A Study of Mathematics Programs Inbeded in Digital Learning Formats to Bridge Junior and Senior High School Curriculum

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The purpose of this study was to investigate the e-learning method in math to implement the curriculum articulation between junior high school and senior high school, and evaluated its learning effects to improve the implement method of curriculum articulation, to strengthen the students' digital mathematical materials of curriculum articulation and to quantify the analyses of the students' learning effects. The research strategies firstly concentrate on interviews to set up teaching content units; secondly evaluate and establish e-learning administrative platform, and then design e-learning materials in ADDIE systems. By previewing and revising contents of these materials, they are practically used in the library activities. In addition to record the pretest and post-test scores of the learners, the data of on-line voting are collected in order to do the comparative analyses to form conclusions as reference for the related researches.The research result showed that using e-learning methods to implement curriculum articulation activities got positive improvement not only in human efforts but also in materials and time; besides, the methods inspired the learners' motivation, strengthened the learning effects and got the positive satisfaction in the whole learning activities. Researchers suggest that the related researches should be conducted continually so as to meet problems of curriculum articulation in new curriculum of senior high school

and help those students who are in need to do automatically learning. Gradually, it can promote school into the learning resources center in the community.

Introduction

Mathematics ability is always the nuclear curriculum in our education for a long time, and it is also a sign to evaluate the scientific development of a country. Therefore, all around the world, every country invests lots of resources to develop mathematics education. Mathematics education is mainly to develop the abilities of logical thinking, abstract concepts, calculating, data analyzing, proving and judging. With the corrective train and development, learners can have better performance in their future advanced learning.

The main objects of Nine-year consistent integrated curriculum in our initial high school education is to develop ability, to focus on the whole basic information and to achieve the life time learning to adjust the change of our society.(Edu, 2003) The objects of mathematics field hope to help students to find the problems about mathematics, have the abilities to solve these problems, develop the corrective and logical communicative abilities in mathematics, have the critical and analyzing abilities in mathematics, and cultivate the ability to appreciate mathematics. These objects not only focus on mathematics skills but also emphasize the associations with other fields. Mathematics learning hopes to instruct students to observe questions, transform questions, solve questions, and communicate and analyze these problems in the hope of developing their abilities through these series of processes.

In order to help most students understand the junior high school mathematics contents, the Nine-year consistent integrated curriculum are much simpler in mathematics contents and designs. Therefore, when students get into senior high school, they feel much confused in facing with the complicated abstract concepts or calculation. This phenomenon causes students' plague and lowers their learning interests. Although Education Ministry has put funds to help senior high school and vocational high school do the mathematical curriculum articulation, it still can't satisfy the students' individual necessity. It is a temporary not a normal method to bridge the drop between junior and senior high school. Therefore, it is certainly a problem that educators and senior high school teachers have to face with.

In order to help the freshman of senior high school to be aware of the interesting about mathematics, it is senior high school mathematics teachers' responsibility to face with the students' learning drop. From the learners' level to design the implement methods, we hope to help students get the information they need. And it is what we want to do in this research about how to improve the current high school curriculum articulation in mathematics and find out the research results.

The purpose of the research

Based on the practical problems met in the real mathematical teaching surroundings, the research team members hope to find out the improvement about these related problems. The purposes of this research are as followings:

I. Improve the learning method of curriculum articulation of the first-grade senior high school students.

The first-grade students have to take 18 hours of curriculum articulation mathematics classes individually in the first and second semesters in 2005 academic year; however, they just accept 18 hours classes in the first semester in 2006 academic year. We can find that the current curriculum articulation classes are temporary not normal methods, causing some plague among school, mathematics teachers and students. If we can go through the help of internet, students can get their individual necessary learning not only in classroom but also on the internet. We hope to inspire the students' learning motivation by implementing this method.

II. Increase the learning effects of curriculum articulation of the first-grade senior high school students.

Traditionally the mathematical evaluation emphasizes on the writing evaluated. Through the processes of e-learning, the learners' learning processes and learning effects can be recorded by the learning platform management (ATSD, 2004). In addition, e-learning can promote students' learning interests, and understand students' problems by on-line questionnaire and voting functions.

