INTERNATIONAL COLLABORATION FOR THE RESEARCH ON LEARNING

AND EDUCATION (ROLE) PROGRAM

Report Submitted to:

Professor Arthur Heinricher

Professor Yi Hua Ma

Washington, Project Center

By

Wei Fu   _____

Gleb Ralka   _____

Letasha Souffrant   _____

In Cooperation With

Dr. Lee L. Zia

_____

National Science Foundation

Division of Research, Evaluation, and Communication

_____

December 18, 2000

Abstract

This report was prepared for the Research, Evaluation, and Communication Division of the National Science Foundation. The purpose of this report is to provide an overview of Western European organizations involved in research on science, mathematics, engineering, and technology education and learning, to propose specific activities for international collaboration, and to recommend directions for further investigation. A total of thirty six organizations were identified and studied.

Authorship

The writing of this report was a joint effort of all team members. Everyone contributed to every chapter in this report.

Acknowledgments

This report would not have been possible without the support of many people.

We would like to thank our liaison, Dr. Lee L. Zia, and Ms. Peggie Weeks for all the time and effort they have put into this project. We would also like to thank the Division of Research, Evaluation, and Communication at the National Science Foundation for providing such a great experience. In particular, we wish to thank Dr. Eric Hamilton, Dr. Barry Sloane, Dr. Elizabeth VanderPutten, Dr. Kenneth Whang, and Dr. Larry Suter for their help. The International Division at the NSF also provided help and valuable information on foreign organizations. Last but certainly not least, we would like to thank our advisors, Professor Arthur Heinricher and Professor Yi Hua Ma for all the guidance they provided us through out the planning and execution of our project.

Executive Summary

This report contains an overview of the Western European organizations that are involved in research on education and learning in science, mathematics, engineering, and technology (SMET). In addition, it proposes specific activities for international collaboration in educational research, and also recommends directions for further investigation of perspectives for such collaboration. The report is intended to be the foundation work for establishing international collaborations for the Research On Learning and Education (ROLE) program within the Division of Research, Evaluation and Communication (REC) at the National Science Foundation (NSF).

There were five steps in completing the project:

1. Internal Interviews — We conducted semi-formal interviews with our liaison, five ROLE program directors within REC and two members of the International Division at the NSF that specializes in Western Europe. From these interviews, we gathered the contact information on some NSF-funded researchers and the names of some Western European organizations.

2. Contact U.S. Researchers — We contacted thirteen NSF-funded researchers in

the field of education and learning to collect information on foreign organizations and researchers. From their responses, a list of organizations within and out-of Western Europe started to form. We were also able to obtain the names of foreign researchers that specializes in psychology and SMET education and learning.

3. Data Collection — With the list of organization names, we began the process of collecting data on these organizations.

4. Data Analysis — Important information regarding each organization including its goal, its major research areas, its organizational type were put into a spreadsheet called "The Matrix".

5. Contact Foreign Organizations — We contacted these foreign organization via e-mail surveys to obtain additional information that are not available anywhere else.

A total of thirty-six organizations in the field of research on education and learning were identified. Twenty-seven of these organizations are in Western Europe and nine are from outside of Western Europe (located in Australia, Israel, Taiwan and the United States). Twenty-two out of the twenty-seven Western European organizations are either funding agencies or research institutes, the rest being research associations.

Most of their research at organizations in Western Europe is concentrated in Quadrants 2 and 3 of the ROLE program, which are cognitive psychology and SMET teaching and learning.

Based on our experience and suggestions from REC staff and U.S. researchers we recommend that the NSF:

- Organize more international conferences and workshops for the researchers.

- Organize international forums dedicated to discussion of each organization's programs, insights, and plans.

- Work with other U.S. and foreign organizations towards organizing a network of educational research web sites providing information for both researchers and organizations.

- Coordinate efforts with other U.S. Organizations.

- Continue to expand the matrix.

We also recommend that the NSF contact the four key research organizations in Western Europe:

- Germany's Deutsche Forschungsgemeinschaft (DFG);

- Higher Education Funding Council for England (HEFCE);

- Centre National De La Recherché Scientifique (CNRS) in France;

- European Union (EU).

Contents

List of Figures

List of Tables

Chapter 1

Introduction

In the United States, research on science and mathematics education is supported by the Directorate for Education and Human Resources (EHR) of the National Science Foundation (NSF), a federal government agency that funds basic civilian research in all fields of science. The directorate is responsible for "the health and continued vitality of the Nation's science, mathematics, engineering, and technology education and for providing leadership in the effort to improve education in these areas" (NSF/EHR, 2000). This project was sponsored by the Research, Evaluation, and Communication (REC) Division of the EHR in order to establish the perspectives and directions for international collaboration within its brand-new Research on Learning and Education (ROLE) Program.

As the result of recent advances in many fields of science, a new multidisciplinary science on learning is beginning to form. ROLE was created as part of an initiative to broaden the scope of educational research. This program supports the entire spectrum of studies — from neuroscience to research on a large-scale of reforms in educational systems. The support of the ROLE program is divided into four areas called quadrants: 1) Brain research as a foundation for research on human learning; 2) Cognitive, affective, and social aspects of learning (primarily cognitive psychology);

3) Research on Science, Mathematics, Engineering, and Technology (SMET) learning in educational settings (for instance, teaching methods, curriculum materials, technological tools); 4) Research on SMET learning in complex educational systems (for instance, large scale reforms). In particular, ROLE is interested in multidisciplinary research at the intersections of these areas.

The goal of our project is to lay the foundation for establishing international collaborations in the emerging multidisciplinary research on learning and education by providing an overview of Western European organizations, their research goals and plans, and interrelations among them. In addition, we will identify and discuss potential joint activities between NSF and these organizations, as well as recommend directions for further investigation.

The next chapter in this report provides background information on REC Division and its programs (Section 2.1), research on learning and education (Section 2.2), and International Comparative Studies (Section 2.3).

The Methodology chapter describes and discusses the procedure we used to obtain and analyze information on organizations, to identify potential joint activities, and to formulate directions for investigation.

The Results & Discussion chapter describes and compares Western European organizations we have identified. Relations among those organizations are identified. Specific joint activities are suggested as part of the possible collaboration.

The Conclusions and Recommendations chapter summarizes the trends in organization of educational research in Western Europe and gives suggestions for further

investigation and for the ways to achieve a higher degree of cooperation in educational

research.

Chapter 2

Background

In this chapter we will briefly review the background material that is necessary to understand the spectrum of research covered within ROLE's four quadrants. In addition, we will look at the history of the REC division and its programs.

2.1 Research, Evaluation and Communication Division and Its Programs

The Research, Evaluation and Communication (REC) Division, formed in 1992, is one of seven Divisions within the Directorate for Education and Human Resources (EHR) at the National Science Foundation (NSF). EHR is responsible for "the health and continued vitality of the Nation's science, mathematics, engineering, and technology education and for providing leadership in the effort to improve education in these areas" (NSF/EHR, 2000). REC provides assistance to many EHR programs and principal investigators. Its objective is to study and analyze the state of the Science, Mathematics, Engineering and Technology (**SMET**) education in the United States (EFRC, 1996). Funds distributed through REC are intended to be used for studies, surveys, conferences, and other activities that help REC accomplish its objective. In
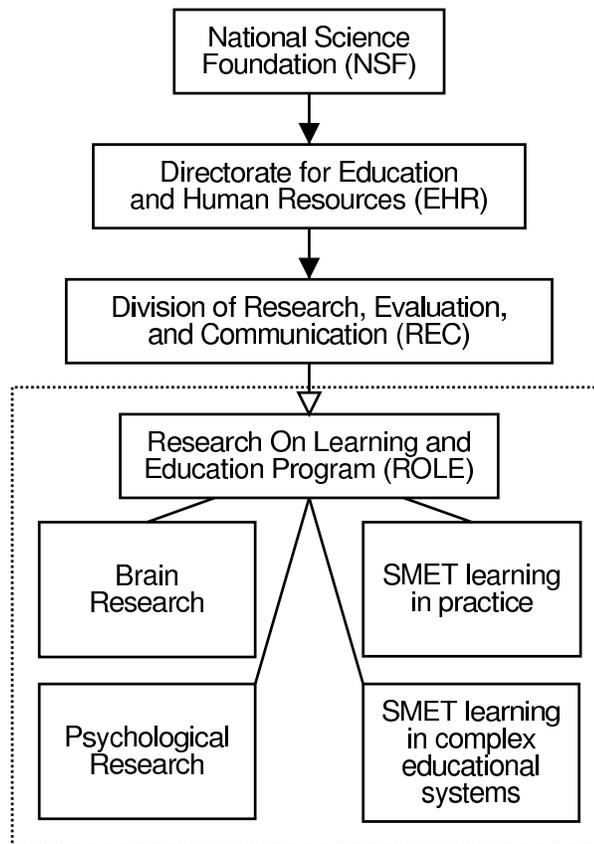
Figure 2.1 ROLE in organizational framework

addition, REC may sponsor basic or applied research in the field of education. In the recent years REC has been increasing its support in the latter area.

2.1.1   Research on Learning and Education (ROLE)

In the fourth quarter of 1999, REC announced the Research on Learning and Education (**ROLE**) Program (NSF, 2000). ROLE brings together several disciplines, such as neuroscience, psychology, economics, and policy research, to look at learning in a broader educational and social context. The goal of this program is to bring together research in areas of education and learning under a single program. Figure 2.1 shows

ROLE's place in NSF's structure as well as its research directions described in more detail below.

