Journal of Mathematics Education at Teachers College

Fall – Winter 2010

A Century of Leadership in Mathematics and its Teaching

TABLE OF CONTENTS

Foreword

Preface

Articles

TABLE OF CONTENTS, continued

The *Journal of Mathematics Education at Teachers College* is a publication of the Program in Mathematics and Education at Teachers College Columbia University in the City of New York.

This issue's cover and those of future issues will honor past and current contributors to the Teachers College Program in Mathematics. Photographs are drawn from the Teachers College archives and personal collections.

This issue honors Dr. Alexander P. Karp, an Associate Professor in the Program in Mathematics at Teachers College. A native of St. Petersburg, Russia who is the author of more than one hundred publications including textbooks used throughout Russia, Professor Karp represents Teachers College at meetings and conferences throughout the world as well as through his role as managing editor of the *International Journal for the History of Mathematic Education*.

Former Teachers College Professor and Mathematics Education Chair, Howard Franklin Fehr, was among the most influential mathematics educators of his era. Through his many international contacts, he was the organizer of conferences, projects, and publications including the Congresses of Mathematics Education, a seminal conference on Needed Research in the field, and curriculum initiatives including the Secondary School Mathematics Curriculum Improvement Study.

Aims and Scope

The *JMETC* is a re-creation of an earlier publication by the Teachers College Columbia University Program in Mathematics. As a peer-reviewed, semi-annual journal, it is intended to provide dissemination opportunities for writers of practice-based or research contributions to the general field of mathematics education. Each issue of the *JMETC* will focus upon an educational theme. Themes planned for the 2011 issues are: *Mathematics Curriculum* and *Technology*. *JMETC* readers are educators from pre K-12 through college and university levels, and from many different disciplines and job positions—teachers, principals, superintendents, professors of education, and other leaders in education. Articles to appear in the *JMETC* include research reports, commentaries on practice, historical analyses and responses to issues and recommendations of professional interest.

Manuscript Submission

JMETC seeks conversational manuscripts (2,000-2,500 words in length) that are insightful and helpful to mathematics educators. Articles should contain fresh information, possibly research-based, that gives practical guidance readers can use to improve practice. Examples from classroom experience are encouraged. Articles must not have been accepted for publication elsewhere. To keep the submission and review process as efficient as possible, all manuscripts may be submitted electronically at www.tc.edu/jmetc.

Abstract and keywords. All manuscripts must include an abstract with keywords. Abstracts describing the essence of the manuscript should not exceed 150 words. Authors should select keywords from the menu on the manuscript submission system so that readers can search for the article after it is published. All inquiries and materials should be submitted to Ms. Krystle Hecker at P.O. Box 210, Teachers College Columbia University, 525 W. 120th St., New York, NY 10027 or at JMETC@tc.columbia.edu

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Call for Papers

The "theme" of the spring issue of the *Journal of Mathematics Education at Teachers College* will be *Mathematics Curriculum*. This "call for papers" is an invitation to mathematics education professionals, especially Teachers College students, alumni and friends, to submit articles of approximately 2000-2500 words describing research, experiments, projects, innovations, or practices related to mathematics curriculum. Articles should be submitted to Ms. Krystle Hecker at jmetc@tc.edu by January 1, 2011. The spring issue's guest editor, Nicholas Wasserman, will send contributed articles to editorial panels for "blind review." Reviews will be completed by February 1, 2011, and final drafts of selected papers are to be submitted by March 1, 2011. Publication is expected in mid-April, 2011.

Call for Volunteers

This *Call for Volunteers* is an invitation to mathematics educators with experience in reading/writing professional papers to join the editorial/review panels for the spring 2011 and subsequent issues of *JMETC*. Reviewers are expected to complete assigned reviews no later than 3 weeks from receipt of the blind manuscripts in order to expedite the publication process. Reviewers are responsible for editorial suggestions, fact and citations review, and identification of similar works that may be helpful to contributors whose submissions seem appropriate for publication. Neither authors' nor reviewers' names and affiliations will be shared; however, editors'/reviewers' comments may be sent to contributors of manuscripts to guide further submissions without identifying the editor/reviewer.