Research design and implement

The purposes of this research are to implement e-learning activities, investigate students' learning effects and set up e-learning materials in the high school library. Firstly, we do the document analyses to understand the current related fields. Secondly, we use the individual interview to set up the research content schema. And then establish mathematical e-learning materials of curriculum articulation to do the practical e-learning activities. Finally, discuss the implementing effects, provide the conclusions, and offer our suggestions to help the further research in the future.

In the processes, researchers interview 13 mathematics teachers in National Yuanli Senior High School. Then use ADDIE teaching system to design teaching materials. Finally, introduce Learning Management System (ECC, 2004) to do the practical e-learning to find out the e-learning possibilities and implementing effects.

There are two schools implement 18 hours curriculum articulation at the same time based on the Education Ministry regulations. Additionally, our school mathematics teachers introduce students how to use on-line e-learning system, and lead students to use on-line learning in the computer classroom; while the next high school mathematics teachers just orally tell students how to use on-line e-learning system.

After deciding the content outlines, we start to design the necessary content materials. The finished curriculum contents show as following:

Chapter 1 Factorization and Expansion of Polynomials
1.1 Expansion of Polynomials
1.2 Factorization of Polynomials
1.3 Simplification of Roots

Chapter 2 Operations of Polynomials
2.1 Definition of Polynomials
2.2 Addition and Subtraction of Polynomials
2.3 Multiplication and Division of Polynomials

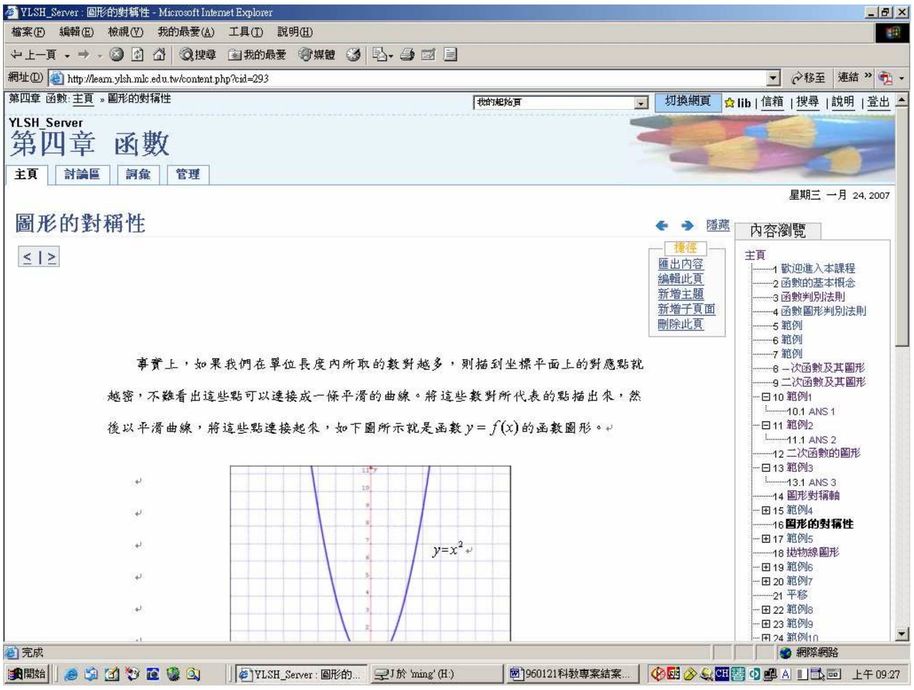
Chapter 3 Quadratic Equations
3.1 Solving Quadratic Equations of One Variable by Factorization
3.2 Solving Quadratic Equations of One Variable by Completion of the Quadratic Equations
3.3 Test of the Solution of Quadratic Equations
3.4 Relations Between Roots and Coefficients of Quadratic Equations

Chapter 4 Functions
4.1 Basic Concept of Functions
4.2 First Order Functions and Their Graphs
4.3 Second Order Functions and Their Graphs

Chapter 5 Inequalities
5.1 Inequalities of First Order with one Variable
5.2 Quadratic Inequalities with One Variable

An example of e-learning page show in Figure 1.

Figure1.



After doing the pre-test on October 23th, 2006, we lead the students to use the on-line learning system immediately. Meanwhile we do the statistic analysis about our students' pre-test and add the content materials to on-line learning about some patterns which students can't answer well. In addition, we also revise the on-line learning contents in the hope of its getting better to help students' learning.