ROLE divides its support into four divisions, called *Quadrants.* Part of our analysis will use the Quadrants framework in order to classify organizations and programs.

The first quadrant: *Brain Research as a Foundation for Research on Human Learning.* The main goal of the research in human learning is to correlate a person's intelligence and ability to learn with specific brain processes. The study subjects range from infants to full grown adults. Studies include the brain's structure, activity and organization. ROLE's support in this quadrant is concentrated on "workshops and similar activities that will inform and gather advice from relevant scientific communities in these areas" (NSF, 2000). The goal of these activities is to build a connection between neuroscience and research on complex learning and education systems (fourth quadrant).

The second quadrant: *Fundamental Research on Behavioral, Cognitive, Affective, and Social Aspects of Learning.* This quadrant covers research on the understanding of foundations of human learning. In particular, ROLE is interested in projects that aim to integrate this area with brain research (first quadrant) or with research on learning in educational settings (third quadrant).

The third quadrant: *Research on SMET Learning in Educational Settings.* Many of the results of research in learning and education are not used in real-life education because of insufficient information exchange between research, development, and implementation communities ("ROLE Program Announcement," 2000). ROLE

attempts to address this problem by sponsoring research that provides a "stronger base to support sustained improvement in science and educational practice" in various education settings (e.g. classrooms, home, non-academic technological education).

The fourth quadrant: *Research on SMET learning in complex education systems.* In order to improve SMET learning, more studies must be conducted. That goal is to establish the ways in which current educational systems can be transformed. ROLE's interests in the subject includes "studies that involve testable hypotheses, studies that challenge current systemic reform strategies, design experiments, and other research methods such as quasi-experiments, test beds, longitudinal data, and national and international comparisons" (NSF, 2000).

2.1.2 Research on Education, Policy, and Practice (REPP)

The Research on Education, Policy, and Practice program was created in August 1996. REPP's goal was to increase the research and resources that were committed to Science, Mathematics, Engineering and Technology (SMET) education. The object was to improve the structure and method for making learning in SMET education possible and effective. At the same time, it would decrease the gap between research, policy and practice in SMET education.

The themes of the research projects that REPP sponsored fall into four areas:

1. Data, methodology and theory — Research on how the collection of measurments, their presentation, use, and interpretation can inform researchers and policy makers. The subjects of this research are case studies, ethnographic

data, experiments, statistical indicators, national and international comparative studies, longitudinal data[1], and research that synthesizes findings in a particular area;

2. Policy — Research on how policy influences educational practice and the way the educational systems is viewed by various groups (e.g. students, parents, teachers).

3. Practice — Research on teaching and learing in formal and informal settings. Investigation of how results from this research can be applied to the theory of systemic education reforms;

4. Technology — Research on how electronic tools can be used to teach and learn the ever changing content of science and math. How long-distance and cross-cultural links can be used in educational context. It also includes the educational use of high perfomance computing.

Some of the research questions raised by the principal investigators included: "How can we improve the effectiveness of technology in supporting education and educational change? What types of professional learning opportunities are likely to be successful in supporting teacher learning? What percent of science and mathematics teachers at each grade level meet the preparation standards recommended by the National Science Teachers Association and the National Council of Teachers of Mathematics? How are other countries using international comparative data to shape

---

[1]longitudinal data - data collected over an extended period of time. For instance, the assessment of students' achievement in mathematics as they progress through school.

policy and practice? What national issues in the U.S. education practice and reform can be illuminated by the examination of educational practice in other countries?" (NSF, 1996).

The REPP program covered the research topics that are now in the third quadrant of the Research on Learning and Education (ROLE) program - learning in educational settings[2]. The third quadrant occupies most of the awards made by ROLE. This is mainly because of the foundation work that has already been established by the REPP program. REPP was known through out the education and research community. When ROLE was announced, many researchers who had worked originally with REPP simply carried over their work from REPP to ROLE.

2.2   Research on Learning and Education

The goals of research on education, teaching, and learning are to develop theories of human learning and identify the factors that affect our learning. This research can be classified into two categories: neurobiological and psychological. This classification is not strict, but it is a good aid in understanding the field.

Research at the biological level studies the inner working of the human brain in connection with learning, while psychological research is concerned with the cognitive, behavioral, and social aspects of human learning.

---

[2]Interview notes with Dr. Kenneth Whang

2.2.1 Neuroscience

Neuroscience is a scientific study of the neural system with the goal of understanding the brain (human and animal), its structure, the mechanics of perception, motor control, reasoning, feeling, memorization, and learning (Kandel et al., 1991). Modern neuroscience is a large and complex area with hundreds of different subareas. Figure 2.2 shows the vertical hierarchy of the neural functions. It provides a good framework for classifying the research in neuroscience. Research on learning is performed on each of those levels: from behavior to the genetic foundations of brain development. In this section, we will provide an overview of the different branches in neuroscience that are relevant to research on education and learning. It is based on the information from Kandel et al. (1991), Arbib (1995), Churchland and Sejnowski (1992), and Pechura and Martin (1991).

Overview

The overall subject of neuroscience studies is the nervous system. We will be concentrating on the brain. Most of the processes that result in what we recognize as learning occur in the brain. The fundamental building blocks of the nervous system are specialized cells called *neurons*. Most neurons have multiple short fibers called *dendrites*. Dendrites often form tree-like structures. In addition, there is usually one rather long (up to a few meters) fiber called *axons*. Axons may branch at the end and form connections with up to a thousand other neurons. Neurons are surrounded by various support cells (glial cells, Schwann cells). In the human brain, there are
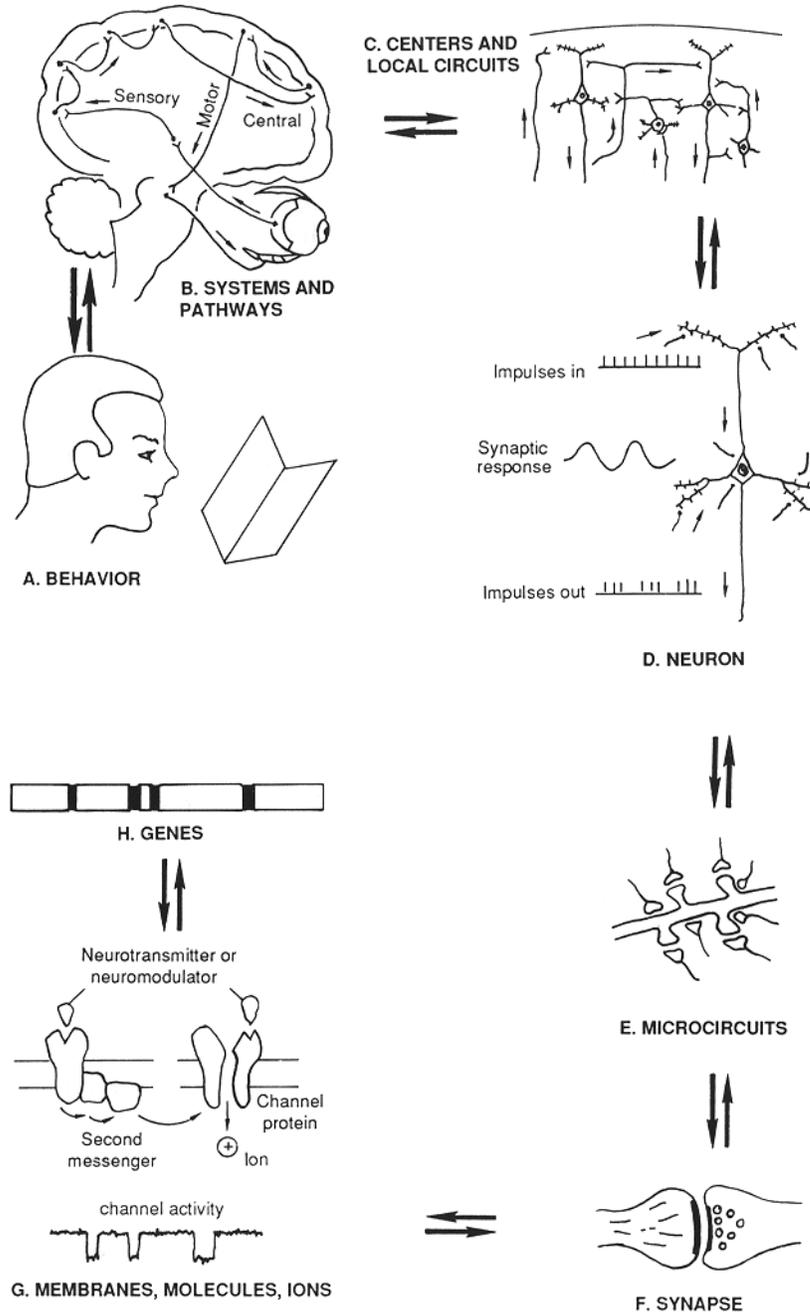
Figure 2.2 The neural hierarchy. Adapted from Shepherd (1988).

approximately 10^{12} neurons and 10^{15} interconnections between those neurons. The number of supporting cells is about 10 to 50 times that of the neurons.

