education that people have been developing is 'distance education'.

Distance education typically implies instruction via nontraditional means, i.e., courses via correspondence, radio, television, satellite and more recently, internet with its associated software, hardware, multimedia, digital links and supplementary audio and videotapes or CD-ROMs. Also, it implies on-campus classes, seminars and workshops where the instructor is not physically present, and communicates with students at several sites simultaneously via electronic media (Federico 2000; Keegan 1996).

The term of 'distance education' was used first officially in 1982 when *International Council for Correspondence Education* (ICCE) changed its name to *International Council for Distance Education* (ICDE). The definition of 'distance education' varying from person to person is basically opposite of traditional school education, in-class education. Distance education is a method of education using modern communication technology between educators and students separated by location and time.

Two types of distance education are frequently mentioned. One is synchronous instruction that requires the simultaneous participation of all students and instructors. The interaction is done in real time, e.g. video teletraining, computer conferencing. The other one is asynchronous instruction that does not require the simultaneous participation of all students and instructors. Students do not need to be gathered together in the same

location at the same time, e.g., electronic mail, internet-based courses (Federico 2000). Similar methods such as 'home school' or 'education by correspondence' have been done. There are advantages and disadvantages with distance education. There is no limit with number of recipients.

Memory and effect of distance education may last longer because of visual and auditory materials. Recipients can find materials, adjust the speed and progress, and eventually can develop creative thinking and mind by themselves. Low maintenance cost is expected. However, recipients can not develop friendship with others. There is no direct communication between recipients and educators during distance education. It may take longer for recipients with weak motivation. High initial cost can be another disadvantage.

### III. METHOD

Two hypotheses were made to study the main question in this study, achievement in mathematics learning by complement between distance education and in-class education. One is "Whether distance education using the internet is better than in-class education or helps for students to study with strong interest?" The other is "Whether distance education using the internet is more effective than in-class education in terms of content understanding?"

The study to test two hypotheses was conducted with two groups consisted of total 40 students of the 3rd grade junior high school at a private educational institution in Korea from January 20, 2002 until March 31, 2002. One group studied through the internet was named 'experimental group' (DE group) and the other studied through in-class was named 'comparative group' (CE group).

The internet class for distance education was opened through an internet site (<http://www.interdy.net>). Before conducting the study, the achievement levels of both sampled groups were examined through a test with 10 questions about exponential law, calculations of monomial and polynomial from formula-calculation chapter of the 2nd grade mathematics of junior high school. The multiplication of polynomial and factorization in the chapter of formula-calculation of the 3rd grade mathematics of junior high school were used as the learning topics during the study. The students were allowed to get into the internet whenever and wherever they wanted to study. They were also allowed to stay longer at the internet class with the class materials even after the internet class when they wanted. Total 7 classes were given during the study and 5 presentation sheets in Power Point were used in every class. During the study two exams were taken to evaluate the achievements of the students from the distance education and in-class

education.

**Table 1.** Contents of distance education

Title	Sub-title	Contents	Date of education
Formula-calculation	Calculation of polynomial	Multiplication of polynomial	Jan. 21, 2002
		Product formula 1	Jan. 24, 2002
		Product formula 2	Jan. 28, 2002
		Rationalization of denominator	Jan. 31, 2002
	Factorization	Definition of factorization	Feb. 4, 2002
		Factorization formula	Feb. 7, 2002
		Factorization of complicate formula	Feb. 14, 2002

Easy Study Generator from Korea Information Engineering Inc. was used with slides from Kumsung Publisher Co. (<http://www.kumsungpub.co.kr>). Easy Study Generator used during distance education was consisted of two components. One is LOD Generator generating voice files, real-time player, HTML and PowerPoint files, image files, and other supporting materials. The other is LOD Viewer for playing generated files by students. Students downloaded LOD viewer though the web site (<http://www.interdy.net>) and repeated the class materials when they wanted more. Student's knowledge and ability to solve the problems after the classes were evaluated through two tests.  $\chi^2$  test and t-test of the survey were done with a statistical program SPSS/WIN to test the hypotheses.

