

**Worlds Apart:
An Analysis of Issues Associated with
Mathematics Education in
Ireland and the United States**

An Honors Thesis (HONRS 499)

by

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Abstract

While a strong history and working relationship has developed between Ireland and the United States, there are still many differences which shape the lifestyle of citizens within each respective country, especially with respect to education. Historical aspects, views toward religion, and long-standing relationships with nearby countries shape the overall education of Ireland and the United States in different ways. Curriculum, instruction, and assessment issues are all shaped by a variety of factors individual to each country, and are therefore surprisingly dissimilar in nature. Mathematics education is also affected within each individual country. Aspects related to technology, content learned by students, teaching methods, and assessment strategies are specifically tailored to meet the goals of each respective society. In particular, the effect of technology has dramatically differentiated the mathematics curriculum and content received by students in Ireland and the United States. The introduction of content standards has dramatically shaped what curriculum is received by students in the classroom and how teachers prepare the lessons they teach. The process of gaining an education as a mathematics teacher is influenced by the size of each country, the responsibilities placed upon teachers by each society, and the general interests of the students in their respective classrooms. Certification procedures are controlled by specific government regulations and the institutions which prepare future teachers for their roles in the classroom. The professional role of the teacher in each country has been dramatically shaped by the societies in which they live and work. Collaboration, views toward professional development, and other issues play a major role within the professional lives of teachers.

Introduction

The Opportunity of a Lifetime

As I was casually walking to class one day through the Honors College reception area, I stopped to check the information table, where various announcements were posted. Usually I perused the selections with little thought, content with the college experience I already enjoyed. However, as I was scanning the selection, one announcement caught my attention. The Honors College was sponsoring a pilot program for a study abroad experience in Ireland. As I picked up the green sheet of paper and continued reading, I began to think of the opportunity available to me. My father and I had talked for years about taking a trip there after I graduated from Ball State. Now it appeared we would be taking our trip much sooner than we first thought, and I would enjoy the experience of a lifetime by studying abroad.

As the beginning of my senior year started, I began to consider the coming year with great anticipation. This would be the pinnacle of my collegiate career, and the opportunities for success were bountiful. I was already excited about teaching an intermediate algebra course at the college level and tutoring some calculus students. While running from classroom to classroom for my various school responsibilities, I still worked to make the trip to Ireland a reality. Luckily, the university I would be attending in Ireland, the University of Limerick, offered the one class I still needed to take to fulfill my graduation requirements. My only other requirements for graduation were student teaching, which was scheduled for the next fall, and completion of my Senior Honors Thesis for the Honors College. As winter approached, I discussed possible topics for this thesis with my professors within the Department of Mathematics and the Honors College.

During some of my education classes, the differences between various state education systems were evaluated and compared with that of Indiana. As I inspected some of the other topics used for honors theses in previous years, I considered what kind of study I could attempt related to mathematics education in Ireland. I gave the idea some thought, and then conferred with Dr. Elizabeth Bremigan of the Department of Mathematics, who was my mathematics education professor. Both she and I concluded that the opportunity to study abroad almost demands that some aspect of my studies deal directly with the country I am visiting. We discussed what aspects of Irish secondary mathematics education were important to examine, possible approaches to gathering appropriate information for the thesis, and hypothesized on the possible outcomes of the thesis. From these discussions, I concluded that the thesis would consist of investigations within a number of different areas related to the field of mathematics education in both Ireland and the United States.

The first area of investigation centers on the experience of typical Irish students within the Irish educational system, with some reflection on interesting similarities and differences between the educational experience of Irish and American students at the secondary level. Areas of interest include the approaches of assessing students, the methods of gaining entry into institutes of higher education within each country, comparing how Irish and American students choose their courses, and how they are stratified according to their ability.

The second area then focuses attention on the secondary mathematics classrooms in Ireland and in the United States. Here, the differences in overall educational philosophy become pronounced within the respective mathematics curriculum standards

of the United States and Ireland. A comparison of the mathematics classroom resources shows some surprising differences in each country's attitude towards the use of technology, such as calculators and computers, as well as the purpose of textbooks within the classroom.

We then turn our attention to issues of secondary mathematics education experienced by third-level students working to become teachers of mathematics. The role of an Irish teacher proves to be much different from that of an American teacher, evident by the education tracks third level institutions currently utilize in each country. Afterwards, focus is turned to the application process of becoming a teacher within each country, highlighting key differences.

Lastly, I would like to draw attention to a particular characteristic of teachers in Ireland concerning the level of teacher professionalism within Irish schools. There are dramatic differences of opinion among Irish and American teachers when discussing collaboration with peers and allowing outsiders into their classroom. This issue warrants special attention, as it proved to be a major deterrent in my search for information relevant to this thesis and my ability to gain access to classrooms within Ireland. However, I was pleased to have access to a university course that addressed this issue and helped me to overcome the obstacles and finish my research.

This thesis is the culmination of more than a year of preparation of ideas, initiation of a plan of action, reflection upon what information I gathered, and examination of the underlying decisions and philosophies that guide mathematics education in the United States and Ireland. While each country has individual goals for their education programs and initiate their respective educational policies in response,

one can gain a clear understanding of the one goal that each country hopes to achieve – to prepare their future citizens for success in their adult lives and meet the demands that their respective society places on education. Working on this thesis has helped me to open my eyes to the broad range of educational resources, methods and styles that shape the people of our world. My hope is that reading this thesis will also broaden your ideas concerning education around the world while allowing you to take a hard look at our own education system. In conclusion, may you find the following reading as resourceful, enlightening, and enjoyable as I did.

Go raibh míle maith agaibh – A thousand thanks to you all!