Research Subjects

The subjects of this study are 448 students of National Yuanli Senior High School and 592 students of nearby senior high school. There are 12 classes in the first grade of National Yuanli Senior High School. Among of these 12 classes, 2 classes provide in art and language respectively and the other 10 classes are common classes, while there are 15 classes in the nearby high school. They are 11 classes distributed in 10 vocational departments and 4 classes of comprehensive department. Through e-learning activities, test their learning effects and get the testing scores to help us to do our research.

The sample of these two schools:

School	Range of entering scores	Average of entering scores
S1	148~267	207.3
S2*	188~265	224

* Excluding learning disabled students.

S1：National Yuanli Senior High School
S2：Vocational high school in Changhua

Research Results and Analysis

In order to know the students' initial ability, we do the pre-test to get related information. The test papers are the same in the pre-test and post-test. They are 25 multiple choices, which four scores in every question. We use computer to help us to do the paper evaluating, to calculate students' scores and to analysis students' answering conditions.

The names of the experimental groups are abbreviated in the tables and figures of this chapter.

National Yuanli Senior High School = S1
Vocational high school in Changhua = S2
The scores of pre-test = T1
The scores of pro-test = T2
High scores group = G1
Middle scores group = G2
Low scores group = G3
Comparison = T2-T1

The number of participants, means, standard deviations of scores for T1 and T2 are presented in Table 1, Table 2 and Table 3.

Table 1.

Paired Samples Statistics

		Mean	N	Std. Deviation	Std. Error Mean
Pair 1	T1	75.1799	1034	16.90130	.52561
	T2	80.2128	1034	14.88989	.46305

Table 2.

Paired Samples Correlations

		N	Correlation	Sig.
Pair 1	T1 & T2	1034	.735	.000

Table 3.

Paired Samples Test

		Paired Differences					t	df	Sig. (2-tailed)
					95% Confidence Interval of the Difference				
		Mean	Std. Deviation	Std. Error Mean	Lower	Upper			
Pair 1	T1 - T2	-5.03288	11.72651	.36468	-5.74847	-4.31729	-13.801	1033	.000

The number of participants, means, standard deviations of progressive grades for S1 and S2 are presented in Table 4, Table 5 and Table 6.

Table 4. S1 and S2 statistics of single variable

Between-Subjects Factors

		N
School	S1	447
	S2	587

Table 5.

Descriptive Statistics

Dependent Variable: Comparison

School	Mean	Std. Deviation	N
S1	7.9016	11.89601	447
S2	2.8484	11.11939	587
Total	5.0329	11.72651	1034

Table 6.

Tests of Between-Subjects Effects

Dependent Variable: Comparison

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	6479.707[a]	1	6479.707	49.326	.000
Intercept	29324.984	1	29324.984	223.232	.000
School	6479.707	1	6479.707	49.326	.000
Error	135569.175	1032	131.365		
Total	168240.000	1034			
Corrected Total	142048.882	1033			

a. R Squared = .046 (Adjusted R Squared = .045)

From the results of statistics, we learn that there are differences in the progressive grades of S1and S2.

Analysis of S1

The number of participants, means, standard deviations of scores for S1 are presented in Table 7, Table 8 and Table 9.

Table 7.

Paired Samples Statistics

		Mean	N	Std. Deviation	Std. Error Mean
Pair 1	T1	72.2148	447	18.15006	.85847
	T2	80.1163	447	14.38313	.68030

Table 8.

Paired Samples Correlations

		N	Correlation	Sig.
Pair 1	T1 & T2	447	.756	.000

Table 9.

Paired Samples Test

		Paired Differences					t	df	Sig. (2-tailed)
					95% Confidence Interval of the Difference				
		Mean	Std. Deviation	Std. Error Mean	Lower	Upper			
Pair 1	T1 - T2	-7.90157	11.89601	.56266	-9.00736	-6.79577	-14.043	446	.000

The average of T2-T1 equals 7.90 is significant in 95% confidence.

Because there is a large range in students' scores, we divide them into three groups with the same student numbers.

Supposed students' initial ability and pre-test scores will influence the progressive condition; therefore, we divide the pre-test scores into three groups with the same student numbers to do analyses. The results show in Table 10.