#### IV. RESULT AND DISCUSSION

From the test of two groups before the study, the following facts were known. Figure 1 shows no significant difference in frequency of distribution before the study by two methods; the averages of DE and CE groups were 64/100 and 64.5/100, respectively. The comparison of the test of two groups after the study is shown at Figure 2; the averages were 59.8 for DE group and 63.5 for CE group. There was almost no much difference compared to the results before the study in the range of higher than 40. However, more students appeared below 30.

The better achievement had been expected from DE group because the students in that group could repeat the educational materials when they couldn't understand. However, the students in DE group could not ask questions right after or at the time of the class,

which made some students less interested and gave up their desire for the study in some extreme cases. Students in DE group might be distracted by surroundings or pay less attention to the materials since they control themselves during the classes. Poor achievement with DE group might be the result of those.

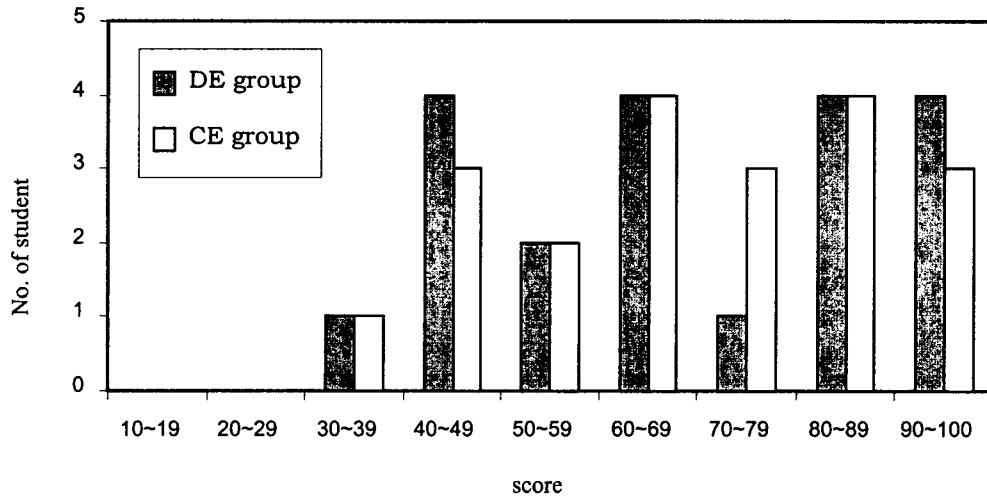


Figure 1. Student scores before the study by two methods

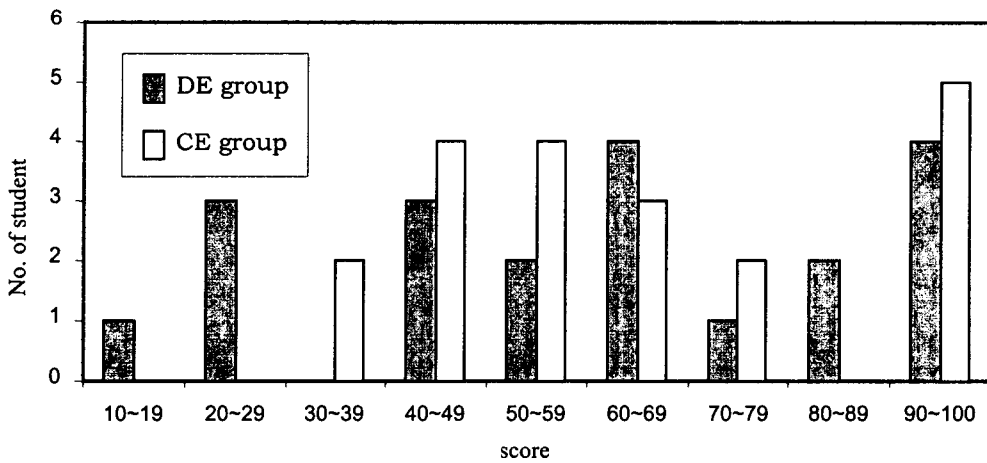


Figure 2. Student scores after the study by two methods

The same survey was conducted at another set of two groups (total 50, DE & CE group) for better evaluating the level of their understanding of the materials for distance education. Therefore the total students involved in this survey were 90. Then the followings are obtained.