Matthew Kennedy

Chapter 1

Overview and Comparison of Irish and American Education

One of my early research goals while I was in Ireland was to grasp a firm understanding of the Republic of Ireland's educational system. When I began my research, I worked under the assumption that the Irish educational system was somewhat parallel to that of England, more so than that of the United States. While this assumption was justified by discussions within my education classes in Ireland, I was surprised to discover that, while the Irish educational system is closely linked to the British educational system, both countries are working to implement changes to their curriculum, instruction, and assessment based on the successes and failures of similar changes in the United States.

The goals of this chapter are to show the similarities and differences between the Irish education system as a whole and that of the United States. By studying the curriculum, instructional techniques, and assessment methods of each country, one can see how the role of education is dependent on the goals that each nation's governments have set for its citizens. This chapter also investigates the ability tracking of students in both countries as well as the process for gaining entry into institutes of higher education. Even at the most basic levels, the contrast between Irish and American education is very pronounced.

Curriculum

Both Irish and American students are presented with a wide range of academic subjects during their time of study, with strong emphasis in the areas of English

Language¹ and Mathematics. Students are usually required to take at least one course in each of these subject areas every semester. Both countries traditionally offer these courses at three ability levels (which will be discussed later in this chapter). In addition, students also take classes in the areas of physical and life sciences (biology, chemistry, earth studies, etc.), social sciences (history, government, economics, etc.), physical education and health, and the arts (music, choir, art, etc.)². Students in each country are also allowed to choose from a variety of elective courses. These courses are suited specifically to the interests of the students. Courses of this type include languages of other countries (Spanish, French, German, Russian, etc.) and vocational courses in a variety of different areas (woodworking, metalworking, computer technology, and mechanical drawing, among many others).

While the majority of the workload for Irish and American students is consistent, there are some differences within each society's educational curriculum. In Ireland, for example, students are also required to become at least partially fluent in the old Irish language of Gaeilge. Gaeilge was once the common tongue of the Celts, who first inhabited the island as early as 600 B.C. When the English gained control of Ireland in the 12th century A.D., they outlawed the use of the language and anglicized the names of a majority of towns and regions of the island. When Ireland gained home rule in 1922, the government worked hard to retain that which was lost during the English occupation, including the old Gaelic language of the Celts. Currently, Gaeilge is the common language in more rural areas of the island, such as the Dingle peninsula and County Kerry

¹ While the English language is the primary language of Ireland (spoken regularly by a majority of Irish citizens), Ireland is officially a bilingual country, which will be discussed in the next paragraph.

²Source: "Secondary Mathematics".

in the southwest, and rural parts of Northern Ireland³. While the Irish language is heavily stressed in the curriculum of Irish schools, a majority of those I spoke with admitted they rarely use the language to communicate with others, and think of the Gaelic language more as a historical and cultural tool than as a useful language to understand and use consistently.

Another difference is the inclusion of religion into the Irish curriculum. The history of Ireland is greatly enriched, and sometimes hampered, by the presence of religion in Irish society. Since the coming of St. Patrick in the 5th Century A.D., Catholicism has grown to become the official religion of Ireland, serving as a moral guide for Irish students. When the English arrived 700 years later, some Catholics converted to the Protestant Anglican church, yet the lessons of morality for both religions were highly valued. Today, in the Republic of Ireland, cathedrals from both religions are some of the oldest landmarks throughout many cities and towns, showing the historical influence of religion in Irish culture. The continuing debate over Northern Ireland also shows that religion is still a major force in the lives of Irish citizens.

Instruction

There is a striking contrast between the instructional techniques used by Irish and American teachers, due primarily to the diversity within the classrooms of each country. In American classrooms, teachers must be able to teach students from a variety of different racial, cultural, ethnical and economic backgrounds. In addition, teachers must also possess the skills to teach students with different behavioral and mental disabilities, which make their jobs difficult at times. Because of the diversity they see among their

³ This information was acquired through lectures in an Irish language course I was able to take during my time in Ireland.

students, teachers use a variety of different teaching strategies and techniques to help individual students succeed in their studies. Many often employ a particular strategy for individual students who require special attention.

While teachers are usually up to the task presented to them, teachers in some parts of the United States, such as large urban areas, must sacrifice assisting individual students in order to reach as many as 35 students contained within their classroom walls. In other parts of the country, new state legislation changes many aspects of school life, which ultimately changes how a teacher runs his or her classroom. Therefore, teachers continually have to adapt to changing conditions and class sizes.

In general, teachers in the United States also use a variety of resources to teach their students. Computers are starting to make a major impact and have a greater presence within the lessons of teachers in different subjects. Field trips to various educational sites are not uncommon, helping students link what they learn in class to real-world situations. Educational programming and videos are also used to help students learn material in a visual manner.

While these new techniques are becoming more prevalent, textbooks are still used in a majority of American classrooms. New textbooks include resources such as CD-ROMS and Internet links to add to the depth of information presented on their pages. This benefits the quality of education received by students by presenting them with resources they can access at home to assist them in their studies.

The typical Irish classroom varies greatly from that seen by students in the United States. There is not nearly as much diversity within the classrooms, and the utilization of technology is dismal when compared to the United States. One of my greatest

disappointments was the reluctance of Irish teachers to discuss their classroom strategies with me, which greatly hampered my efforts to gain a clear understanding of the typical Irish classroom. From what I could gather, the average Irish student is forced into very teacher-centered classrooms. Teachers have ultimate control in their classroom, from the way material is presented to the discipline level. Some of the students I spoke with felt their teachers were almost afraid to explore the possibilities that came with using sources of technology within their classroom for fear of failure in front of the students.