Signals & Impulses

The primary function of neurons is to transmit and process signals. Signals are represented as the propagating electrical potential difference across the neuron's membrane. The potential is created and maintained through unequal distribution of Na^+, K^+, Cl^-, and organic anions (negative charged ions). This unequal distribution is maintained by the *sodium-potassium pump.* It should be noted that this process is metabolically driven, that is, it consumes the cell's energy. This fact allows us to monitor the levels of neural activity in different areas of the brain using the methods based on tracking oxygen consumption[3] (for instance, BOLD-fMRI — Blood-Oxygen-Level-Dependent functional Magnetic Resonance Imaging, which is based on the fact that deoxygenated hemoglobin is magnetic, whereas oxygenated hemoglobin is not).

Synapses

An interaction between the neurons occurs at the *synapses*[4] — the places where the membranes of two neurons come close together. Most of the junctions are between the axon of one neuron (the source neuron) and the dendrite or body of another (the target neuron). The source neuron acts on a target neuron through the release of chemicals,

---

[3]Intensive neural activity results in a huge energy consumption, which increases cell metabolism and, therefore, oxygen consumption.

[4]We will limit our discussion to chemical synapses. Some neurons are electrically coupled. These connections are faster and more reliable, but are less flexible (especially from learning point of view).

called *neurotransmitters*[5]. Neurotransmitters influence the target neuron's ability to generate membrane action potential and the effect is either inhibitory or excitatory. The output signal is usually discrete, it's either on or off, but sometimes, it is not constant. Sometimes, the output is analog. A neuron can generate a set of spikes of various frequencies and wave shapes. Inputs can affect all of these characteristics.

Neurons as Computation Devices

Neurons and individual dendrites can be viewed as the computing devices that accept a set of inputs from axons of other neurons and generate an output on their own axon. Initially, scientists believed that neurons performed simple operations similar to those of computers (logical and, logical or, summation). More complex theories have developed as time passed. For example, the most frequently used model for neural network simulations consider the neuron to be a summing device with a numeric threshold and a discrete output (on or off). Each input is assigned a numeric weight: positive for excitatory action or negative for inhibitory action. If the sum of the weights of active inputs is greater than the threshold, the neuron will become active. As we know today, neurons can perform rather complex operations, such as current-to-frequency transduction, impulse transmission, temporal/spatial filtering, linear addition, modification of synaptic connectivity, resonant filtering, gain control, and information routing[6].

---

[5]There is many different classes of neurotransmitters. Neurotransmitters may also be released into inter-cellular space and act on many neurons at once. Neurotransmitters and other chemicals involved in neural functioning are studied in Chemical Neurobiology (Bradford, 1986).

[6]This list is far from exhaustive.

Memory & Learning

Synapses are also associated with learning and memorization. There is not a distinct area in the brain that is responsible for these processes[7]. Information is represented in terms of the "weights" of the synapses. In the process of learning, synapses are modified. As a result, the contribution of that particular input changes. The mechanisms of learning are not very well understood, and this is a very active area of multidisciplinary research. Even so, there are a few interesting facts worth mentioning.

Researchers have identified a few subsystems[8] in our brains that are responsible for particular functions such as vision, sensory information (for instance, feeling of touch or temperature) preprocessing, and motor control. In general, it is impossible to arrange all subsystems according to their order in the information processing chain. Still, some subsystems clearly have a higher level of functionality (e.g. visual image stabilization versus logic processing). Subsystems are interconnected through a collection of axons called *projections*. For any *feed-forward* projection from one area to the other, there is a reciprocal (feedback) projection in the other direction with at least as many axons and, thus, with as wide an information bandwidth. These feedback connections are most likely responsible for adjusting the synaptic connections, and hence learning.

---

[7]Nevertheless specialization of function still occurs.

[8]One of the heuristic principles in neuroscience is spatial locality. That is, anything that works closely together is grouped to minimize the mass of long interconnecting axons and the delay of signal propagation.

Parallel Processing in the Brain

Neurons are relatively slow devices. Synaptic transmission takes about 5 milliseconds. Signal propagation velocity in axons ranges from 1 to 100 meters/second. Human reaction time is in the order of $150 - 200$ milliseconds. Therefore, the number of neurons in signal pathways involved in a reaction is in the magnitude of 10 to 100. These numbers suggest a great deal of parallel computation in our brain. Input signals are dissected into components, which are later processed separately in parallel.

Neuroscience and Psychology

One of the ultimate goals of neuroscience is to explain behavior in terms of physiological processes. There is a smooth transition between neuroscience and psychology at the highest levels of the neural hierarchy shown in Figure 2.2 on page 11.

Biopsychology[9] is a scientific investigation of relationship between behavior and underlying physiological processes. Various techniques are used in this area, from comparative studies of behavior of different species to the recording of brain activity as the subject performs a particular operation (Microsoft, 1998).

Experimental Psychology, a branch of psychology that uses experimental methods to study psychological issues, has contributed a number of facts to neuroscientific research.

---

[9]Sometimes called neuropsychology, physiological psychology, or psychophysiology. Gradients of meaning are used to emphasize one aspect or the other.

2.2.2   Psychology

Psychology is a study of the mental process and behavior in humans and other animals. Throughout its history, psychology has been divided into many smaller fields of study. All of these fields are interrelated and many overlap. The pioneers of psychology were physicist Gustav T. Fechner and physiologist Wilhelm Wundt, both German (Microsoft, 1998). They are considered the first experimental psychologists. Fechner developed the first method to measure physical sensations in response to external stimuli. Wundt founded the first laboratory of experimental psychology in Leipzig, Germany, which promoted studies in the field of psychology.

Behavioral Psychology

Behaviorism is an area of psychology that uses strict experimental procedures to study the relation between the behavior of a subject and external stimuli. An American psychologist, John B. Watson, first introduced the concept of behaviorism in the early 20th century. Watson believed that through the use of laboratory experiments, all forms of emotion and behavior could be seen as simple muscular movements that can be studied and measured. Experiments by the famous psychologist Burrhus Frederic Skinner demonstrated that language and problem solving can be studied scientifically and altered using reinforcement. Reinforcement is a procedure through which the subject can be conditioned for a certain response in reply to a given stimuli (Microsoft, 1998). Reinforcement has the ability to modify behavior and stimulate learning through the use of a reward after the successful completion of a particular

task. Similarly, if the task was not done correctly, no reward is given to the subject, which would encourage the subject to try again (Mowrer, 1961). Through these basic concepts, it is easily seen why behavioral psychology is so important to learning and education.

Social Psychology

Social psychology is the study of human behavior in its social and cultural setting. According to Lindzey and Aronson (1968), it is closely related to political and economic sciences as well as cultural anthropology. Sociology, the human behavioral science which studies the causes and effects of social relations among individuals and groups, is an integral part of social psychology. Research in social psychology includes studies of socialization, attitudes, social affiliation, group structure and function, personality and society.

Many research techniques have been used in social psychology: from the traditional theory-based investigations to mathematical models based on theory and arithmetic precision. Questionnaires and interviews are also very useful and popular. Using these methods, researchers proved that social stimuli still influenced the subject even when the subject was alone.

Cognitive Psychology

Cognitive psychology is the area of psychology that concentrates on human perception, thought, and memory. Cognitive science attempts to identify and define the

processes involved in thinking without regard to their physiological basis. Historically, cognitive psychology is an attempt to "free psychology from the more restrictive aspects of behavioral studies" (Microsoft, 1998). Through cognitive studies, it is often shown that human learning presents a negatively accelerated learning curve, that is, fast learning and large gains at first, then slower and smaller.

Cognitive psychology has contributed a significant part of its terminology to computer science. Eysenck (1984) argues that due to the complexity of human learning, the most intuitive way of studying this subject is through information processing, using keywords such as encode, transform, store, retrieve and output, much like the inner workings of a computer. Using this approach, it is possible to map the mental processes and problem solving within narrow, limited, tested fields.

Educational Psychology

Educational psychology is an area of psychology that concentrates on "the learning process and psychological problems associated with the teaching and training of students" (Encyclopedia Britannica, Inc., 2000). It is a study of the cognitive developments of a person and all aspects that are involved in learning. Educational psychology is closely related to both cognitive psychology and behavioral psychology. Educational psychologists often engage in the research and development of school curriculums. Due to the complexity of human learning and the diversity of the field of studies, psychologists work on developing theories for specific areas in learning, motivation, development, teaching and instruction instead of one general theory (Mi-

crosoft, 2000).

Learning

Learning is one of the main concepts studied in the field of educational psychology. Research conducted in this area has greatly influenced and improved educational practice (Greeno et al., 1996). Learning theories, also know as behavioral theories, can help educational psychologists to understand, predict and perhaps, control a person's behavior. Techniques derived from this theory are used in teacher-training courses which could be applied to solve typical classroom problems (Encyclopedia Britannica, Inc., 2000).

Motivation

If a person is doing something interesting and involving, to everyone else around him, that person has high motivation.

> "One approach to enhancing motivation stresses 'intrinsic' motivations (Deci, 1975), or motivational 'flow' (Csickszentmihalyi, 1975), where conditions are created that increase interest so that learning and mastery are sought for their own sake." (Graham and Weiner, 1996)

Motivational theories are a network of closely related ideas that provide educational psychologists views on the reasoning behind every motivation. There are five general theories within motivational psychology:

1. Hull's Drive Theory

2. Lewin's Field Theory

3. Atkinson's Achievement Theory

4. Rotter's Social Learning Theory

5. Heider, Kelley and Weiner's Attribution Theory.

During the past sixty years motivational theory has shifted from mechanism to cognition, and new concepts have been introduced such as learned helplessness and self-efficacy which may be applied to everyday teaching and learning (Graham and Weiner, 1996).