If you wish to be considered for review assignments, please request a *Reviewer Information Form*. Return the completed form to Ms. Krystle Hecker at jmetc@tc.edu or Teachers College Columbia University, 525 W 120th St., Box 210, New York, NY 10027.

Looking Ahead

Anticipated themes for future issues are:

Spring 2011	Curriculum
Fall 2011	Technology
Spring 2012	Evaluation
Fall 2012	Equity
Spring 2013	Leadership
Fall 2013	Modeling
Spring 2014	Teaching Aids
Fall 2014	Special Students

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The Analysis on the Length and Content Changes on Secondary Mathematics Textbooks in North Korea

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North Korea is one of the most closed nations in the world. It is difficult to access information about their education system. North Korea's economic system was reorganized on July 1, 2002, as well as the education system. This change has impacted North Korea's mathematics education. With limited information on North Korean mathematics textbooks, this study examines the North Korean education system and compares the content and length of mathematics textbooks of the mid-1990s and 2002s.

Introduction

According to last year's results of the International Mathematics Olympiad, the North Korea team ranked in fifth place, behind China, Japan, Russia, and South Korea, among 97 countries (International Mathematics Olympiad, 2010). The U.S team came in sixth. North Korea's team participated in the International Mathematics Olympiad for the first time in 1990, and it placed 19th among more than 100 countries. Since 1993, when they were in 16th place, until 2006, North Korea had stopped participating in the Olympiad due to President Kim Il Sung's unexpected death on July 8, 1994, when his successor Kim Jong Il's era began. During Kim Jong Il's regime, the North Korean team returned to the International Mathematics Olympiad and ranked 8th in 2007 and 7th the following year. Considering the drastic change in rankings, it would be interesting to question what has changed within North Korea's mathematics education from 1994 to 2007.

On July 1, 2002, eight years after Kim Jong Il became the leader of North Korea, he reorganized the economic system as well as the education system (U.S. Library Congress, 2003). This was a major change in North Korea's history. This change of the education system has impacted the country's mathematics education as well. As a result of the reorganization, new mathematics textbooks were published by the North Korean government (Korean Association of North Korean Studies, 2006). This study intends to introduce North Korea's education system and answer the above question of comparing the mathematics textbooks of the mid-1990s with those from 2002.

Limitations of the Study

(1) Since North Korea is one of the most restricted nations in the world, the general public does not have access to North Korean textbooks. The Ministry of Unification in South Korea classifies North Korean textbooks as special materials in the Data Center, which makes them difficult to access. Most textbooks are not original copies but photocopied documents.

(2) Mathematics textbooks are the only documents available to answer the question "What has changed in Mathematics Education in North Korea?" Unfortunately, there is no information about how teachers use the textbooks in classrooms; therefore, the findings of this study must be interpreted in light of these limitations.

The Education System in North Korea

Juche *Education*

The main North Korean education is *Juche*, which refers to a unique political ideology in education (Ministry of Unification, 1987). *Juche* was developed by the former leader Kim Il Sung in 1975; however, the ideas were introduced much earlier and were continued by his son and current leader, Kim Jong Il (Ministry of Unification, 1987). *Juche* is most often translated as "self-identity" or "self-reliance," but its meaning is still not clear (Bunge, 1981). *Juche* can also refer to national pride, national assertiveness or national identity, depending on the context (Bunge, 1981). As North Korean education focuses on *Juche*, the ideological curriculum starts from the primary level to the secondary level. Students study about the life and endeavors of both Kim Il Sung and Kim Jong Il in primary schools. Then in secondary schools, students learn about the revolutionary accomplishments of Kim Il Sung and Kim Jong Il.

Education System

The education system in North Korea is free and universal, beginning at the age of four until the age of fifteen, comprising an eleven-year compulsory education (Mantri, 1981). Table 1 shows there are four levels of education; kindergarten, primary, secondary, and college and university (Ministry of Education, 2004).