One of the major visible differences between the two educational systems revolves around each country's views toward technology, which was all too evident when I visited Crescent College Comprehensive, a secondary school located on the outskirts of Limerick. While the United States is often one of the first nations to develop and utilize new sources of technology, Ireland is struggling to keep up with the many new advancements that have arisen in the past twenty years. The difference is evident in the classrooms of each country. Many classrooms across the United States have televisions installed, which gives teachers and students the ability to teleconference with different classrooms across the country and watch educational videos or educational programming on selected channels, such as Discovery, The Science Channel, and the National Geographic Channel. Most U.S. schools also have a computer lab within the school with access to the Internet as well as many educational databases. Students are now learning to access information in a variety of different ways, greatly enhancing the quality of their studies. Some teachers bring old personal computers directly into their classroom to use for various educational programs and games.

Irish students in primary and secondary school usually have to wait until after they graduate before they can utilize the benefits of technology in their educational studies. When I toured a secondary school outside Limerick, I saw only one computer within the school, used by a deaf student to help him communicate with his teacher. It was surprising to notice such a lack of technology within the school. When I asked one particular teacher for his opinion concerning technology, he felt that technology took away from the interactions teachers have with their students. It seems as if there is a general reluctance among teachers and administrators to make the conversion to a more technologically based curriculum.

Teachers use textbooks as their primary resource for teaching their students and providing exercises for homework. While teachers have some freedom to teach outside the required curriculum, teachers in Ireland are primarily concerned with preparing their students for high stakes examinations such as the Leaving Certification Examination (which will be discussed later in this chapter), using former test questions for practice and assessment. I concluded that teachers are primarily concerned with teaching students only the required material for the examination, and do little to expand on topics that fall outside the scope of the exam.

Assessment

The assessment styles of Ireland and the United States also represent the differences in the two country's educational philosophies. The first of the differences deals with the actual governments that control the education in each country. For example, schools in the United States are governed at the state level, with each state setting different policies for its educational testing, while Irish schools all fall under the

jurisdiction of the national Irish government. For the purposes of this thesis, I will use the assessment policy of the state of Indiana, my home state, to compare assessment methods of the United States to those of Ireland.

In Indiana, many teachers continuously assess their students within their individual classrooms. Teachers themselves often create tests for their students based on what material they covered in their particular classes. Since schools are now giving teachers access to computers to use as a teaching resource, they are able to use a variety of computer programs and CD-ROM text banks provided by textbooks to create tests based on the goals for the assessment. Throughout my time as a student and pre-service teacher, I have come to the understanding that teachers feel assessment fulfills two purposes. Assessment of students helps teachers discover their students' strengths and weaknesses on a continual basis and drives teachers to improve upon their own strengths and weaknesses while teaching a particular class or student. Testing of students usually occurs at particular times in the curriculum, such as the end of a chapter within a book, the end of a play or novel, or a specific time within a semester, such as end-of-quarter and end-of-semester tests. End-of-semester tests are usually cumulative in nature and account for a major portion of a student's final grade for the course. In some cases, teachers also quiz students at random times throughout a particular teaching cycle.

Statewide testing of students at particular times within their school tenure occurs in various states. In some cases, states also require students to pass a final graduation-qualifying exam (GQE) in order to be eligible for graduation from their secondary program. In Indiana, students must pass an English/Language Arts and Mathematics GQE to graduate with a high school diploma. Students are sometimes given up to six

attempts to pass each test before graduation. These tests are intended to ascertain whether the student has the basic skills necessary to function in society, especially with regard to reading and quantitative abilities.

If students are interested in pursuing higher education at the college or university level, they voluntarily take the Scholastic Aptitude Test (SAT) and/or the American College Test (ACT), then submit their scores, secondary transcript and description of their extra-curricular activities to the colleges and/or universities to which they are applying. Some private and professional colleges and universities also require that prospective students write an essay on a selected topic to gain admittance.

Testing in Ireland shows a very different assessment philosophy than that in the United States. Most of the assessment needs of the country are met through the Junior Certification Programme (taken halfway through the secondary cycle) and the Leaving Certification Programme (taken at the end of the 5 to 6 year secondary cycle). Each examination tests the students in all areas of their education at two ability levels, ordinary and higher. In the case of English, Irish, and Mathematics, a foundational level is also available⁴. These are high-stakes tests which institutes of higher learning use to determine which students have the proper skills to succeed in their third-level courses (comparable to college or university courses which will be clarified later in this thesis).

From what I could gather, teachers within their individual classrooms in Ireland rarely create their own tests. They assess students using other methods, such as individual success on board presentation and solutions of exercises. Teachers are usually

⁴ Higher, Ordinary, and Foundation ability levels in all Ireland courses are comparable to advanced, college preparatory and modified courses in the United States.

assessed on their students' scores on the Junior and Leaving Certification Examinations, so they try to assess students on their solutions to questions from previous examinations.

The similarities and differences found within both Irish and American schools are founded on individual elements of history, religious affiliation, and educational goals that benefit each respective country in a variety of ways. The next chapter explores how these similarities and differences are expressed within the mathematics education field. We will see how such differences present two very different ideals regarding how the teaching of mathematics is prepared, initiated, and assessed in Ireland and the United States.

Chapter 2

Overview and Comparison of Irish and American Secondary Mathematics Education

Mathematics education in both the United States and Ireland constitutes a major portion of a student's secondary curriculum. Because of this, there have been attempts by both nations to enhance and simplify the mathematics education their students receive. Through curriculum studies, teacher seminars, and other information-gathering strategies, efforts are made to ensure students receive the best education possible. It is hoped that these coming changes will enhance the mathematical curriculum studied by American and Irish students and adequately prepare them for the needs of their respective societies.

While each country strives to prepare their students for the challenges they will face upon completion of their education, the needs of each society have played a major role in the way mathematics is taught. The curriculum is organized in very different ways. Instruction is defined within the bounds of each society's experience with a multitude of various resources, and assessment follows the boundaries set by the governments responsible for education in each country.