Table 10.

Report

Group		T1	T2
G1	Mean	90.3624	91.9195
	N	149	149
	Std. Deviation	4.50857	5.98141
G2	Mean	75.7315	81.9329
	N	149	149
	Std. Deviation	5.21255	9.43374
G3	Mean	50.5503	66.4966
	N	149	149
	Std. Deviation	11.34439	12.97379
Total	Mean	72.2148	80.1163
	N	447	447
	Std. Deviation	18.15006	14.38313

From Table 10, we know that students' pre-test scores would not influence their progressive conditions. Furthermore, we divide students into three groups to do analyses.

Table 11.

Tests of Between-Subjects Effects

Dependent Variable: Comparson

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	16071.374[a]	2	8035.687	75.840	.000
Intercept	27908.331	1	27908.331	263.396	.000
Group	16071.374	2	8035.687	75.840	.000
Error	47044.295	444	105.956		
Total	91024.000	447			
Corrected Total	63115.669	446			

a. R Squared = .255 (Adjusted R Squared = .251)

The progressive conditions in different groups in S1 show in Table 12.

Table 12.

Descriptive Statistics

Dependent Variable: Comparson

Group	Mean	Std. Deviation	N
G1	1.5570	6.70154	149
G2	6.2013	10.13889	149
G3	15.9463	13.04451	149
Total	7.9016	11.89601	447

In high scores group: the mean of progressive scores is 1.56, the standard deviations is 6.7, and it gets significance under 95% confidence. The results show in Table 13,Table 14 and Table 15.

Table 13..

Paired Samples Statistics

		Mean	N	Std. Deviation	Std. Error Mean
Pair 1	T1	90.3624	149	4.50857	.36936
	T2	91.9195	149	5.98141	.49002

Table 14.

Paired Samples Correlations

		N	Correlation	Sig.
Pair 1	T1 & T2	149	.208	.011

Table 15.

Paired Samples Test

		Paired Differences					t	df	Sig. (2-tailed)
					95% Confidence Interval of the Difference				
		Mean	Std. Deviation	Std. Error Mean	Lower	Upper			
Pair 1	T1 - T2	-1.55705	6.70154	.54901	-2.64196	-.47213	-2.836	148	.005

In middle scores group: the mean of progressive scores is 6.20, the standard deviations is 10.34, and it gets significance under 95% confidence. The results show in Table 16,Table 17 and Table 18.

Table 16.

Paired Samples Statistics

		Mean	N	Std. Deviation	Std. Error Mean
Pair 1	T1	75.7315	149	5.21255	.42703
	T2	81.9329	149	9.43374	.77284

Table 17.

Paired Samples Correlations

		N	Correlation	Sig.
Pair 1	T1 & T2	149	.136	.098

Table 18.

Paired Samples Test

		Paired Differences					t	df	Sig. (2-tailed)
					95% Confidence Interval of the Difference				
		Mean	Std. Deviation	Std. Error Mean	Lower	Upper			
Pair 1	T1 - T2	-6.20134	10.13889	.83061	-7.84273	-4.55996	-7.466	148	.000

In low scores group: the mean of progressive scores is 15.95, the standard deviations is 13.04, and it gets significance under 95% confidence. The results show in Table 19,Table 20 and Table 21.

Table 19.

Paired Samples Statistics

		Mean	N	Std. Deviation	Std. Error Mean
Pair 1	T1	50.5503	149	11.34439	.92937
	T2	66.4966	149	12.97379	1.06285

Table 20.

Paired Samples Correlations

		N	Correlation	Sig.
Pair 1	T1 & T2	149	.431	.000

Table 21.

Paired Samples Test

		Paired Differences					t	df	Sig. (2-tailed)
					95% Confidence Interval of the Difference				
		Mean	Std. Deviation	Std. Error Mean	Lower	Upper			
Pair 1	T1 - T2	-15.94631	13.04451	1.06865	-18.05809	-13.83453	-14.922	148	.000

Analysis of S2

The number of participants, means, standard deviations of scores for S2 are presented in Table22, Table23 and Table24.

Table 22.

Paired Samples Statistics

		Mean	N	Std. Deviation	Std. Error Mean
Pair 1	T1	77.4378	587	15.52464	.64077
	T2	80.2862	587	15.27629	.63052

Table 23.