Development

Historically, developmental psychology has contributed to educational practices only indirectly through research for learning and teaching techniques and only recently, with the increase in cognitive research since the 1970s, have educational and developmental psychology been connected directly (Paris and Cunningham, 1996). Developmental theories focus on the different development stages during a person's life in areas such as behavior and cognition. With these theories, developmental psychologists have a large impact on educational programs because it is possible to determine the best kind of learning for each age group.

Teaching

Scientific studies in teaching are a relatively new topic; there was little research conducted in this area until the 1950s (Microsoft, 2000). Teaching theories provide the teacher with ways of enhancing learning and academic achievement in the classroom. Concepts of cognitive psychology on learning and thinking can be applied to teaching practices (Borko and Putnan, 1996). Educational psychologists have found many variables to be important in teaching in a classroom setting including the length of instruction, the amount of content been covered, the ability of the teacher to give clear directions, create a comfortable environment for learning, and providing feedback to the students.

Instruction

By combining cognitive psychology and research on verbal learning, educational psychologists developed a new way to systematically design instructions known as "Instructional Design Theory." American experimental psychologist Robert M. Gagne is the pioneer of instructional design. The basic concept behind his reasoning is that "complex competence is built by adding coordination and other structure to simpler pieces of knowledge" (Derry and Lesgold, 1996) and that it is ideal to make the amount of learning manageably small at any given time. Gagne's work on hierarchical theory shows that some types of learning are prerequisites to other types of learning, which means that determining the sequence of instruction is very important (Microsoft, 2000).

2.3   International Comparative Studies

"International Comparative studies of educational performance can play a central role in assisting policy-makers, curriculum experts, and researchers in judging the extent to which an education system meets national expectations and the extent to which it is likely to contribute to a nation's overall economic and social well-being" (Robitaille et al., 2000). With the results from an international comparative study, each participating country is able to see where they are doing well and where they need to improve.

The International Association for the Evaluation of Educational Achievement (IEA) was established in 1959. The organization brings researchers who are interested in investigating educational issues together to study problems that cannot be analyzed within a single school system. Since 1959, the IEA has carried out more than fifteen studies on international comparisons of student achievements. The IEA conducted four studies on mathematics and science before the Third International Mathematics and Science Study (TIMSS). They were the First International Mathematics Study (FIMS) from 1959 to 1967; First International Science Study (FISS) from 1966 to 1973; Second International Mathematics Study (SIMS) from 1976 to 1987; and the Second International Science Study (SISS) from 1980 to 1989 (Robitaille et al., 2000). The questions and results from all four studies, FIMS, FISS, SIMS and SISS, were used as guides for the design of the TIMSS study.

2.3.1   Third International Mathematics and Science Study

TIMSS, the Third International Mathematics and Science Study was the largest study conducted to date by the International Association for the Evaluation of Education and Achievement (IEA). It was also the first study that integrated two subject areas, mathematics and science, into one assessment. TIMSS was intended to paint a clear picture for the policy-makers, curriculum specialists, and researchers on the performance of the their respective educational systems. More than forty countries from around the world participated in this study to measure their own achievements in those fields. The goal of TIMSS was to "learn more about what kinds of curricula, teaching practices, and organizational arrangements are associated with high levels of student achievement in mathematics and science in order that the teaching and learning of mathematics and science might be improved for students everywhere" (Robitaille et al., 2000).

To conduct a complex project such as TIMSS required significant collaboration from many agencies. The IEA served as the international coordinator for TIMSS study. Funding for the international coordination aspect of TIMSS was provided by the National Center for Education Statistics (NCES) of the United States Department of Education, the United States National Science Foundation (NSF), and the Applied Research Branch of the Strategic Policy Group of the Canadian Ministry of Human Resources Development. Each participating TIMSS country also contributed to the international coordinating costs as well as funding their own nation's implementation of the study (ISC, 2000a).

The Data for TIMSS was collected in 1995 for approximately half a million students in three population groups throughout the participating countries. The test questions and questionnaires for the assessment were translated into more than thirty different languages. Population one consisted of students who were nine years old; third and fourth grade in the North America. Population two was made up of students who were thirteen years old; seventh and eighth grades in the North America. And population three was students in their last year of high school. Each student was asked to complete a test booklet that covered materials on mathematics and science within ninety minutes. In addition to the test, a questionnaire was given to record the student's attitude and beliefs about learning, studying habits, and family backgrounds. More than fifteen thousand mathematics and science teachers were also part of the data collection. The textbooks used by the teachers from participating countries were analyzed. Questionnaires were given to the teachers to reflect their view as a teacher, their class population, the kinds of topics covered in class, homework assignments, and how the class is structured. Administrators of the surveyed schools were asked questions about community backgrounds, staff, curricula within the schools, enrollments, and courses offered in that school. Previous IEA studies showed that the society's influence on a student could greatly affect how well that student learned in school. This is the reason TIMSS paid special attention to record the student's surroundings.

The achievement results of TIMSS for most participating countries were considered bad news. Even higher ranked countries expressed concerns that their student's

attitude towards learning presented a problem. The education system in every country is different. This is due to their social and political differences. From TIMSS, many countries realized that there should be improvements made to their educational system, and system could learn from one another. "They can learn that different approaches to common concerns are taken in different countries. They can study the relative success and efficacy of those different approaches and then make decisions about what might work in their setting"(Robitaille et al., 2000). TIMSS showed that each country had its own weakness in education. In order to eliminate these weaknesses, counties learned from others' success.

2.3.2 Third International Mathematics and Science Study Repeated

The Third International Mathematics and Science Study Repeated (TIMSS-R) is a repeat of the TIMSS study from 1995. Just like TIMSS, over forty countries participated in the study (ISC, 2000b). Most of the countries were the same as in TIMSS, but there were also some new countries added to the study. TIMSS-R was administered only to the eighth-grade students. These are the same eighth-graders who participated in the original TIMSS study back in 1995 (NCES, 2000).

TIMSS-R, conducted in 1999 much like TIMSS, required significant collaboration between organizations. The International Association for the Evaluation of Education and Achievement (IEA) served as the international coordinator for TIMSS-R study. The National Center for Education Statistics (NCES) of the United States

Department of Education, and the United States National Science Foundation (NSF) provided funding for the TIMSS-R study. The TIMSS International Study Center at Boston College directed the study at the international level. Westat, Inc. handled the data collection in the United States for the main TIMSS-R assessment. The format of the TIMSS-R assessment was almost exactly the same as TIMSS with the only exception being that some of the questions in the test booklet were changed due to the fact that those questions were publish along with the TIMSS results (ISC, 2000b).

For the countries that were a part of TIMSS, TIMSS-R would give them the opportunity to observe trends in mathematics and science achievement during the past four years. For those counties that were not a part of TIMSS originally, TIMSS-R would provide them with the opportunity to benchmark their own achievements in mathematics and science to that of the international level (ISC, 2000b).

Chapter 3

Methodology

This chapter describes the procedures we used in our project. We start by depicting the kind of information we were looking for and how it was organized. The next section discusses the methods we used to identify Western European organizations, and to collect information.

3.1 Collected Information and Data Organization

From conversations with our liaison and advisors, as well as from our informal study of the structure and procedures of the National Science Foundation (NSF), we developed a list of organizational qualities. The selection criterion was potential usefulness to other organizations (including NSF) seeking to establish international collaborations in educational research. The following characteristics were identified:

- Country/Alliance — organization's sphere of activity;

- Contact Information — mailing addresses, telephone and fax numbers, e-mail addresses, web site URL, names of representatives. If applicable, contact information for departments associated with research on learning;

- Brief description — a few sentence providing overview of organization;

- Type of activities — whether organization funds research, performs research itself, or coordinates research (e.g. by organizing conferences for researchers or by coordinating a cross-organizational program);

- Budget — financial resources available for organizations that fund or perform research. If organization is not dedicated to educational research, the budget of educational research component of that organization;

- Structure and activities — information on how organization works;

- Relevant departments — if organization is not dedicated to educational research, the departments that responsible for research on learning within this organization;

- Research interests — subjective classification of organization's learning related research according to ROLE's quadrants and additional notes, such as: organizations framework for learning-related research (e.g. priority directions), presence of research on information technology in education, and on integration of learning-related research across different departments[1];

- Relevant programs and projects;

- Relationship with other agencies — there is a high degree of cooperation be-

---

[1]Typically, in organizations supporting scientific research in general (for instance, national science foundations or national research councils) research on learning and education is scattered over a few departments. For example, research on learning from neuro-scientist's point of view can be supported by the Life Sciences Department, while research on teaching methods and curriculum can be supported by the Education Science Department. More complex schemes also exist. Since interdisciplinary research is the key component of the emerging science on learning, it is important to determine if there are connections between relevant departments.

tween research organizations (as is the case in science in general). There are a lot of joint activities between organizations in educational research. Thus, we think it is important to describe connection between organizations in order to foster multi-organizational collaborations;

- Collaboration interests;

- Future plans — organization's (or department's) vision of future developments, especially, organization's interest in supporting Science on Learning (SOL) initiative.