Curriculum

As described in the last chapter, the United States and Ireland have different educational philosophies. When organizing the mathematics curriculum, each country sets different goals for its students and plans the curriculum accordingly; therefore, the curriculum for each country is defined by different parameters.

In the United States, the curriculum for mathematics courses at the secondary level is defined by teachers, administrators, and other related personnel at the state level. While states ultimately have control over their curriculum, most state mathematics

curriculum planners create their individual curriculum based on recommendations by the National Council for Teachers of Mathematics (NCTM). In Indiana, the curriculum was created using a template based on NCTM's *Principles and Standards for School Mathematics*.

Indiana's Academic Standards for Mathematics lists the curriculum students should learn. The objectives for each respective grade level or course title (discussed in the next two paragraphs) are referenced first by the grade level or course of study, then by number of the content standard being addressed, and finally by a number stating the specific objective in reference to the content standard⁵. The objectives are written in full sentences and are followed by an example question that would be addressed by the objective. The standards are written in such a manner as to be accessible by not only teachers and administrators, but students and parents as well. The organization of the curriculum is extraordinary, making it relatively simple for one to easily understand and interpret the curriculum to fulfill their needs.

The curriculum is organized at the primary level into grade levels (Kindergarten through 8th grade). At the beginning of each grade level, a general synopsis of the grade-specific content is presented in the form of content standards (numbers and operations, algebra, geometry, measurement, data analysis and probability, problem solving) and process standards (communication, reasoning and proof, connections, representation). Then the specific objectives are stated in relation to each of the content standards. By reviewing the content at the primary level, it is clear that progression in each specific

⁵ For example, objective 5.7.3 references the third objective studied by the seventh content standard (in this case, problem solving) at the 5th grade level.

content standard is consistent throughout the primary school sequence for Indiana students, giving students the material they need to succeed at the secondary level.

Curriculum at the secondary level is organized using a different method. Courses at this level are grouped by six specific topics within the field of mathematics (i.e., Algebra I, Algebra II, Geometry, Pre-Calculus, Calculus, Probability and Statistics, and Discrete Mathematics). The curriculum is organized to reflect the specific content standards contained within each individual course, which are listed by their respective course titles below.

Algebra I

Operations with Real Numbers
 Linear Equations and Inequalities
 Relations and Functions
 Graphing Linear Equations and Inequalities
 Pairs of Linear Equations and Inequalities
 Polynomials
 Algebraic Fractions
 Quadratic, Cubic, and Radical Equations
 Mathematical Reasoning and Problem Solving

Algebra II

Relations and Functions
 Quadratic Equations and Functions
 Conic Sections
 Polynomials
 Algebraic Functions
 Logarithmic and Exponential Functions
 Sequences and Series
 Counting Principles and Probability
 Mathematical Reasoning and Problem Solving
 Linear and Absolute Value Equations and Inequalities

Geometry

Points, Lines, Angles, and Planes
 Polygons
 Quadrilaterals
 Triangles
 Right Triangles
 Circles
 Polyhedra and Other Solids
 Mathematical Reasoning and Problem Solving

Pre-Calculus

Relations and Functions
 Logarithmic and Exponential Functions
 Trigonometry in Triangles
 Trigonometric Functions
 Trigonometric Identities and Equations
 Polar Coordinates and Complex Numbers
 Sequences and Series
 Data Analysis
 Mathematical Reasoning and Problem Solving

Calculus

Limits and Continuity
 Differential Calculus
 Applications of Derivatives
 Integral Calculus
 Applications of Integration

Probability and Statistics

Descriptive Statistics
 Probability
 Statistical Inference

Discrete Mathematics

Counting Techniques
 Matrices
 Recursion
 Graph Theory
 Social Choice
 Linear Programming
 Game Theory

Source: "Mathematics", 2003.

In Ireland, the material covered on the Junior and Leaving Certification Examinations defines the curriculum. Because the tests themselves are meant to

determine the ability level of students after they complete the examination, the exercises on the mathematics portion are highly organized to thoroughly test a student's understanding of many areas covered under the heading of mathematics at all ability levels (Higher, Ordinary, and Foundation). The curriculum outlines what material students must cover before they attempt the examinations. Both curricula are organized to be easily accessible to administrators who write the tests and teachers who are responsible for teaching the material.

When I reviewed the Junior and Leaving Certificate Programme Curriculum for Mathematics, I was surprised by the intense mathematical terminology and context in which the curricula were written. The objectives were written in such a way that those unfamiliar with the terminology and symbols of mathematics would be quite confused, especially parents who did not grasp the material themselves when they were in school. Concepts to be studied were written in phrase form, foregoing the use of full sentences and stating the material in its simplest form. While there is some use of mathematical language and symbols to describe the objectives, there are no examples with solutions to assist in an objective's understanding. The curriculum seemed difficult to understand for those not directly involved with mathematics education; however, teachers responsible for teaching the material would find the curricula easy to navigate and useful in determining teaching strategies best suited for specific material. The curriculum also identifies key aspects of the material that are vital for a student's success on the examinations.

There are some differences between the Junior and Leaving Certification Programmes in the way of mathematics curriculum. For example, the Junior

Certification curriculum is only slightly varied according to ability level, as the table below illustrates.

Junior Certificate Programme – Mathematics Curriculum

Mathematical Content	Foundation	Ordinary	Higher
Sets	*	*	*
Number Systems	*	*	*
Applied Arithmetic and Measure	*	*	*
Algebra	*	*	*
Statistics	*	*	*
Geometry	*	*	*
Data Handling	*		
Trigonometry		*	*
Functions and Graphs		*	*

Source: "Maths (Higher, Ordinary, and Foundation Level) – Junior Certificate Syllabus"

The evolution of the curriculum with regard to the progression of ability levels is worth discussion. The Foundation course lists specific objectives to be met under each content area. The Ordinary level course employs all of the Foundation objectives and includes some more encompassing topics. The Higher-level course includes all topics contained within the Foundation and Ordinary levels along with a few added topics of study.