Paired Samples Correlations

		N	Correlation	Sig.
Pair 1	T1 & T2	587	.739	.000

Table 24.

Paired Samples Test

		Paired Differences					t	df	Sig. (2-tailed)
					95% Confidence Interval of the Difference				
		Mean	Std. Deviation	Std. Error Mean	Lower	Upper			
Pair 1	T1 - T2	-2.84838	11.11939	.45895	-3.74976	-1.94700	-6.206	586	.000

The average of T2-T1 equals 2.85 is significant in 95% confidence.

Because there is a large range in students' scores, we divide them into three groups with the same student numbers.

Table 25.

Report

Group		T1	T2
G1	Mean	92.0612	90.6122
	N	196	196
	Std. Deviation	3.74526	6.97193
G2	Mean	80.3673	83.3469
	N	196	196
	Std. Deviation	3.36921	8.80455
G3	Mean	59.7949	66.8308
	N	195	195
	Std. Deviation	12.84158	16.70197
Total	Mean	77.4378	80.2862
	N	587	587
	Std. Deviation	15.52464	15.27629

Supposed students' initial ability and pre-test scores will influence the progressive condition; therefore, we divide the pre-test scores into three groups with the same student numbers to do analyses. The results show in Table 26.

Table 26.

Tests of Between-Subjects Effects

Dependent Variable: Comparson

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	7042.349[a]	2	3521.175	31.438	.000
Intercept	4786.311	1	4786.311	42.733	.000
Group	7042.349	2	3521.175	31.438	.000
Error	65411.157	584	112.005		
Total	77216.000	587			
Corrected Total	72453.506	586			

a. R Squared = .097 (Adjusted R Squared = .094)

From table 26, we know that students' pre-test scores would not influence their progressive conditions. Furthermore, we divide students into three groups to do analyses.

The progressive conditions in different groups in S2 show in Table 27.

Table 27

Descriptive Statistics

Dependent Variable: Comparson

Group	Mean	Std. Deviation	N
G1	-1.4490	6.70112	196
G2	2.9796	8.80673	196
G3	7.0359	14.63134	195
Total	2.8484	11.11939	587

In high scores group: the mean of progressive scores is -1.45, the standard deviations is 6.70, and it gets significance under 95% confidence. The results show in Table 28,Table 29 and Table 30. However the mean of pre-test scores gets 92.06 so we can know that students get limited progress.

Table 28.

Paired Samples Statistics

		Mean	N	Std. Deviation	Std. Error Mean
Pair 1	T1	92.0612	196	3.74526	.26752
	T2	90.6122	196	6.97193	.49800

Table 29.

Paired Samples Correlations

		N	Correlation	Sig.
Pair 1	T1 & T2	196	.339	.000

Table 30.

Paired Samples Test

		Paired Differences					t	df	Sig. (2-tailed)
					95% Confidence Interval of the Difference				
		Mean	Std. Deviation	Std. Error Mean	Lower	Upper			
Pair 1	T1 - T2	1.44898	6.70112	.47865	.50498	2.39298	3.027	195	.003

In middle scores group: the mean of progressive scores is 2.98, the standard deviations is 8.81, and it gets significance under 95% confidence. The results show in Table 31,Table 32 and Table 33.

Table 31.

Paired Samples Statistics

		Mean	N	Std. Deviation	Std. Error Mean
Pair 1	T1	80.3673	196	3.36921	.24066
	T2	83.3469	196	8.80455	.62890

Table 32.

Paired Samples Correlations

		N	Correlation	Sig.
Pair 1	T1 & T2	196	.191	.007

Table 33.

Paired Samples Test

		Paired Differences					t	df	Sig. (2-tailed)
					95% Confidence Interval of the Difference				
		Mean	Std. Deviation	Std. Error Mean	Lower	Upper			
Pair 1	T1 - T2	-2.97959	8.80673	.62905	-4.22021	-1.73897	-4.737	195	.000

In low scores group: the mean of progressive scores is 7.04, the standard deviations is 14.63, and it gets significance under 95% confidence. The results show in Table 34,Table 35 and Table 36.

Table 34.

Paired Samples Statistics

		Mean	N	Std. Deviation	Std. Error Mean
Pair 1	T1	59.7949	195	12.84158	.91960
	T2	66.8308	195	16.70197	1.19605

Table 35.