The information was stored in one large spreadsheet with columns corresponding to the characteristics listed above. Two Microsoft Excel documents accompany this report: one with the information on Western European organizations, and another with information on organizations in other regions that, although outside the scope of our project, was collected along the target data.

3.2 Information Collection Methods

Five approaches were used to identify Western European organizations involved in educational research and to collect information on them:

1. Interviews with Research, Evaluation, and Communication (REC) Division staff;

2. A survey of NSF-funded U.S. researchers;

3. Interviews within NSF's International Division;

4. A study of paper and online documentation on Western European organizations;

5. A survey of foreign organizations identified from methods 1–4.

Procedures 1, 2, and 4 were also used to develop a list of potential joint activities for collaboration in educational research.

3.2.1 Interviews with REC Staff

Interviews with REC staff served as a starting point. They were used to construct an initial list of organizations and to identify NSF-funded U.S. researchers to survey. Furthermore, REC interviews provided ideas about what form the collaborations might take in terms of specific joint activities. As a secondary goal, these interviews were used to improve our understanding of the ROLE Program (its mission, unique features, and historic perspective) and educational research in general.

We interviewed six people[2]: four ROLE program directors (including our liaison), REC deputy Division Director Dr. Larry Suter and REC division director Dr. Eric Hamilton — originator of the ideas behind the ROLE program. Participants were chosen using *purposive sampling* (Berg, 1998); the subjects were selected with the help of our liaison according to their knowledge of the ROLE program and aspects of international collaboration in educational research.

The interviews were purely informational, since there were no risks associated with the disclosure of the information we sought. Nevertheless, according to the

---

[2]See Appendix E.1 on page 91 for the list of names

Social Exchange Theory[3] (Dillman, 1978), the respondent benefits must outweigh the costs in order for the interview to be productive. The major cost for our interviewees was time; program directors are very busy people. Since all the interviewees are working on ROLE, the major benefit was the information that our final report might provide them. Each interview was conducted in the interviewee's office. This provided a comfortable environment for the interviewees.

The format of the interviews were semi-structured. We had a set of written questions, but interviewees were allowed to diverge. Additional questions were formulated as the interview progressed. The questions were pretested on each member of our team and were discussed with our advisors.

Our first interview[4] — was conducted using the questionnaire in Section D.1.1 on page 84. The interview took around an hour, much longer than we had planned. The interview provided plenty of information about ROLE's research areas, but little information about foreign organizations and international collaboration. Thus, we revised our questionnaire to shorten the time and shift the foci of the interview. Some of the questions were removed, while some were rephrased to be more clear and specific. The revised version (Section D.1.2 on page 85) was more direct and was structured to fit within the time frame we had set (15–30 minutes).

The following arrangement was used:

- One person asked the questions;

---

[3]See Appendix G on page 130
[4]See Section F.1.1 on page 93 for the transcript

- Another person took notes;

- The third person, if present, observed the conversation and occasionally asked additional questions.

The observer ensured that all of the questions were asked by the interviewer (and asked them, if not), asked questions if additional information was needed, and sometimes helped clarify what was asked. The third person took notes as a back-up plan in case something went wrong with the tape recording or tape recording was not allowed by the interviewee (each interviewee was asked at the beginning of the interview if we could tape record).

We allowed each interviewee to review the transcript. This was useful because it gave the interviewees an opportunity to clarify their responses and provide more details. In addition, the chance to edit the answers served as an encouragement to permit tape recording. Overall, four of the interviews were tape recorded. The transcripts are shown in Appendix F.1 on page 93. The transcription was done by all three team members in order to distribute the workload.

3.2.2   U.S. Researcher Survey

We surveyed NSF-funded U.S. researchers in education in order to identify more organizations, collect some information on them, and to learn about the inter-organizational joint activities researchers would like to see.

We talked to our liaison and reviewed the proposals funded by the ROLE and REPP programs to obtain the names of key U.S. researchers and their areas of re-

search. Some of the names came from the interviews with REC staff. NSF files contained e-mail addresses for every researcher. Telephone numbers were obtained through directory searches on the web sites of the organizations (usually universities), which were identified by the domain component of the e-mail address. Thirteen names and contacts were obtained. The name and contact information chart is available in Appendix E.3 on page 92; researchers that chose not to disclose their responses (see below) are not listed. Six responses were received from people on the list. Respondents were allowed to forward our survey to other people. Four additional responses were obtained. We received a total of thirteen responses. The responses are included in Appendix F.2 on page 122.

Respondents were provided with three ways to fill in the survey: over the web (by filling out the HTML form), over the e-mail (by editing the attached plain text file and sending it back to us), or by fax. The participants were asked to respond within three weeks. Follow-up calls were made to obtain more information, to express our appreciation and to answer any additional questions.

We first called the U.S. researchers and then sent them an e-mail with information on how to respond (via the web, e-mail, and fax). The calls were intended to attach a voice to the unfamiliar name in the electronic mail and hence encourage a response. We also answered any questions that the researchers had. Each phone call was no longer than ten minutes. We explained who we were, what our project was, and informed them that we were going to send them a survey through electronic mail. The phone calls were followed by an e-mail because written communication was easier

to record and translate.

The questionnaire was designed in accordance to the Total Design Method[5] (Dillman, 1978). It began with a description of who we were (we, including our sponsor, NSF) and what we were trying to achieve (with an emphasis on benefits to the researchers). In terms of the Social Exchange Theory[6] the cost to the researchers was time, while the benefit was the possibility of increased number of workshops and conferences REC might organize based on the results of our research, and the possibility of collaborations to take place.

The survey was pretested on our advisors, liaison, and another program director at NSF. The survey was revised after each pretest before further tests were conducted. The final version of this survey is shown in Appendix D.2.1 on page 86.

3.2.3   Interviews within the International Division

In addition to interviews with REC staff, we conducted unstructured interviews with three International Division staff members specializing in Western Europe.[7] Each interviewee was an expert on a separate set of countries; and one interviewee was an expert on the European Union. The goal for these interviews was to revise our list of organizations, to confirm the presence of all relevant organizations, and to obtain or revise information on research areas and structure of some organizations. In addition, the interviews helped us identify four key organizations that should be given priority

---

[5]See Appendix G on page 130
[6]See Appendix G on page 130
[7]See Appendix E.2 on page 91 for the list of interviewees.

for establishing international collaboration.

3.2.4 Documentation Study

We studied official documentation and information on the web sites of the identified organizations. This included project reports, conference notes, pamphlets, program announcements, program home pages, and online reports. Dr. Eric Hamilton, who has been working on organizing international collaborations for the ROLE program, contributed the notes from his meetings with representatives of organizations and conferences he attended, along with information packets on the Western European organizations he has been working with.

The primary goal for this documentation study was to collect information described in Section 3.1; the secondary goal was to identify more organizations in educational research through exploring the network of connections between organizations[8]. This study was essential in our quest for information and took the "lion's share" of our project's time.

We had encountered a number of problems, such as unavailability[9] of documentation in any form (paper or electronic), poor organization of some web sites, complete or partial absence of English translations, and vague writing.

---

[8]This method helped us to identify many orgaizations.
[9]Or, at least, unreachability within the duration of our project.

3.2.5   Survey of Foreign Organizations

We sent out surveys to the twenty-seven Western European organizations one week before the end of our project. The goal for this survey was to obtain information that we could not find using other methods, as well as to verify the collected data. Responses will be sent directly to Dr. Lee Zia at the NSF.

The questionnaire for the survey is shown in Appendix D.2.2 on page 88. It was developed and pretested with the help of Dr. Larry Suter. A special consideration in the design of the questionnaire was the fact that many respondents are not native English speakers. Thus, the questions were designed for simplicity, sometimes at the expense of detail[10]. The introduction also provides more information on the ROLE program, since, unlike NSF-funded researchers, most subjects of this survey have never heard of the ROLE program.

---

[10]For instance, the instead of using a scale to indicate an organization's research interests, a simple yes or no question was used.

Chapter 4

Results & Discussion

We have identified thirty six organizations from around the world that are involved in science and mathematics educational research. Twenty seven of these organizations are in Western Europe and nine are from outside of Western Europe (located in Australia, Israel, Taiwan and the United States).

In this chapter, different aspects of twenty seven Western European organizations will be discussed and analyzed.

4.1   Brief Descriptions of Organizations

In this section, we will give a brief description and some interesting fact for each of the twenty seven Western European organizations. The organizations are listed alphabetically by name.

The *Bertelsmann Foundation* is a non-profit organization located in Germany. It supports its research partners from government and scientific and private institutions to formulate and provide funding to implement projects. It is also the biggest shareholder (68.8%) of the Bertelsmann Corporation, the non-voting shares were donated to this non-profit research funding organization by Reinhard Mohn in 1993, which has business in areas such as music labels, films, television and online services. This

organization is also associated with the Bertelsmann Science Foundation. The Bertelsmann Foundation has an annual budget of 80.2 million Deutsche Marks or 36.7 million U.S. Dollars.

The Federal Ministry for Education and Research, *Bundesministerium für Bildung und Forschung (BMBF)* is the German Federal Ministry for Education and Research, promotes the exchange of information in teaching and learning with other countries and also research in education and learning. The BMBF supports research projects in many fields and it has an annual budget of 14.6 billion Deutsche Marks or 6.68 billion U.S. Dollars.