While the topics within the Junior Certification Programme vary little across courses of different ability levels, there seems to be a greater amount of differentiation within the Leaving Certification Programme courses. The table on the next page shows the distribution of topics divided amongst the three ability levels, as well as the optional additional topics teachers can cover if they wish.

Leaving Certificate Programme – Mathematics Curriculum

Mathematical Content	Foundation	Ordinary	Higher
Number Systems	*		
Areas and Volumes	*		
Statistics and Probability	*		
Functions and Graphs	*		
Arithmetic	*	*	
Trigonometry	*	*	*
Geometry	*	*	*
Finite Sequences and Series		*	
Algebra		*	*
Functions and Calculus		*	*
Sequences and Series			*
Discrete Mathematics and Statistics			*
Further Geometry		opt.	opt.
Plane Vectors		opt.	
Further Sequences and Series		opt.	
Linear Programming		opt.	
Further Calculus and Series			opt.
Further Probability and Statistics			opt.
Groups			opt.

Sources: "Maths - Leaving Certificate Syllabus"

"Maths Foundation Level – Leaving Certificate Syllabus."

Instruction

The differences in curriculum organization in Ireland and the United States also reflect some of the differences concerning instructional strategies, but there are many other factors that differentiate mathematics education in the two countries. Access to new technologies, reliance on old resources, and teacher attitudes towards the task of teaching play a major role in the instruction received by Irish and American students.

Mathematics classrooms in the United States are no strangers to the utilization of technology. Scientific calculators are a common sight in many classrooms at all levels, and graphing calculators are sometimes used in more advanced classes dealing with

graphs and data analysis. Some schools provide the calculators within each classroom or allow teachers to borrow a department set for selected classes. Some teachers also utilize a projector and LCD display in association with the graphing calculator to help students visualize aspects of their lessons. Graphing calculators, in particular, are quite applicable for many topics within the curriculum and serve as a useful tool for teachers to display a great deal of mathematical content and help students interpret and apply what they learn during class.

Computers are also becoming a useful tool in the mathematics classroom. There are many computer resources related to mathematics instruction, including games, tutorials, web-quests, and other applications. From my experience, students enjoy using computers during the learning process, because it provides them with a private and interactive resource and makes the learning process more enjoyable. During my pre-service education, I was able to take a course on how to implement the use of technology in the classroom. It seems apparent that computers and other technological sources will become a more vital aspect within the field of mathematics education in the United States.

Mathematics textbooks in the United States serve as a student's primary resource outside of the classroom setting. Because of their importance, textbook creators are releasing newer versions of current textbooks to keep up with the demands of schools and society. There are many styles of textbooks, ranging from basic versions which have little color and possess only demonstrations and exercises to some filled with color, pictures, additional activities, and links to other topics related to mathematics. Teachers and school administrators are responsible for choosing which textbooks are used in their

classrooms based upon the needs of their students. In addition, many classrooms utilize the use of manipulatives to help students learn mathematical concepts in a variety of ways. Because of the many resources available, students in the United States possess the potential to grasp a firm understanding of the most basic mathematical concepts before they complete their secondary education.

One of the greatest strengths of mathematics educators in the United States is their diverse and interesting approaches to teaching. Teachers are encouraged to relate what students encounter in mathematics classes to aspects of mathematics used in different career fields and daily life. Some of my previous secondary mathematics teachers introduced new topics by discussing which career fields employed the material we were about to study. Others took us on field trips to places that utilized a great deal of mathematics. Throughout my secondary experience, my interactions with various careers and situations that required the use of mathematics helped me to gain respect for the benefits mathematics can bring to a variety of situations, and should actively be pursued by mathematics teachers of today and tomorrow.

Mathematics classroom instruction in Ireland differs in many respects. For one, the use of technology is scarce, if present at all. Throughout the investigative process, I did not witness any secondary students using technology (such as computers) for the purposes of learning or applying their mathematical skills. I also could not determine whether the school utilized a computer lab to give students access to the benefits of technology.

The use of calculators in Irish classrooms is present, but at a much more limited level than that of the United States. In classes I observed, students used either four-

function calculators or scientific calculators to assist them in solving exercises. Further, the teachers in these classes incorporated the use of these calculators within their lessons. However, one student asked me to help him to insert prompts into his calculator, demonstrating that students do not rely heavily upon the use of a calculator. When I showed one particular class the graphing calculator I used during my secondary mathematics experience, both the students and teacher were astonished by its abilities. From what I could gather, students in Ireland find the use of calculators beneficial, but do not have the experience to use them to their full potential.

Irish classrooms also use limited amounts of additional resources, such as manipulatives, to aid in the teaching process. Classes I observed usually used only a textbook and previous certification examination exercises as teaching resources. I could not determine whether schools are lacking the funding for additional resources, if teachers were responsible for purchasing their own additional resources, or if school administrators frowned upon their use. All of the textbooks I was able to review were simple and basic in nature, possessing only demonstration of typical mathematical topics, examples with solutions, and a bank of exercises for students to complete. However, during my observations, I only witnessed one out of five classes actively using the textbooks as a resource during the lecture. I felt as if classrooms contained only one major resource, in the form of the teacher at the head of the classroom, which disturbed me as a pre-service teacher. Students should be given access to any and all resources that might assist them in their study of mathematics.

Assessment

Assessment in mathematics classrooms helps teachers to ensure that students are developing their mathematical skills. Both the United States and Ireland put a great deal of emphasis on the testing of mathematical competency. Their test procedures (as discussed in the last chapter) again demonstrate how different the educational philosophies are in these two countries. Most of the information regarding assessment covered in the last chapter focused on general assessment. This section will review what was covered before and relate it directly to mathematical situations where appropriate.