Table 1. Levels of Education and System

Grade Level	Years/Grade	Age(s)	System
Kindergarten (*Yuchiwon)*	1~2 years	4~5 year olds	Formal/1 yr. compulsory
Primary School (*Inmin Hackgyo)*	4 years/1~4	6~10 year olds	Formal/compulsory
Secondary School (*Kodeung Chunghakgyo)*	6 years/1~6	11~16 year olds	Formal/compulsory
College & University (*Deahak)*	2~12 years	Adult	Formal/Informal

During the primary level, students learn about communist morality, North Korean language, mathematics, history, science, physical training, arts, and basic engineering (Ministry of Unification, 2008). At the secondary level, students learn about communist party policies and morality, North Korean language, mathematics, history, geography, chemistry, biology, physics, physical training, art, electronic technology, and engineering (Ministry of Unification, 2008). Under Kim Jong Il's reign, English and Chinese, in place of Russian, were introduced to construct a more globalized nation (Korean Association of North Korean Studies, 2006). The English language would be helpful in increasing foreign currency from international trade, and the Chinese language would be used to read the text of South Korea's policy for reunification, as it is mainly written in Chinese characters.

According to North Korea's Ministry of Education (2004), the total number of students in 2004 was approximately 1.5 million children in over 28,000 nurseries, approximately 757,000 children in 14,312 kindergarten schools, 1.65 million students in 4,948 primary schools, 2.25 million students in 4,825 secondary schools, and 1.9 million students attending more than 300 colleges and universities.

Teacher Education

The teaching certification program requirements are different for primary and secondary levels. The primary level certification requires a three-year teacher college training licensure, whereas the secondary level certification requires four years (Ministry of Education, 2004). For primary teacher training schools, there are thirteen colleges throughout the country, and each city or region has its own teacher training college (Ko & Park, 2002). For secondary training schools, there are nineteen four-year education universities that offer licensure throughout the country (Ko & Park, 2002). Teachers are required to renew their licenses by attending retraining sessions in reeducation institutes. In addition to renewing teacher licenses, every summer or winter, all teachers are tested to assess their ideological correctness (Oh & Hassing, 2000).

In 2003, UNESCO reported that North Korea had approximately 37,000 pre-school and kindergarten teachers, approximately 69,000 primary school teachers, and approximately 112,000 secondary school teachers.

Mathematics Curriculum in North Korea

Method

After the North Korean government began to reorganize its economic system on July 1, 2002, many changes were also made within their mathematics curriculum. New mathematics textbooks were published in 2002 (Ministry of Education, 2004). Textbooks are one of the most important materials for understanding a nation's mathematics curriculum. This study analyzes the changes in the new textbooks by comparing them to previous textbooks.

In order to analyze the changes, North Korean mathematics textbooks were needed. As mentioned previously, it is impossible to purchase or borrow the textbooks in public. With the help of the author's colleague and by requesting to the Ministry of Unification in South Korea, it was possible to collect copies of mathematics textbooks, which enabled the analyses of content and length. All information was translated into English. This study then analyzed the mathematics textbooks in terms of their content and length.

The Changes in Contents

To compare North Korea's secondary mathematics textbooks, two specific textbooks were used in the comparison: the mid-1990s textbook (Kim, 1996a; Kim, 1996b; Oh, 1996; Oh, 1995; Park, 1994; Rue, 1995; Seo, 1996) and the 2002 textbook (Lee, 2002a; Lee, 2002b; Nam, 2002; Rue, 2002a; Rue, 2002b;). Appendix 1 shows the contents of secondary school mathematics textbooks in both the mid-1990s and 2002. One of the significant changes that occurred in mathematics textbooks in 2002 is that the algebra and geometry contents were combined to one textbook, as opposed to the contents being used as separate textbooks in the mid-1990s. The changes are as follows:

- For 1st year textbooks, there was a 62-page total decrease in the sections on fractions, integers, lines and angles, and triangles, and there was a 13-page decrease in the review section.
- For the 2nd year, linear functions, systems of linear equations, expansion and factorization, and circle chapters were decreased by a total of 27 pages. The variable and expression sections were decreased by 11 pages and moved to the 1st year textbook.
- For the 3rd year, the section on properties of polygons was decreased by 13 pages, and the section on systems of linear equations with 3 variables was eliminated. However, the section on quadratic functions was increased by 12 pages.
- For the 4th year, rational expressions and complex expressions, sequences, proportions and trigonometric functions, congruence of geometric figures and an additional theorem of trigonometric functions section were reduced by a total 37 pages.
- For the 5th year, the portion on properties of plane figures was eliminated and an additional theorem of trigonometric functions was moved to the 4th year. The chapter on trigonometric functions was augmented by 9 pages and a new 5-page section on set theory was added.
- For the 6th year, the section on calculators and programming was deleted, but 23 pages of probability and statistics were added. Moreover, the chapter on differentiation and integration in the 2002 textbook was decreased by 41 pages because the differentiation and integration chapters in the mid-1990s textbook were combined into one chapter.

The changes in terms of content and page numbers are: similar contents were combined to one section or chapter, and the mathematics concepts that were difficult for students to understand were either decreased in terms of page numbers or eliminated altogether.

There are typically five content areas in North Korea mathematics education; Number & Operation, Expression & Equation, Function, Probability & Statistics, and Geometry (Lim, 2004). Table 2 shows the portion of areas in 2002's mathematics textbooks. It seems that four areas, Number & Operation (24.48%), Expression & Equation (26.70%), Function (21.14%), and Geometry (22.95%) except Probability & Statistics (4.73%), are the main areas in the mathematics textbooks. Number & Operation content occupies a large portion of the 1st year textbook and is retained in the mathematics textbooks up until the 5th year. The textbooks contain Expression & Equation from the 1st to the 4th years and the 6th year. Students study Functions from the 2nd to 5th year. Probability & Statistics area, however, shows up only in the 6th year textbook. On the other hand, Geometry is shown throughout all textbook levels. None of the secondary textbooks dealt with all five areas.

How about the area changes between the mid-1990s textbooks and 2002? Since some pages have been omitted due to the lack of information available, this study compares only 1st and 2nd year textbooks. Table 3 shows the portion of areas. The portion of Geometry decreased by 3.16%, but Number & Operation and Expression & Equation increased by 1.28% and 2.21%, respectively. It could be concluded that there is no significant difference between the textbooks from the mid-1990s and 2002.

The Changes in Page Length

Another significant change can be observed in the length of pages in North Korea's secondary mathematics textbooks. Table 4 shows the total number of pages of the mid-1990s and 2002 secondary mathematics textbooks.

Table 2. The Portion of Pages Per Area in 2002's Mathematics Textbooks

Textbook	**Secondary School Year**	**Areas** Number & Operation	Expression & Equation	Function	Probability & Statistics	Geometry	**Total Pages**
2002	1	80	42	0	0	16	138
	2	18	45	19	0	67	149
	3	49	49	20	0	39	157
	4	20	29	47	0	14	110
	5	9	0	66	0	19	94
	6	0	27	0	34	10	71
	Total Pages	176	192	152	34	165	719
	%	24.48%	26.70%	21.14%	4.73%	22.95%	100%

Table 3. The Comparison of Portion of Areas

Textbook	Secondary School Year	Areas					Total Pages
		Number & Operation	Expression & Equation	Function	Probability & Statistics	Geometry	
Mid-1990s	1	122	25	0	0	46	193
	2	40	41	26	0	74	181
	Total Pages	162	66	26	0	120	374
	%	43.32%	17.65%	6.95%	0%	32.08%	100%
2002	1	80	42	0	0	16	138
	2	48	15	19	0	67	149
	Total Pages	128	57	19	0	83	287
	%	44.60%	19.86%	6.62%	0%	28.92%	100%

Table 4. The Total Number of Pages of the Mid-1990s' and 2002's Secondary Mathematics Textbooks