## (1) Comparison of study time

**Table 2.** Comparison of study time in two groups (t-test)

Group	N	Mean	Standard deviation	Standard error of mean
DE group	45	2.00	2.52	.38
CE group	45	1.07	1.79	.27

	Levene's equal variance test		t-test					
	F	Significance probability	T	Degree of freedom	Significance probability	Mean difference	Standard error of difference	95% Confidence interval
w/ equal variance	2.68	.105	2.03	88	.046	.93	.46	1.72E-2 ~ 1.85
w/o equal variance			2.03	79.32	.046	.93	.46	1.58E-2 ~ 1.85

Equal variance test shows that F is larger than significance probability ( $2.677 > 0.105$ ), which indicates the different variance in DE and CE groups. Therefore, without assumption of equal variance at Table 2, the fact that the significance probability 0.046 is smaller than 0.05 means that DE group spent more time for study than CE group.

## (2) Effect of distance education on learning attitude within DE group

**Table 3.** Development of self-study habit through distance education ( $\chi^2$  test)

Opinion on development	Number of observation (NO)	Expected frequency (EF)	Residual (NO - EF)
Very well	3	9	-6
Well	16	9	7
No favor	14	9	5
Not much	7	9	-2
Not at all	5	9	-4
Total	45	45	0

$\chi^2$	Degree of freedom	Approximate significance probability
14.444	4	0.006

Table 3 shows that opinions of 'very well, well or no favor' have relatively higher observation than expected frequency compared to the rest of the opinions. Distance education helped students strongly interested in their study and development of their self-study habit. The interesting points to DE group students could be the educational materials and/or educational method (internet).  $\chi^2$  goodness-of-fit test explains the same effect (significance probability  $0.006 < \alpha = 0.05$ ).

(3) *Level of content understanding in DE group*

**Table 4.** Understanding of contents in DE group ( $\chi^2$  test)

Level of understanding	Number of observation (NO)	Expected frequency(EF)	Residual (NO - EF)
Highest	1	9	-8
High	18	9	9
Average	16	9	7
Low	6	9	-3
Lowest	4	9	-5
Total	45	45	0

$\chi^2$	Degree of freedom	Approximate significance probability
25.333	4	0.00

Understanding levels of 'highest, high and average' have more students than expected frequency compared to the rest of the opinions.

It means that distance education is relatively easily understood.  $\chi^2$  test (approximate significance probability  $0.000 < \alpha = 0.05$ ) supports that majority of students agree on the conclusion, easy understanding through distance education.

(4) *Expected effect of distance education as a tool for preparation and review of educational materials*

**Table 5.** Application of distance education for preparation and review ( $\chi^2$  test)

Level of effect	Number of Observation (NO)	Expected frequency (EF)	Residual (NO - EF)
Very effective	2	22 ~ 23	-21 ~ -20
Effective	63	22 ~ 23	40 ~ 41
Less effective	17	22 ~ 23	-6 ~ -5
Least effective	8	22 ~ 23	-15 ~ -14
Total	90		



$\chi^2$	Degree of freedom	Approximate significance probability
102.267	3	0.00

Table 5 shows distance education is expected to be very useful to both groups for preparation and review regardless of the educational methods. Students expect the effect of distance education for their study.