Mathematical testing in the United States usually occurs most often in the classroom. Teachers are responsible for testing their students at regular intervals to ensure the students understand the material. In addition, many states employ the use of statewide tests to determine if students have the mathematical skills to effectively live and work after secondary school. If students wish to pursue higher learning, they must achieve a passing score on the mathematics portion of college entry tests such as the SAT and ACT.

In Ireland, students and teachers realize the implications associated with the scores from Junior and Leaving Certification Examinations, so their major focus is to succeed on these tests. Teachers in the classroom use previous examination questions to test and quiz their students. In general, both teachers and students realize the importance of assessment, but feel that the two certification examinations fulfill the goals they have regarding mathematics education, and therefore do not put much emphasis on any other forms of assessment.

This chapter has explored the differences that shape the mathematics education programs within Ireland and the United States. Teachers and administrators within each country are working diligently to improve the mathematics education their students receive. The next chapter will detail the training programs such teachers (specifically, teachers of mathematics) receive within each country before they assume full-time teaching responsibilities within their respective schools.

Chapter 3

Gaining Certification as a Secondary Mathematics Teacher in Ireland and the United States

The teaching profession is not only one of the oldest careers in the world, but also one of the most important. Teachers are responsible for transmitting the necessary knowledge and skills to the future workforce of their respective societies and improving the elements of what they teach to better prepare their students for the challenges they will face after completion of secondary school.

Because teachers significantly influence the success of future generations, both Ireland and the United States invest a great deal into the preparation of future teachers. Teachers are required to be competent within their subject area and possess a strong knowledge of child development, learning styles, and motivational skills. These abilities are essential to teach today's students and the workforce of tomorrow. Those who are responsible for teacher education in each country work hard to ensure that future teachers are well prepared to deal with the challenges that will face them in their classrooms.

This chapter will investigate the education provided to future mathematics teachers receive in Ireland and the United States. Once a teaching candidate completes his or her formal education and begins to apply for a teaching position, specific criteria for teacher certification in their respective countries must be met. The similarities and differences in the teacher certification process will be evaluated and compared, giving insight into the importance each country places on training and hiring competent mathematics teachers.

Education Training

Public colleges and universities in the United States that train teachers in various subject areas must follow strict guidelines enforced by the state governments who govern schools. Because of the different standards set by various states, as well as the goals of the individual teacher education institutions, I will use my experience as a secondary mathematics education major at Ball State University in Indiana as an example of a typical mathematics education training program within the United States.

College students who pursue a career in mathematics education at the secondary level take courses rich in educational philosophy and mathematical content knowledge. They learn about the creation of the American education system and the foundational philosophies that continue to shape the field of teaching today. Future teachers also learn about the development of children from birth through adolescence, noting key physical, emotional, and psychological changes children experience as they grow older. Because of the diversity within today's classrooms, pre-service teachers also take a course in multi-cultural education to prepare them for the differences in race, culture, ethnicity and learning ability of students that they will encounter. After thorough preparation, teacher candidates then participate as teacher assistants within local schools, gaining first-hand knowledge of teaching strategies and classroom organization.

Mathematics teachers must also possess a strong knowledge of mathematical content to anticipate and respond to the needs of their students. Pre-service teachers take a variety of mathematics courses to build their knowledge of the subject. Courses include calculus, linear algebra, discrete mathematics, advanced calculus, modern geometry, statistics, algebraic structures, mathematical modeling, and other elective courses in

advanced mathematics. In addition, mathematical departments sometimes initiate specific courses related to the mathematics teaching field, such as utilization of technology within mathematics classes and in-depth analysis of the content taught at the pre-secondary (middle or junior high school) and secondary (high school) levels. In addition, pre-service mathematics teachers in the state of Indiana are required to achieve a passing score on a mathematics content-knowledge examination before graduation, which determines if candidates have achieved the mathematical content knowledge to effectively teach high school mathematics. Topics on the test range from finding possible solutions to algebraic equations, linking algebraic concepts to geometrical concepts, understanding the foundations of calculus, basic computer science, logic and reasoning, and other selected topics.

Upon completion of the education and mathematics courses, the pre-service teacher then participates as a student teacher in an actual classroom in a school for a period of one semester. During this time, the teaching candidate is placed within the school of his or her choice to evaluate and reinforce the skills that have been acquired. This period serves as the capstone experience for pre-service teachers, allowing them to discover new teaching strategies, apply their knowledge to a variety of situations, learn disciplinary techniques, and determine which aspects of their teaching ability need improvement. At this level, pre-service teachers receive the full teaching experience, and work to adequately prepare themselves for their roles as a secondary mathematics teachers.

In contrast, the process for becoming a secondary mathematics teacher in Ireland can be achieved in two ways, both through an approved college or university (known as

third-level schools). The first education track instructs pre-service teachers in the area of primary education (what Americans refer to as elementary education). Here candidates receive the knowledge to teach all subjects at the primary level. Once they graduate and serve a given period as a primary teacher, they can enroll in a graduate school program that is devoted to secondary education. Here they learn advanced skills and techniques to build upon their previous primary school knowledge, and choose a particular subject in which to specialize. If a graduate student chooses mathematics as the area of concentration, advanced courses rich in mathematical content are offered which, in addition to the advanced graduate education sequence, certifies them to teach at the secondary level as a mathematics teacher.

The second education track is available to pre-service teachers who wish to teach mathematics specifically at the secondary level. However, there is no program within Irish institutes of higher learning specifically designed for those wishing to teach secondary mathematics. Such students must enroll in a secondary physical education program, and then choose mathematics and another subject (Irish language, English, or Physical Science) as areas of concentration. The students progress through a general education sequence, courses in physical education studies, and content courses for their concentration areas. While this program allows graduates to find employment within the secondary school, there are no courses specifically related to the teaching of mathematics.