Paired Samples Correlations

		N	Correlation	Sig.
Pair 1	T1 & T2	195	.536	.000

Table 36

Paired Samples Test

		Paired Differences					t	df	Sig. (2-tailed)
					95% Confidence Interval of the Difference				
		Mean	Std. Deviation	Std. Error Mean	Lower	Upper			
Pair 1	T1 - T2	-7.03590	14.63134	1.04777	-9.10238	-4.96941	-6.715	194	.000

Through the experimental results, we find students in middle scores group and low scores group get significant progress after one month learning. This means if they can strengthen their learning in mathematics and promote their interest in mathematics the students with lower achievement will get significant assistance.

On-line voting results analyses

In order to know the learners' e-learning behaviors, we design some learning strategies, learning effects and opinions feedback. Meanwhile, we encourage students to express their opinions on-line by the voting functions on the learning platform, providing us to do necessary research analyses.

Every registered member has one voting right to every question. After their voting, the results will show on the computer screen automatically. The viewers can quickly understand the results of voting and get the new cognition about the issue. After finish the learning curriculum, researchers can get into the learning platform as an administrator, download the voting materials and then divide these materials into three parts to do discussion.

I. The analyses about students' information environment and information behaviors.

Through our research, we find that 92%student members have internet system at home, and 84% students consider that our internet information system reaches well in Taiwan and it is good for e-learning. Moreover, 83% students get on-line once a week and 92% students spend more than 30 minutes surfing internet. Therefore, our e-learning materials implement once a week for 30 minutes.

II. The analyses about learning strategies and learning necessities.

Teaching design, teaching contents, and activities design are the main learning activities for students. Without proper arrangement, these activities will increase students' problems. In this research, there are 60%~68% students think that e-learning in mathematics curriculum articulation is good for their learning. This means our learning activities design is positive but it leaves much to do improvement. And it deserves to do future research and revision.

III. The analyses about learning interests and learning effects.

60%~65% students express that this e-learning activities can promote their interests and effects in mathematics learning. This statistics can be accepted but it is not satisfying to us. The students consider that it is necessary for them to be guided by the teachers in the learning process. In addition, they hope that curriculum contents have to add some animated cartoon, background music and provide game testing functions in the learning process. And the most important reason for them to do e-learning is that digital curriculum can match with school teaching schedules and tests. Therefore, in order to promote students' learning interests, these are what we can improve.

Conclusion

I. It is good for e-learning activities in our mature internet environment.

Internet has become the necessity in this informative society in 21st century. Every country invests lots of efforts in e-learning industry all around the world. So we also have to promote e-learning actively.

II. It is available to implement curriculum articulation in senior high school freshmen.

In order to help these high school freshmen to quickly adjust mathematics curriculum and bridge the drop in their mathematics ability, it is teacher's responsibility to help them find the solution from the learners' level to design the learning materials.

III. It is effective to implement e-learning activities in curriculum articulation in high school freshmen.

In this research, initially, we compare students' pre-test and post-test scores to understand the effects of e-learning. From the statistics, we find students get progress through the e-learning; especially for the lower grade students, they get significant progress no matter in our school or in the nearby high school. It shows that this learning activity can actually help those who are in need to improve their learning condition.

IV. It can improve traditional curriculum articulation by adding e-learning.

Traditional curriculum articulation is temporary method not normal one, so it is doubtful in its effects.

Suggestion

I. Continue to set up complete mathematics digital curriculum articulation learning.

Due to many reasons, this research just focuses on polynomial in e-learning. Through our study, we find that it is available to introduce e-learning in high school mathematics curriculum articulation.

II. Design the different teaching activities to inspire students' learning motivation automatically.

About 70% students approve of this digital curriculum articulation learning. They show positive attitude about this learning activities, but they leaves much room to do improvement.

III. Combine community high school league to implement e-learning activities.

If high school can form into a league and add the concept of e-learning, it will be beneficial to a large number of learners.

IV. Promote e-learning activities to other subjects.

High school new curriculum is implemented in 2006 academic year. High school learning environment is much different. In order to inspire students' learning interests, cultivate their voluntary learning, in addition to formal curriculum, it is necessary to provide another learning method for students to do voluntary learning.

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