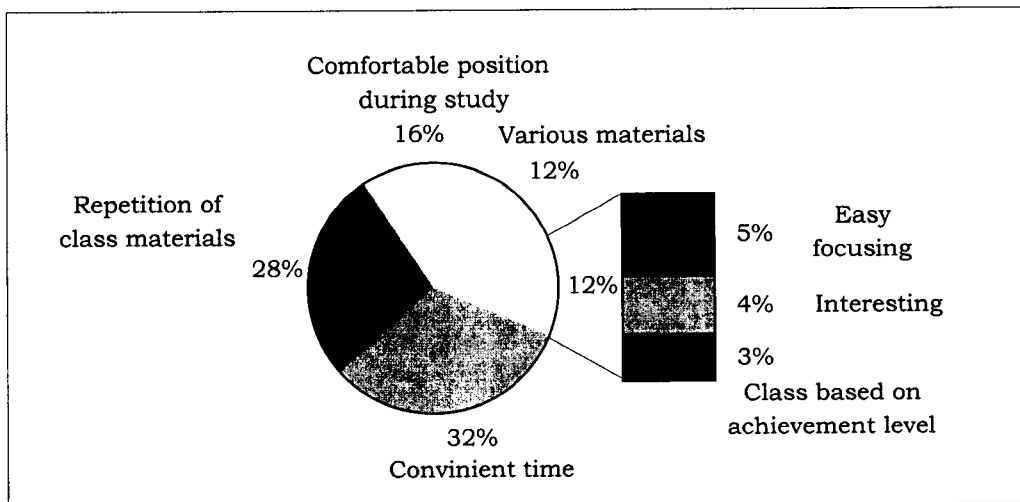
(5) *Distance education is more effective than in-class education?*

**Table 6.** Change of score in mathematics test in DE group

N	Mean	Standard error of mean	Standard deviation	Variance	Median	Range
45	2.91	0.12	0.82	0.67	3	3

The change of score in mathematics test and level of understanding of contents at DE group were scrutinized to answer this question. From Table 6 mean is 2.91, median is 3 and 95% confidence interval is 2.66~3.16. The effect of distance education on improving score within DE group before and after distance education was not significant. The level of educational material understanding didn't show much difference between both groups.

(6) *Student opinions on distance education*



*Figure 3.* Merits of distance education

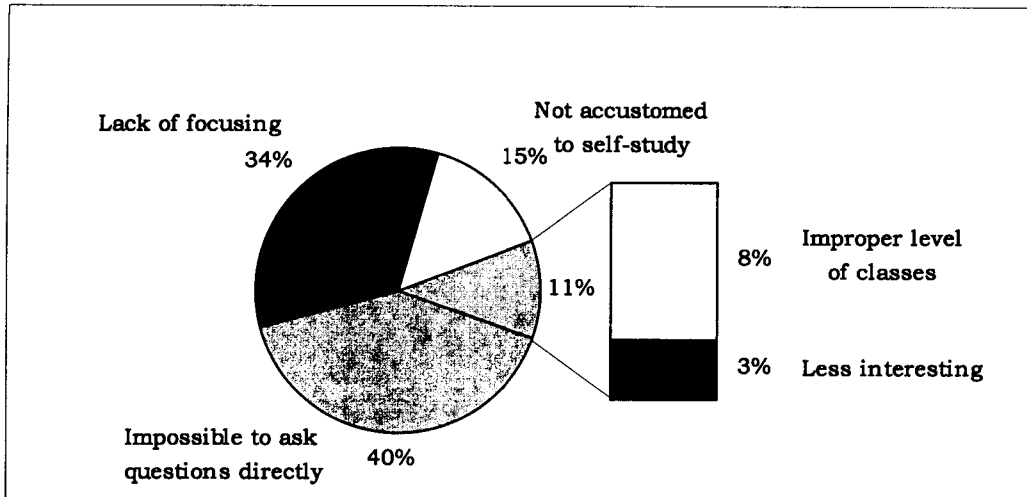


Figure 4. Shortcomings of distance education

Figure 3 and Figure 4 show student opinions about distance education regardless of their experience of distance education.