Secondary School Year	Mid-1990s' Textbook		2002 Textbook Number of Pages	Number of Difference
	Number of Pages	Total		
1	Algebra – 184 Geometry – 63	247	150	-97
2	Algebra – 156 Geometry – 92	248	180	-68
3	Algebra – 135 Geometry – 63	198	190	-8
4	Algebra – 99 Geometry – 83	182	150	-32
5	Mathematics	176	110	-66
6	Mathematics	184	86	-98

The difference in the number of pages for the 1st year is 97, 68 for the 2nd, 8 for the 3rd, 32 for the 4th, 66 for the 5th, and 98 for the 6th year. This shows that there was a decrease in the pages of textbooks, a total of 368 pages, by approximately 30%, compared to 1,235 pages, which is the total page number of the mid-1990s mathematics textbooks.

Due to the lack of information available, it is difficult to identify the cause of these changes; however, this study hypothesizes two reasons. First, the reason for these changes may be due to the decreased time allotment of mathematics in a school day at the secondary level. One of the major changes in the education system was improving science and technology education (Ministry of Education, 2004). According to the school time allotment in secondary school (Ko & Park, 2002), the ministry of education in North Korea opened a new computer class in secondary schools so that students from 4th to 6th year were enrolled in the class for two hours a week. This may have cut into time previously allocated for mathematics. The second reason may be that North Korea's economy was destabilized and the government did not have enough education funds to publish textbooks with large numbers of pages.

Conclusion

This study examined North Korea's education system and analyzed their mathematics curriculum based on the comparison of textbooks between the mid-1990s and 2002. Their education system is based on *Juche* education, the ideological curriculum, which starts from primary school. Secondary school, which is compulsory education for all students, starts from ages 11 to 16. This is the equivalent of grades 5 to 10 in the U.S.

The study shows three major changes within content and length of mathematics textbooks. First, similar contents were combined into one section or chapter. For example, the properties of rectangles and basic geometry figures were combined with the properties of triangles and rectangles in 2nd year. Also, difficult mathematics concepts were eliminated from textbooks or decreased in terms of the number of pages. For example, mathematical induction was eliminated in the 6th year, and differentiation and integration were combined into one section in the same year.

Second, there has been a decrease in the number of pages of mathematics textbooks by about 30%. One of the reasons for decreasing the number of pages is that algebra and geometry textbook contents were separate until the 1990s, but by 2002, the contents were combined into one textbook. The following suggests two reasons: (1) After July 1, 2002, a new computer class was opened in secondary school to improve science and technology education which, as a result, decreased the school time allotment in mathematics. (2) the Ministry of education in North Korea may not have had enough funds to publish textbooks with a large number of pages.

Third, Number & Operation, Expression & Equation, Function, Probability & Statistics, and Geometry are five areas of mathematics curriculum in North Korea. The portion of four areas except Probability & Statistics was balanced in 2002 textbooks. Probability & Statistics was offered only once, at the 6th year. On the other hand, Geometry was included in all secondary textbooks. In terms of portion changes of those five areas between the mid-1990s and 2002, there were no major changes.

An exploratory study that compares Singapore's mathematics textbooks with U.S. mathematics textbooks shows that grade 6 *Everyday Math* contains 37% of Number & Operation, 19% of Algebra, 18% of Geometry, and 22% of Data Analysis & Probability (U.S Department of Education Policy and Program Studies Service, 2005). North Korea's 2nd year mathematics textbook, which is the equivalent of grade 6 in the U.S., shows 32.21% of Number & Operation, 22.82% of Algebra, 44.97% of Geometry, and 0% of Probability & Statistics. From the above comparison and result of this study, North Korean textbooks contain Geometry every year and in large portions, especially during the 2nd year. What about the U.S. textbooks? They consist of 18% of Geometry. Most secondary students in the U.S. have a difficult time learning geometry. If textbooks contained more Geometry, would it help students learn its content?