While I discovered the two tracks available for gaining the knowledge to teach mathematics present within Irish colleges and universities, I was unable to determine whether students who wish to teach mathematics were required to pass any specific tests for content knowledge. As far as I could discover, the scores students achieve on the

mathematics portion of the Leaving Certification Examination (discussed in Chapter 1 and 2) serves as the only assessment consistent across Ireland for students who wish to pursue a career as a mathematics teacher. I would have to assume that the teaching courses of study independently assess teaching candidates in order to receive their degree, and their degree serves as the final proof of mathematical and educational competency.

Certification Process

Both Ireland and the United States require teachers to meet a specific set of qualifications in order to become a certified teacher. The governments responsible for school administration work directly with colleges and universities to ensure their education programs adequately prepare pre-service teachers with the proper courses and assess them in specific ways to ensure they have adequate knowledge of their respective content areas. While each country works hard to ensure that future teachers are adequately prepared to teach within their schools, the certification process for each country varies in many respects.

Because schools in the United States are governed by the state in which they are located, there are different certification requirements for every state. In Indiana, the state government works directly with post-secondary institutions to ensure pre-service teachers are adequately prepared for their future roles. The Indiana Professional Standards Board is responsible for ensuring that teachers in the state of Indiana are adequately prepared to teach before they are given an official teaching license. In order to be eligible for any teaching position at public schools at any level, teachers must be licensed by the state. Licensing specialists are employed by colleges and universities to make sure teacher

education programs meet the requirements for teaching and assist future teachers to ensure they have fully completed their course of study and passed any required examinations. Upon completion of the student teaching experience, the teaching candidate registers his or her information with their college or university's licensure office, which then verifies and communicates this information to the Indiana Professional Standards Board. A license to teach within a specific age level and subject area is then conferred upon the teaching candidate, which he or she can then submit to schools as proof of competency when searching for a teaching position.

While the requirements for licensure differ with respect to specific teaching positions, the application for a teaching license in the state of Indiana is very general in nature and is used by all candidates. The form includes fields for personal information (name, Social Security number, etc.), asks which type of license is being requested, fields for candidates to state their educational background, and a section regarding the candidate's criminal history. The application also includes a loyalty affidavit which states that by signing the application, the candidate "solemnly swear[s] (or affirm[s]) that [they] will support the Constitutions of the United States of America and the State of Indiana." To complete the application, the candidate must also submit a limited criminal history report to ensure that teachers in schools do not introduce a criminal element to students⁶. Overall, I find it surprising that only one form is required to apply for a teaching license.

While the process of becoming registered (or licensed) in Ireland is relatively similar in nature to various processes in the United States, the paperwork of the registration process can be quite overwhelming. While Indiana's teaching license

⁶ Source: "State Form 9331".

application is only one page, the application for the Republic of Ireland is four pages in length. Applicants in Ireland must submit personal and contact information, and degree information from their college or university. The applicant must also have their degree information verified by the university by way of a stamp on the application (giving them a “certification of fitness for teaching”).

In addition, applicants must participate or have participated in a teacher-in-training program, where they teach under a supervisor within a school for 18 hours per week for a period of one year. Usually, pre-service teachers gain the teacher-in-training certification through their degree programs, while those with professional degrees must participate in the teacher-in-training program. Applicants must also have their teacher-in-training participation verified by the school in which they taught.

If applicants completed their teacher-in-training experience in a different country (such as other European Union nations), they have an additional page to complete to submit their application. This page requires almost the same information as the certification of fitness for teaching page, but also requests information regarding the school administration and philosophy within the respective country.

After an applicant has thoroughly completed the application, it is then submitted to the Registration Council. In addition to the application, applicants must also submit an original birth certificate or passport, their original marriage certificate (if appropriate), an official transcript from their college or university, and an official transcript from their teacher-in-training experience, and a copy of their teaching (or related) degree. Without these documents, the Council will not consider the application valid⁷.

⁷ Source: “Registration Council”.

While each country trains and certifies future teachers using different methods, the goals for each nation's new teachers is consistent with the general goal of educators across the world – to prepare students for the challenges they will face as adults, both in the personal and professional sense. In addition, the training is meant to prepare teachers for their professional roles as educators. The next chapter will investigate areas of teacher professionalism within each country, highlighting areas related to collegiality among teachers and efforts by teachers to stay up-to-date with the sweeping changes in the field of technology, which have the potential of changing the professional role of both Irish and American teachers in a variety of ways.

Being the major superpower within the world, the United States plays a significant role in global affairs. As a result, American students are shaped in a manner that prepares them for their future role in the world at large. The teachers and administrators responsible for this education take the job very seriously. While students are gaining the skills to succeed and thrive in their future careers, the drive to continuously improve within their field is instilled by teachers whose influence, in some small part, is responsible for their devotion to success.

This drive for success is also evident within the educational field. In general, it would be fair to say that teachers in the United States realize their career field shapes a variety of other fields, and they feel it is important to continuously develop professionally in order to drive the development of other fields. Therefore, teachers participate in a variety of professional development activities that help to improve the quality of education within American schools. They also participate as coaches or mentors in extra-curricular activities, showing their devotion to their students by helping to shape their lives in a positive fashion in arenas outside of the classroom. Teachers are also responsible for developing the field to stay current with material, educating students using proven methods, and making the job of teaching and learning easier for both teachers and students. From my previous studies, it seems as if the typical educational philosophy present within American schools is a combination of elements from essentialism and progressivism.