The Federal Ministry of Education, Science and Culture, *Bundesministerium für Bildung, Wissenschaft und Kultur*, oversee the entire Austrian education and cultural Affairs. With its seven Department Governments, the Federal Ministry of Education is responsible for all aspects with regards to the school including the education of teachers, school development and educational research. The Ministry is also involved in international cooperation activities and it is associated with the European Union.

The *Center for Research in Development, Instruction and Training (CREDIT)* in the United Kingdom was established with funding from the Economic and Social Research Council (ESRC) in 1992. CREDIT conducts research on effective teaching and learning. It brings together experts from psychology, education, human-computer interaction and cognitive science. With funding from both the Higher Education Funding Council of England (HEFCE) and IBM, CREDIT also supports research on the design and evaluation of advanced technologies. This organization is associated

with the Economic and Social Research Council (ESRC) and the School of Psychology at the University of Nottingham.

The *Centre National De La Recherché Scientifique (CNRS)*, established in 1945, is the French National Center for Scientific Research that conducts all kinds of research in areas ranging from nuclear physics to international relations. The National Committee of Scientific Research, founded at the same time as the CNRS, evaluates the 12,000 researchers and the 1,200 CNRS laboratories. The committee also governs the seven research departments within CNRS. The department of Life Sciences within the CNRS focuses its research on human beings including the fundamentals inner workings of the brain. The budget for CNRS is 15.5 billion Francs or 2,116 billion U.S. Dollars.

The German Science Foundation or *Deutsche Forschungsgemeinschaft (DFG)*, is a funding agency much like the National Science Foundation. It is the central public funding organization to serve science and arts in all fields by supporting research projects carried out in universities and public research institutions in Germany. Like many other organizations, the DFG is multidisciplinary with many inter-connecting research areas. One of DFG's key programs is called "Education Formation of School: Technical and learning in the mathematical scientific instruction as a function of school contexts". The programs aim is to improve the quality of education in mathematics and science. The DFG is a member of the European Science Foundation (ESF), the International Council for Science (ICSU), the International Foundation for Science (IFS) and it is also a part of the Max Planck Institutes (MPI) and the

Bundesministerium fur Bildung und Forschung (BMBF).

Economic and Social Research Council (ESRC) is the leading funding agency for research and training. The organization aims to improve the exchange of knowledge, international collaboration and opportunities for co-funding research programs. The Teaching and Learning Research into Practice (TLRP) is a £12.5 million program announced by the ESRC and funded by the Higher Education Funding Council of England (HEFCE), the Scottish Executive, the Welsh Assembly and the Department for Education and Employment (DfEE). TLRP concentrates on the implantation of educational research to enhance teaching and learning in practice. The program also promotes multi-disciplinary and multi-sector research in teaching and learning. ESRC's total budget is 65 million Pounds or 95.9 million dollars.

The *European Union (EU)* is an association of European countries that is analogous to the Federal Government in the United States. (However individual nations posses a higher degree of sovereignty than the U.S. states.) Thus, EU similar to the U.S. government established a set of agencies to perform various functions. Different Directorates carry out the many aspects of EU's interests. The Education and Culture Directorate-General of the European Commission for example, organizes research in Quadrants three and four of the ROLE program.

The *European Association for Research on Learning and Instruction (EARLI)*, located in The Netherlands, is an organization that has over one thousand members from forty countries. EARLI encourages contact between researchers through Special Interest Groups that support activities such as newsletters, seminars and publications

in the fields of education and learning. It is associated with the American Educational Research Association (AERA), an American organization, which has similar objectives to that of EARLI. It also works with EURYDICE, the Information Network on Education in Europe, which promotes the exchange of reliable and comparable information on education systems and policies in the field of education in Europe.

The *European Educational Research Association (EERA)* was established in 1994 as a learning society that supports communication between educational researchers and international governmental organizations (such as the European Commission, OECD and UNESCO). The association, located in the United Kingdom, also disseminates the findings of educational research and highlighting their contribution to practice and policy making. The members of EERA are thirteen national associations for educational research and twenty-four research institutes.

The *European Science Education Research Association (ESERA)*, was formed during the European Conference on Research in Science Education that was held in England, 1995. ESERA aims to enhance the quality of research and research training in science education in Europe, to relate research to the policy and practice of science education in Europe, and also to link science education researchers in Europe and similar communities elsewhere in the world. The association holds conferences every two years and the next conference will be in Greece, 2001.

The *European Science Foundation (ESF)* located in France is an association of sixty-seven member organizations from twenty-three European countries. The ESF is committed to facilitate both collaboration and cooperation in science on behalf of

the European scientific community. It is independent from the government, which means it can collaborate and cooperate with anyone and anywhere. The ESF is a multidiscipline organization with many inter-discipline research areas. The research is categorized into five areas. One of the areas is called Standing Committee for the Social Sciences (SCSS). The SCSS covers a wide range of scientific disciplines including research in education and psychology. A project conducted by the SCSS during 1994 to 1997 called Learning in Humans and Machines (LHM) was aimed at encouraging a new learning discipline with roots in psychology, educational research and sociology, and at integrating the results with those of the neuroscientific and neurocomputing approaches to learning. ESF's total yearly budget is over 15.2 million Euros or 13.6 million U.S. Dollars.

The Austrian Science Fund, *Fonds zur Förderung der wissenschaftlichen Forschung (FWF)*, was established in Austria in 1967, at the time when the Austrian Research Funding Law came into force. The FWF aims to stimulate European research cooperation and provide funding for all aspects of basic scientific research in Austria including natural sciences, social sciences and the humanities. The FWF both provides funding for research and conduct its own research. It is a member of the European Science Foundation (ESF). The FWF has a budget of 958 million Schillings or 70.7 million U.S. Dollars

The *Fund for Scientific Research (FWO)* - Flanders (Belgium) was founded in 1928 with an interest in the support of scientific research. The FWO encourages and finances fundamental scientific research in biological sciences, medical sciences,

applied sciences, humanities and social sciences. This organization promotes national and international scientific contacts and cooperation. It is also a member of the European Science Foundation, supporting all aspects of its research.

The *Higher Education Funding Council for England (HEFCE)* distributes public funds for teaching and research to universities and colleges. The HEFCE funds individual institutions. It has a number of programs in the field of research on teaching and learning methods. The HEFCE is partners with other funding agencies such as the Further Education Funding Council (FEFC), the Higher Education Funding Council for Wales (HEFCW), the Scottish Higher Education Funding Council (SHEFC) and Teacher Training Agency (TTA). HEFCE's total budget is 4.38 billion Pounds or 6.46 billion U.S. Dollars. Out of the total budget, 867 million Pounds or 1.28 billion U.S. Dollars are devoted to research.

The Department of Educational Science at the *Institute for Science and Education (IPN)* in Germany is devoted to developing and promoting science education through research. One of IPNs research projects is called BIQUA - Bildungsqualität von Schule, which studies students' learning in math and science and their cross-curricular competencies depending on both in-school and out-of-school contexts. The IPN is closely affiliated with the University of Kiel and it is also a member of the Wissenschaftsgemeinschaft Gottfried Wilhelm Leibniz (WGL).

The *International Association for the Evaluation of Educational Achievement (IEA)* is a non-profit scientific society based in The Netherlands. IEA is an international cooperative of research centers from over fifty countries including the

United States. It conducts comparative studies focusing on policies and practices in education to improve learning within the educational system. The funding for this organization comes from member subscriptions, government grants and contributions from other organizations. The IEA has conducted quite a few international studies including the Second International Math and Science Study (SIMS and SISS) and Third International Math and Science Study (TIMSS). The participating country use the results from these studies to compare the performance of their students to others around the world.

The *Knowledge Foundation (KKS)* supports research at Sweden's university colleges and works on bridging the gap between the academic and business worlds. The KKF is determined to "boost Sweden's international competitiveness" by promoting the use of Information Technology (IT) and funding research at Sweden's universities and colleges.

The Center for Educational Research at the *Max Planck Institute (MGI)* for Human Development studies individual development and the human learning processes from a scientific point of view. Its research areas include learning behavior along with optimization for the teaching and learning processes. MGI is currently working with the ROLE program by reviewing proposals and encouraging project level connections. The Max Plank Institute is a part of the Max Plank Society and also a member of the ESF.

The *National Foundation for Educational Research (NFER)* was founded in 1946 as an independent organization in the United Kingdom that undertakes research and

development projects in all fields of the public educational system. The NFER aims to collect, analyze and disseminate research-based information that would improve education. "Focus on Educational Research" is a database, which seeks to include all types of completed and ongoing research from large sponsored programs to individual projects on education and related fields. Most of NFER's research work is carried out within the public education system, in local schools and colleges. The NFER is a member of the European Educational Research Association (EERA). In addition to research NFER performs evaluation of impact of various education and training programs.

The *Netherlands Organization for Scientific Research (NWO)* is an independent organization established in 1988. The NWO plays an important role in the development of science, technology and culture in The Netherlands by supporting fundamental scientific research. It is responsible for seventeen percent of the national research capacity. The NWO is governed by seven Councils which represent many fields of science including life science, social science, and the humanities. It has a relationship with many major scientific organizations including the Centre National de la Recherché Scientifique (CNRS) and the European Science Foundation (ESF). The NWO's budget for 1998 was 665 million Guilders or 366 million U.S. Dollars.