This study was unable to address the following questions and suggests them as areas of future research: (1) How do teachers utilize the mathematics textbook and how do students learn from the textbook in class? (2) What kinds of problems are found in the textbook, and what is their level of difficulty? (3) What are teachers' opinions of the changes in the textbook? (4) How is the ideological curriculum contained in mathematics textbooks? These are some research questions that may allow a further understanding of North Korea's mathematics education.

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Appendix 1
The Contents and Page Numbers of Secondary School Mathematics Textbooks

1st Year		2nd Year	
Mid-1990s	**2002**	**Mid-1990s**	**2002**
(Algebra)	I. Natural Number	(Algebra)	I. Ratio & Rate
I Natural Number	1.Natural number p.4	I. Letter & Expression	1.Ratio & rate p.4
1.Natural number p.3	2.Arithmetic p.8	1.Letter p.3	2.Rate & inverse rate p.16
2.Natural number arithmetic p.9	3.Divisors and multipliers p.12	2.Expression p.15	3.Review p.23
3.Divisors and multipliers p.16	4.Factorization p.19	3.Polynomials p.16	
4.Factorization p.24	5.Review p.24	4.Adding & subtracting p.21	II. Linear Equation
5.Review p.30		5.Review p.27	1.Linear equation p.25
	II. Line & Angle		2.Solving linear equation p.29
II. Fraction	1.Line p.27	II. Linear Function	3.Application of linear equation
1.Properties of fraction p.35	2.Angle p.33	1.Function & graph p.33	p.35
2.Adding & subtracting p.48	3.Review p.40	2.Linear function & graph p.42	4.Review p.40
3.Multiplying & dividing p.56		3.Linear function with 2 variables	
4.Fraction & decimal p.67	III. Fraction	p.53	III. Triangle & Rectangle
5.Percent p.74	1.Properties of fraction p.41	4.Review p.60	1. Reflection & Rotation p.42
6.Review p.80	2.Fraction arithmetic p.49		2.Triangle p.54
	3.Fraction & decimal p.63	III. Linear Equation	3.Rectangle p.60
III. Integer	4.Review p.80	1.Linear equation with 2 variables	4.Area p.68
1.Negative integer p.88		p.66	5.Review p.77
2.Adding & subtracting P.100	IV. Horizontal & Vertical Line	2.Solving linear equation p.72	
3.Multiplying & dividing p.112	1.Vertical line p.70	3.Application of linear equation	IV. Linear Function
4.Review p.125	2.Horizontal line p.75	p.80	1.Coordinates p.81
	3.Review p.77	4.Review p.85	2.Linear function p.85
IV. Equation & Inequality			3.Solving linear equation with
1.Equation & calculation p.131	V. Integer	IV. Expansion & Factorization	graph p.95
2.Meaning of equation &	1.Positive & negative integer p.79	1.Property of exponent p.92	4.Review p.101
inequality p.139	2.Adding & subtracting P.89	2.Multypling polynomials p.100	
3.Equation p.143	3.Multiplying & dividing p.96	3.Multiplying & factorization	V. Expansion & Factorization
4.Inequality p.151	4.Review p.103	formula (1) p.114	1.Property of exponent p.105
5.Review p.157		4.Multiplying & factorization	2.Expansion & factorization p.111
	VI. Triangle	formula (2) p.125	3.Multiplying & factorization
V. Ratio & Rate	1.Polygon p.104	5.Review p.133	formula p.121
1.Ratio & rate p.163	2.Triangle p.106		5.Review p.136
2.Rate & inverse rate p.173	3.Review p.109	(Geometry)	
3.Review p.181		I. Plane Figure	VI. Circle
	VII. Letter & Expression	1.Reflection p.3	1.Circle p.139
(Geometry)	1.Letter & Expression p.110	2.Rotation p.8	2.Drawing circle p.145
I. Line & Angle	2.Polynomials p.113	3.Review p.19	3.Circumference & area p.150
1.Line p.3	3.Review p.123		4. Review p.155
2.Angle p.17		II. Rectangle	
3.Measuring angle & Vertical line	VIII. Equation & Inequality	1.Rectangle p.22	VII. Solid Figure
p.24	1.Equation p.124	2.Area p.30	1.Cylinder & prism p.159
4.Horizontal line p.30	4.Inequality p.138	3.Review p.39	2.Sphere p.170
5. Review p.37	5.Review p.149		3.Volume of sphere p.173
		III. Circle	4.Review p.178
II. Triangle		1.Circle p.44	
1.Triangle p.42		2.Circumference & area p.50	
2.Various triangles p.51		3.Circle & straight line p.55	
3.Review p.56		4.Drawing circle p.59	
		5. Review p.66	
		IV. Solid Figure	
		1.Circumference of cylinder &	
		prism p.71	
		2.Sphere p.81	
		3.Volume of sphere p.84	
		4.Review p.89	