While teachers in Ireland also possess a strong work ethic and desire to succeed within their field, their approach to teaching is shaped by the Irish professional teaching philosophy of individualism. Teachers expect to have total control of their classroom,

free to teach in whatever manner they feel best prepares the students for the upcoming certification tests. They rarely ask for assistance when faced with a difficult situation, because they feel they will be seen as unprofessional by their peers.

From what I witnessed while observing some classes within an Irish second level school, the levels of teacher professionalism are as varied as the number of teachers who work within a school. One possible reason for the various professional views could stem from one educational philosophy which I studied while participating in an Irish teacher professionalism course, known as the “egg-crate school” philosophy, which best paralleled the Irish school setting. The analogy suggests that each classroom is an individual learning “cell”, independent from all others, and these “cells” are part of the same “carton”, or school.

Each teacher was autonomous within their classroom, and felt they were solely responsible for the teaching within their classroom. There was little to no collaboration among teachers within the same teaching discipline. In extreme cases, some teachers did not even welcome visitors within their classroom, as they felt it was an invasion of their privacy and an unwelcome assessment of their teaching abilities⁸. It seemed the Irish professional teacher relationship was an individual one. While the content was covered in a very acceptable format, it was not consistent across different classrooms, so students taking the same course most likely received two dissimilar educational approaches to the same material.

⁸ I wish to restate that this observation was an extreme case, and most likely did not occur in all classrooms. It should also be noted that the teacher was a Catholic priest. While this in itself is irrelevant, I have gathered from various conversations that priests are seen more as teachers of morality, usually quite strict and reserved when in a classroom setting, and did not represent the teaching philosophy of the majority of Irish teachers.

I do not wish to be overly critical of the professional nature of Irish teachers. I felt teachers I observed were good teachers who prepared their students for the challenges they would face outside of the classroom. Those I spoke with were quite helpful to share any information relevant to the teaching profession. However, after speaking with the professor of the course and teachers in the field, I gathered that the individual nature of the classroom in Ireland was consistent with many Irish schools, and that my experiences would be relatively similar if I would have visited more schools on different parts of the island.

Educational Resources

The utilization of educational resources can have a major impact on the success of students in both Ireland and the United States. Developments in technology such as the computer and the Internet have revolutionized the educational field in areas of research, information gathering, analysis, and documentation. Manipulatives allow students to view material in a variety of different ways, which yields to the individual needs of each student. I observed the availability of these resources within Irish schools was quite limited when compared to the resources available in American classrooms.

Schools in the United States have witnessed the benefits of multiple and varied educational resources. Computers can now be seen in a majority of American classrooms, allowing students to access the Internet for information-gathering purposes, document their work using word processing programs, and learn in a variety of different formats by using user-friendly computer programs. Teachers can use the computers to track the success of their students, prepare teaching material, and easily create assessment tools. The use of manipulatives in education helps students to learn the course content in

an appropriate learning style relative to their needs. Because of the many advantages educational resources bring to the classroom, teachers in the United States are taking it upon themselves to learn about the new developments and actively utilize the resource manager of their respective school or discipline department, thus leading to professional development while in the field.

From what I observed within the second-level school in Ireland, the use of various educational resources is quite limited. Because of the independence of Irish teachers, teachers do not share resources, and therefore their impact is restricted by the willingness of the teacher to learn about and utilize the new forms of resources as they are developed. Some teachers told me they would use more resources if the school made them readily available, but would not purchase the materials on their own. They feel it is the responsibility of the school and parents to purchase educational resources for their students. While the argument might seem harsh, I can understand the reluctance of the teacher to purchase the supplies with their own funds. After watching a news program on television, I learned Ireland is currently the most expensive country within the European Union, and property taxes as well as insurance premiums are outrageously expensive. They would not be able to support themselves if they were responsible for the purchase of many educational resources. However, when presented with the resources, I found that teachers are quite interested in their active use.

Governmental Influence

Government forces in both the United States and Ireland have a great deal invested within their education systems. While the United States relies on the education system to prepare its future citizens for their role in society and ensure its place as a

world superpower, the education system in Ireland wants to empower its future citizens for their role in the newly initiated European Union, which is still in the early phases of development. Because of the goals for each nation, the governments in each country continuously strive to improve the educational field. When the field itself changes, the professional role of the teacher changes in response to meet the requirements of the government.

In the United States, each of the fifty state governments is responsible for the implementation of an education system. Therefore, there is no consistent educational policy or structure within the United States. However, a consortium consisting of representatives from 37 states recently met to discuss the needs of schools and defined what skills future teachers are required to possess in order to fulfill those needs. The Interstate New Teacher Assessment and Support Consortium, an organization made up of government officials and education administrators from each state participating in the conference, created ten standards of teaching (known as the INTASC principles) to define what skills and traits new teachers needed to possess. In addition, current teachers are now being assessed in a format that is based on the INTASC principles. From these standards, individual states were able to draft standards for each of the disciplines present in schools. It details the content teachers are responsible for presenting to students within each subject⁹.

The national government of Ireland is responsible for the implementation of an education system on the island nation. Usually, Ireland follows the British education system in terms of developments within the field. However, the new initiatives to create standards for education in the United States are finding their way into the discussions of

⁹ Specifically, standards for mathematics courses are discussed in Chapter 2.

Irish lawmakers who deal with educational issues. There is already some fallout from these initiatives, as teacher training in Ireland is starting to discuss the professional role of teachers in Ireland. While the role of the professional teacher in Ireland seems lacking when compared to the United States, there is sure to be some change within the coming years as these standards take precedence over old beliefs about the teaching profession.

This chapter has highlighted how issues related to teacher professionalism in Ireland and the United States can have a major effect on the education received by students within their respective classrooms. While it is hoped that teachers continue to grow professionally within both nations, I feel confident that Irish and American teachers have a firm grasp of their individual professional responsibilities and await any items of knowledge that will assist them in becoming better teachers and professionals.

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