The *Nuffield Foundation* is a major independent sponsor of research and innovation in education. The foundation supports projects which could advance education and social welfare. Educational research and innovations is one of the four special interest areas for the Nuffield Foundation. Out of the total 8 million Pounds or

11.8 million U.S. Dollars budget, 1.5 million Pounds or 2.21 million U.S. Dollars are devoted to educational research.

The *Organization for Economic Cooperation and Development (OECD)*, Center for Educational Research and Innovation (CERI) based in Paris, is a focal point for information and discussion exchange on trends in education systems throughout the industrialized world. The twenty-nine member countries that are represented by the OECD govern CERI. Some of the activities that CERI conducts include studies on key educational issues and hosting seminars and conferences to develop and disseminate findings. It also organized a series of forums on learning sciences and brain research and its implications for education.

The *Swedish Foundation for Strategic Research (SSF)* was one of three strategic research foundations established by the Swedish government in 1994. The SSF aims to support research in natural science, engineering and medicine. It promotes the development of research of the highest international class. SSF's work is outlined by its Governing Board and its Executive Director in four areas: life science, material science, industrial technologies and emerging science and technology. The SSF has a budget of 6 billion Kronas or 622 million U.S. Dollars.

The *Swiss National Science Foundation (SNSF)* was founded in Switzerland in 1952. Its goal is to provide financial support for basic scientific research projects in all disciplines and also to encourage young scientists. Four research councils oversee the funding for all the research programs and projects. They are also responsible for the performance of each research program. The SNSF coordinates its activities

with other Swiss bodies who are responsible for setting science policy, and cooperates with foreign organizations, which performs similar research. Programs are funded to provide solutions to scientific problems and to approach and create links between research and teaching. Research projects and programs are the focal point of the promotion of activities at the Swiss National Science Foundation.

The *Wissenschaftsgemeinschaft Gottfried Wilhelm Leibniz (WGL)* is an association of seventy-eight independent institutes in Germany. It encourages the cooperation in research and promotes young scientific talents. The WGL has five major research areas including education research, life sciences and mathematics. The federal (50%) and state (50%) governments jointly fund these seventy-eight institutes. The association coordinates common interests of its member institutions and presents them to the public. The budget for WGL is 1.2 billion Deutsche Marks or 549 million U.S. Dollars.

4.2   Organizations by Activity Categories

It is useful to classify organizations involved in education research by the kind of activities they perform. From our investigation of organizations, we identified three basic categories:

- Funding of research — Distribution of public or private funds to individual researchers or institutions usually on a project or a quality of research basis;

- Execution of research — The organization itself sets up labs and projects, hires

researchers and administers the whole process of research;

- Coordination of research — The organizations (often called association) supports coordination between the organizations, organizes conferences and workshops for the researchers, and disseminates information.

Table 4.1 shows the organizational types for all the organizations in Western European we have identified. Each category provides rather different opportunities for collaboration. Collaborations with organizations that fund or execute research may entail the creation of joint projects or synchronous proposal reviews. Coordinating organizations can be used to organize international conferences and workshops or to establish relations with other organizations.

Table 4.1: Western European Organizations by Activity Categories

Organization	Country	Funding of research	Execution of research	Coordination of research
Bertelsmann Foundation	Germany	✕		
Bundesministerium fur Bildung und Forschung (BMBF) Federal Ministry for Education and Research	Germany	✕		
Bundesministerium für Bildung, Wissenschaft und Kultur (Federal Ministry of Education, Science and Culture)	Austria		✕	
Centre for Research in Development, Instruction and Training (CREDIT)	United Kingdom		✕	
				continued on next page

Table 4.1: Organizations by Activity Categories (continued)

Organization	Country	Funding of research	Execution of research	Coordination of research
Centre National De La Recherché Scientifique (CNRS)	France		×	
Deutsche Forschungsgemeinschaft (DFG) German Science Foundation	Germany	×		
Economic and Social Research Council (ESRC)	United Kingdom	×		
Education and Culture Directorate-General European Commission	European Union	×		×
European Association for Research on Learning and Instruction (EARLI)				×
European Educational Research Association (EERA)				×
European Science Education Research Association (ESERA)				×
European Science Foundation (ESF)		×		×
Fonds zur Förderung der wissenschaftlichen Forschung (FWF) Austrian Science Fund	Austria	×		
Fund for Scientific Research - Flanders (FWO)	Belgium	×		
Higher Education Funding Council for England (HEFCE)	United Kingdom	×		
				continued on next page

Table 4.1: Organizations by Activity Categories (continued)

Organization	Country	Funding of research	Execution of research	Coordination of research
Information Society Directorate-General European Commission	European Union	×		×
Institute for Science and Education (IPN) Department of Educational Science	Germany		×	
International Association for the Evaluation of Educational Achievement (IEA)	The Netherlands			×
Knowledge Foundation (KKS)	Sweden	×		
Max Planck Institute (MGI) for Human Development Center for Educational Research	Germany		×	
National Foundation for Educational Research (NFER)	United Kingdom		×	
Netherlands Organization for Scientific Research (NWO)	The Netherlands	×		
Nuffield Foundation	United Kingdom	×		
Organization for Economic Cooperation and Development (OEDC) Directorate of Education, Labor and Social Affairs (ELS) Centre for Educational Research and Innovation (CERI)				×
Swedish Foundation for Strategic Research (SSF)	Sweden	×		

Table 4.1: Organizations by Activity Categories (continued)

Organization	Country	Funding of research	Execution of research	Coordination of research
Swiss National Science Foundation (SNSF)	Switzerland	×		×
Wissenschaftsgemeinschaft Gottfried Wilhelm Leibniz (WGL)	Germany		×	

Fourteen out of the total twenty seven organizations are funding agencies, while seven out of the twenty seven organizations performs research, and nine out of the twenty seven organizations coordinate research.

4.3   Budget, Size, and Priority for Further Investigation

Germany, the United Kingdom, and France contain the largest centers of educational research in Western Europe. Collaborations with agencies from these countries can be particularly productive because of their resource and connections.

Deutsche Forschungsgemeinschaft (DFG) accounts for the majority of research in Germany. It gets it funding from the German government and it is associated with many other major scientific organizations for example, the European Science Foundation (ESF) and the International Council for Science (ICSU).

In United Kingdom, the *Higher Education Funding Council for England (HEFCE)* oversees the entire education system. It carries out it own research in education and

also funds other institutions. With its enormous budget, it is able to provide funding
for almost one third of the overall support for higher education in England.

The *Centre National De La Recherché Scientifique (CNRS)* of France supports
and conducts all aspects of scientific research. It accounts for a large portion of
the research towards education and learning in France including fundamental brain
research.

The *European Union (EU)* performs a great deal of scientific investigations. Its
member organizations support the entire spectrum of basic research. With the ability
to establish agencies to perform various functions, the EU is becoming a key player
in Western European educational research.

Table 4.2 shows the budget of organizations that fund or perform research (coor-
dinating organizations are not included).

Table 4.2: Budget for Funding/Research Organizations

Organization	Country	Budget in millions, national currency, and US. Dollars
Bertelsmann Foundation	Germany	80.2 DM, 36.7 USD Project Expenditure: 84.9%
Bundesministerium fur Bildung und Forschung (BMBF) Federal Ministry for Education and Research	Germany	14,600 DM, 6,683 USD 3.7 % of Federal Budget
Bundesministerium für Bildung, Wissenschaft und Kultur (Federal Ministry of Education, Science and Culture)	Austria	No Information
		continued on next page

Table 4.2: Budget for Funding/Research Organizations (continued)

Organization	Country	Budget (in millions)
Centre for Research in Development, Instruction and Training (CREDIT)	United Kingdom	No Information
Centre National De La Recherché Scientifique (CNRS)	France	15,506 francs, 2,116.14 USD
Deutsche Forschungsgemeinschaft (DFG) German Science Foundation	Germany	No Information
Economic and Social Research Council (ESRC)	United Kingdom	£65, 95.9075 USD £12.5, 18.4437 USD (TLRP prorgram)
Education and Culture Directorate-General European Commission	European Union	No Information
European Science Foundation (ESF)		basic budget: 5.5 Euros, 4.92 USD total budget (including à la carte funding of programs and EU funding for conferences): over 15.2 Euros, 13.6USD
Fonds zur Förderung der wissenschaftlichen Forschung (FWF) Austrian Science Fund	Austria	1999: 958 ATS, 70.7 USD
Fund for Scientific Research - Flanders (FWO)	Belgium	No Information
Higher Education Funding Council for England (HEFCE)	United Kingdom	Academic year 2000-01: £4382, 6465.64 USD (total) £867, 1279 USD (researh only)
Information Society Directorate-General European Commission	European Union	No Information
Institute for Science and Education (IPN) Department of Educational Science	Germany	No Information

Table 4.2: Budget for Funding/Research Organizations (continued)

Organization	Country	Budget (in millions)
Knowledge Foundation (KKS)	Sweden	No Information
Max Planck Institute (MGI) for Human Development Center for Educational Research	Germany	No Information
National Foundation for Educational Research (NFER)	United Kingdom	No Information
Netherlands Organization for Scientific Research (NWO)	The Netherlands	1998: 655 guilders, 366 USD (total)
Nuffield Foundation	United Kingdom	£8, 11.8 USD (yearly income) £ 1.5, 2.21 USD (educational research)
Swedish Foundation for Strategic Research (SSF)	Sweden	SEK 6000, 622 USD
Swiss National Science Foundation (SNSF)	Switzerland	No Information
Wissenschaftsgemeinschaft Gottfried Wilhelm Leibniz (WGL)	Germany	1200 DM, 549 USD

4.4 Organizational Structure and Characteristic Activities

Table 4.3 summarizes the basic organizational structure and relevant departments involved in educational research for each organization.