3rd Year		4th Year	
Mid-1990s	**2002**	**Mid-1990s**	**2002**
(Algebra) I. Fraction Equation 1.Fraction Equation p.3 2.Reducing fraction & common denominator p.6 3.Fraction calculation p.14 4.Review p.22 II. Linear Equation & Inequality 1.Linear equation with 3 variables p.27 2.Linear inequality p.31 3.Solving linear inequality p.38 4.Application of linear inequality p.42 5.Review p.45 III. Estimation 1.Approximation & error p.49 2. Scientific Notation p.59 3.Calculation scheme p.63 4.Review p.66 IV. Square Root & Real Number 1.$y=x^2$ function p.69 2.Square root p.72 3.Calculating square root p.78 4.Expression p.86 5.Review p.99 V. Quadratic Equation & Function 1.Linear function p.102 2.Quadratic equation p.107 3.Solving quadratic equation p.111 4.Application of quadratic equation p.122 5.Review p.127 (Geometry) I. Triangle 1.Method of proof 2.Triangle 3. Review II. Rectangle 1.Parallelogram 2.Rectangle & square 3.Drawing 4.Review III. Circle & Polygon 1.Circle & triangle 2.Angle at circumference 3.Circle & rectangle 4. Review	I. Fraction Equation 1.Fraction Equation p.4 2.Fraction calculation p.17 3.Review p.25 II. Linear Inequality 1.Number line & interval p.28 2.Linear inequality p.31 3.Application of linear inequality p.40 4.Review p.43 III. Property of Polygon 1.Triangle p.46 2.Rectangle p.54 3.Drawing p.59 4.Review p.64 IV. Estimation 1.Approximation & error p.67 2.Calculation of approximation p.73 3.Review p.77 V. Square Root & Real Number 1.Real number p.78 2.Square root p.88 3.Calculating square root p.108 4.Review p.119 VI. Quadratic Equation 1.Quadratic equation p.122 2.Formula of solving quadratic equation p.128 3.Application of quadratic equation p.135 4.Review p.138 VII. Quadratic Function 1.Linear function & graph p.140 2.Solving quadratic equation with graph p.157 3.Review p.161 VIII. Circle & Polygon 1.Circle & triangle p.164 2.Angle at circumference p.170 3.Circle & rectangle p.180 4. Review p.187	(Algebra) I. Number and Expression 1.Complex number p.3 2.Division of polynomial p.10 3.Rational & irrational expression p.15 4.Review p.26 II. Function 1.Function p.31 2.Quadratic function p.37 3.Fractional & irrational function p.49 4.Review p.54 III. Equation 1.Quadratic equation p.59 2.Application of quadratic equation p.63 3.Review p.70 IV. Inequality 1.Proof of inequality p.74 2.Quadratic inequality p.78 3.Application of quadratic inequality p.82 4.Review p.85 V. Sequences 1.Sequence p.89 2.Arithmetic sequences p.91 3.Geometric sequences p.96 4.Review p.100 (Geometry) I. Proportional & Trigonometric Ratio 1.Proportional ratio 2.Trigonometric ratio 3.Review II. Congruence of Geometric Figures 1.Symmetric 2.Congruence 3.Review III. Similarity of Geometric Figures 1. Pythagorean theorem 2.Calculating trigonometric ratio	I. Proportional & Trigonometric Ratio 1.Proportional ratio p.4 2.Trigonometric ratio p.12 3.Review p.19 II. Rational & Irrational Expression 1.Division of polynomial p.21 2.Rational expression p.25 3.Irrational expression p.31 4.Review p.33 III. Function 1.$y=ax^2+bx+c$ & graph p.35 2.Fractional & irrational function p.42 3.Review p.59 IV. Equation 1.Quadratic equation p.61 2.Fractional & irrational equation p.65 3.Review p.73 V. Inequality 1.Proof of inequality p.75 2.Quadratic inequality p.78 3.Fractional & irrational inequality p.81 4.Review p.83 VI. Congruency of Geometric Figures 1.Congruence p.85 2.Triangle congruency p.88 3.Congruent ration p.97 4.Review p.100 VII. Exponent and Logarithm 1.Exponent p.106 2.Logarithm p.113 3.Review p.123 VIII. Trigonometric Ratio 1.Property of trigonometric ratio p.130 2.An addition theorem of trigonometric functions p.134 3. 4.Review p.139 IX. Sequences 1.Arithmetic sequences p.141 2.Geometric sequences p.144 3.Review p.148