The students like distance education because of several facts. They can study when they want (32%). They can repeat the educational material even after the distance education (28%). And the variety of materials at distance education is another reason (12%).

The reasons some students didn't like distance education were that they cannot ask questions right at the distance education (40%), that they pay poor attention during distance education (34%), and that they are not accustomed to self-study (15%).

## V. CONCLUSIONS

Rapid changes in information and communication technology have given strong influences to educational system as well as to curriculum. The effect of distance education using the internet was studied for better education in this paper; what kinds of advantages students can get in mathematics and how both can be compensated. Several conclusions were drawn from the study with two sampled groups.

First, distance education seems to be useful for students to develop studying habit in Mathematics study because they need to get connected by themselves for study (Table 2 and Table 3). Students also develop the study habit naturally through repetitive activities. More studying time of students with distance education than students with in-class

education is the indication of their habit that has been developed through distance education. Since students recently tend to spend more time with computers, it is important to provide students more attractive programs and ideas for the study, especially, of mathematics they think a difficult subject to learn.

Second, distance education through the internet can be repeated and used anytime and anywhere in their convenience (Figure 3). But, distance education can be lack of attention since it is a self-oriented method (Figure 4). Therefore, communication between teachers and students during distance education may make distance education more effective. Advanced multimedia technology with a video function will help distance education more improved than now.

Third, distance education may be a good turning point from the current educational system, one direction from teachers to students. Distance education itself can't be a solution for all education. It may be good enough for delivering knowledge.

Somewhat, easier understanding doesn't seem to be directly related to improving problem-solving skills. It means distance education itself may not be enough for high academic achievement. The fact that students can't ask their questions directly at the moment of distance education is negative in mathematics education. However, an advantage with distance education is that they can go back and study the materials during education and problem solving. From the advantages and disadvantages of both methods, it is not straightforward to say which method is better than the other. Combination of both methods may give a better education. Instead of education with the same materials and at the same time, modified contents and educational methods may work better in problem solving and understanding of definitions, concepts and topics such as geometry in mathematics.

Distance education is also good for preparation and review of in-class education in Mathematics education by providing lectures, supporting materials, distributing homework, and submitting homework. There is a potential for distance education to be a good part of educational system since students are very interested in distance education. The study in this paper was conducted with only students. More fundamental studies are needed with teachers too. Other possibilities of applications of distance education are to provide more educational opportunities for talented students and to teach geometry for junior and high school mathematics.

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## Appendix

The survey questions were asked to DE and CE groups. Some of the questions were only for DE or CE group. Some of them were for both groups. Example questions are listed here.

### *Some questions for DE group*

1. The change of mathematics grade after distance education (DE)?
  - A. Improved a lot
  - B. Improved some
  - C. Same
  - D. Decreased some
  - E. Decreased a lot
2. Do you agree that DE is easier to understand than in-class education (CE)?
  - A. Totally agree
  - B. Agree
  - C. No preference
  - D. Disagree somewhat
  - E. Disagree totally
3. DE is better for self-studying habit than CE?
  - A. Totally agree
  - B. Agree
  - C. No preference
  - D. Disagree somewhat
  - E. Disagree totally

### *Some questions for both groups*

1. What are the better factors with DE than CE?
  - A. Class depend on student academic level
  - B. Good focusing
  - C. Repetition of the educational materials
  - D. Various educational materials
  - E. Convenient study time
  - F. Relaxed environment during the study
  - G. Interesting

H. Others (describe specifically)

2. What do you think about DE as preparation and review of the classes?

- A. Very effective
- B. Effective
- C. No better effect
- D. Less effective

3. What are the shortcomings with DE compared to CE?

- A. Poor focusing
- B. Impossible to ask questions at the moment of education
- C. Level of the educational materials is not proper
- D. Not accustomed to self-study
- E. Not interesting
- F. Others (describe specifically)