5th Year		6th Year	
Mid-1990s	**2002**	**Mid-1990s**	**2002**
I. Properties of Plane figures	I. Function, Equation & Inequality	I. Calculator & Program	I. Permutation & Combination
1.Basic properties of plane figures & proof	1.Function p.3	1.Calculator	1.Permutation p.3
	2.Square function p.12	2.Algorithm	2.Combination p.7
2.Properties of plane figures & method of proof	3.Equation p.14	3.Program	3.Binomial Theorem p.12
	4.Inequality p.22		
	5.Review p.28	II. Permutation & Combination	II. Probability & Statistics
II. Equation & Inequality		1.Permutation	1.Probability p.17
1.Equation	II. Exponential & Logarithmic Function	2.Combination	2.Arrangement of a set of data p.27
2.Inequality		3.Binomial Theorem	
	1.Exponential function p.30	4.Mathematical Induction	3.Summary of a set of data p.31
III. Square Function	2.Logarithmic function p.36		4.Measures of dispersion p.35
1.Root of nth power	3.Review p.40	III. Space Figures	5.Review p.40
2.Square function		1.Straight line & parallel plane in 3-dimension	
	III. Trigonometric Function		III. Equation in the Plane
IV. Exponential & Logarithmic Function	1.Angle & trigonometric function p.42	2.Straight line & perpendicular plane in 3-dimension	1.Equation of straight line p.41
			2.Conic curve p.48
1.Exponential function	2.Graph p.43	3.Polyhedron & rotor	
2.Logarithm	3.Inverse trigonometric function p.54	4.Volume	V. Differentiation & Integration
3.Logarithmic function			1.Limit p.57
4.Calculating logarithm	4.Trigonometric equation p.61	IV. Equation in the Plane	2.Differentiation p.63
	5.Review p.65	1.Equation of straight line	3.Integration p.76
V. Trigonometric Function		2.Conic curve	4.Review p.85
1.Definition of trigonometric function	IV. Trigonometric Identities		
	1.Sine and Cosine p.65	V. Differentiation	
2.Trigonometric function	2.Trigonometric identities p.72	1.Limit & continuity	
3.Graph	3.Complex number & trigonometric p.75	2.Differentiation	
		3.Rules of differentiating functions	
VI. Trigonometric Identities	4.Review p.77	4.Applicaiton of differentiation	
1.Angle sum			
2.Angle sum formula	V. Set & Logic	VI. Integration	
3.Inverse trigonometric function	1.Properties of set p.78	1.Indefinite integrals	
4.Complex number & trigonometric	2.Logic & proof p.82	2.Definite integrals	
	3.Review p.88	3.Application of integration	
	VI. 3-Dimensional Figures		
	1.Plane & straight line in 3-dimension p.89		
	2.Polyhedron p.96		
	3.Rotor p.103		
	4.Review p.109		

(Note: Some pages have been omitted due to the lack of information available.)