Table 4.3: Organizational Structure and Characteristic Activities

Organization	Relevant Departments (if applicable[1])	Organizational Structure and Relevant Activities
Bertelsmann Foundation	• Government and administration • Higher education	No Information
Bundesministerium fur Bildung und Forschung (BMBF) Federal Ministry for Education and Research	No Information	No Information
Bundesministerium für Bildung, Wissenschaft und Kultur (Federal Ministry of Education, Science and Culture)	No Information	No Information
Centre for Research in Development, Instruction and Training (CREDIT)	NA	No Information
		continued on next page

---

[1]Sometimes organizations have no departments, or all departments are connected to research on learning (organization is dedicated to educational research).

Table 4.3: Organizational Structure (continued)

Organization	Relevant Departments (if applicable)	Organizational Structure and Relevant Activities
Centre National De La Recherché Scientifique (CNRS)	• Physical Sciences and Mathematics • Life Sciences — Cognitive and psycholinguistic sciences laboratory • Social Humanities and Sciences	25,400 employees (11,470 researchers and 13,930 engineers and technical and administrative staff)
Deutsche Forschungsgemeinschaft (DFG) German Science Foundation	No Information	No Information
Economic and Social Research Council (ESRC)	NA	Two-thirds of the budget is allocated to research and nearly one-third to postgraduate training, with the remainder being used for evaluation, dissemination, forging business links and other activities. Funds are distrbuted to indivdual researchers. Research is funded through open competitions and grants awarded on the basis of academic excellence. Research priorities are listed in Research Notes column, but some funding is less structured and directed at questions proposed by researchers themselves. Main funding schemes: research centres, research programmes, research grants (see http://www.esrc.ac.uk/research.html)
Education and Culture Directorate-General European Commission	No Information	No Information
European Association for Research on Learning and Instruction (EARLI)	NA	Information dissemination and discussion support for researchers and organizations

Table 4.3: Organizational Structure (continued)

Organization	Relevant Departments (if applicable)	Organizational Structure and Relevant Activities
European Educational Research Association (EERA)	NA	Association for Information exchange between researchers and organizations
European Science Education Research Association (ESERA)	NA	The Executive shall be empowered both to collect an Annual Membership Fee from personal and Organisational Members of The Association and to make applications to Fund-Awarding Bodies on behalf of The Association.
European Science Foundation (ESF)	• Standing Committee for the Social Sciences (SCSS) • European Medical Research Councils (EMRC)	Structure: see http://www.esf.org/about/structure.htm Actvities: international workshops for researchers, coordination of European research networks, conferences, multi-national programs (à la carte funding - member organizations provide funding on per program basis), European Cooperative Research Projects (EUROCORES)
Fonds zur Förderung der wissenschaftlichen Forschung (FWF) Austrian Science Fund	• Technical Sciences • Social Sciences • Humanities	Funding of precisely defined research projects by individual applicants or groups of applicants from all scientific areas, insofar as they serve further development of such areas
Fund for Scientific Research - Flanders (FWO)	• Biological Sciences • Humanities • Social Sciences	No Information

Table 4.3: Organizational Structure (continued)

Organization	Relevant Departments (if applicable)	Organizational Structure and Relevant Activities
Higher Education Funding Council for England (HEFCE)	No Information	Structure: see http://www.hefce.ac.uk/ AboutUs/People/Structure.htm Funding is provided to institutions (colleges and universities) and not to individuals. Funding is selective: universities and colleges with high quality research departments get a larger share of the money. Funding method is described in more detail at http://www.hefce.ac.uk/Research/ rfund00.htm
Information Society Directorate-General European Commission	No Information	No Information
Institute for Science and Education (IPN) Department of Educational Science	• Department of Education Sciences • Department of Educational-Psychological Method Teachings	No Information
International Association for the Evaluation of Educational Achievement (IEA)	No Information	No Information
Knowledge Foundation (KKS)	No Information	No Information
Max Planck Institute (MGI) for Human Development Center for Educational Research	NA	No Information
		continued on next page

Table 4.3: Organizational Structure (continued)

Organization	Relevant Departments (if applicable)	Organizational Structure and Relevant Activities
National Foundation for Educational Research (NFER)	• Department of Assessment and Measurement • Department of Evaluation and Policy Studies • Department of Professional and Curriculum Studies	No Information
Netherlands Organization for Scientific Research (NWO)	No Information	Open competition between research proposals. About 80 percent of the NWO resources are spent on the proposals emerging from this open competition. For Organization's structure see: http://www.nwo.nl/english/nwo/ organizationandoperation/content.html
Nuffield Foundation	NA	No Information
Organization for Economic Cooperation and Development (OEDC) Directorate of Education, Labor and Social Affairs (ELS) Centre for Educational Research and Innovation (CERI)	NA	No Information
Swedish Foundation for Strategic Research (SSF)	• Biosciences • Information technology	The Foundation has a Governing Board of 13 personal appointed by the Government. SSF's capital assets are managed by a special capital committee reporting to the Governing Board.
Swiss National Science Foundation (SNSF)	No Information	No Information
		continued on next page

Table 4.3: Organizational Structure (continued)

Organization	Relevant Departments (if applicable)	Organizational Structure and Relevant Activities
Wissenschaftsgemeinschaft Gottfried Wilhelm Leibniz (WGL)	• Liberal Arts and Education Research • Economics, Social Sciences and Regional Infrastructure Research • Life Sciences • Mathematics, Natural Sciences and Engineering	WGL-institutes together have roughly 11000 employees, 5000 of whom are scientists. Additional 1600 coworkers are financed by grants from other sources. All member institutes have a supra regional importance and work in nation wide interest. They are jointly funded by the federal and state governments. The institutes are generally financed by the government (50%) and the states (50%).

4.5   Research Areas

Table 4.4 indicates the research interests of each organization according to the framework of ROLE's quadrants.[2]

Table 4.4: Research Interests of Organizations Outside Western Europe

Organization	Quadrant[3]				Notes
	1	2	3	4	
Bertelsmann Foundation	NI	NI	4	NI	
Bundesministerium fur Bildung und Forschung (BMBF) Federal Ministry for Education and Research	NI	4	4	NI	
Bundesministerium für Bildung, Wissenschaft und Kultur (Federal Ministry of Education, Science and Culture)	NI	NI	NI	NI	
Centre for Research in Development, Instruction and Training (CREDIT)	NI	5	5	1	1) Principles of Learning and Instruction 2) Visualisation and Representation: Analyzing and Designing Knowledge Representations 3) Modeling the Learning Process 4) Collaborative Learning and Computer Supported Communication
Centre National De La Recherché Scientifique (CNRS)	4	4	5	NI	
					continued on next page

---

[2]The ranking came from the results of surveyed NSF-funded research, interviews with the INT Division personal, and our informal study of each organization. Please refer to Table 4.4

[3]Quadrant 1: Brain research in connection with learning
Quadrant 2: Cognitive and developmental psychology of learning
Quadrant 3: Teaching and learning methods, curriculum design, assessment methods
Quadrant 4: Educational Policy and large-scale reforms

Note: For each research area the scale is from 0 (no research) to 5 (top research priority). NI stands for no information (we were unable to find it). The scale is subjective and is only approximate.

Table 4.4: Research Interests (continued)

Organization	Quadrant				Notes
	1	**2**	**3**	**4**	
Deutsche Forschungsgemeinschaft (DFG) German Science Foundation	NI	3	3	NI	
Economic and Social Research Council (ESRC)	4	4	3	2	Overall Priorities: 1) Economic Performance and Development 2) Environment and Human Behaviour 3) Governance and Citizenship 4) Knowledge, Communication and Learning 5) Lifecourse, Lifestyles and Health 6) Social Stability and Exclusion 7) Work and Organisations Note: Research on the impact of information technology on learning and teaching is also supported.
Education and Culture Directorate-General European Commission	1	NI	3	4	
European Association for Research on Learning and Instruction (EARLI)	1	3	5	4	1) Assessment and Evaluation 2) Comprehension of Verbal and Pictorial Information 3) Conceptual Change 4) Higher Education 5) Individual Differences in Learning and Instruction 6) Instructional Design 7) Knowledge Handling 8) Learning and Instruction with Computers 9) Motivation and Emotion 10) Qualitative Studies of Experience and Understanding 11) Social Interaction in Learning and Instruction 12) Teaching and Teacher Education 13) Writing 14) Moral Education
European Educational Research Association (EERA)	NI	5	5	5	Since this is association for researchers, research areas are not defined by organization (except for general field of educational research)
European Science Education Research Association (ESERA)	1	2	5	3	
European Science Foundation (ESF)	2	5	3	1	
					continued on next page

Table 4.4: Research Interests (continued)

Organization	Quadrant				Notes
	1	**2**	**3**	**4**	**Notes**
Fonds zur Förderung der wissenschaftlichen Forschung (FWF) Austrian Science Fund	4	4	NI	NI	Educational Sciences Pedagogy, Linguistics and Literature
Fund for Scientific Research - Flanders (FWO)	5	4	3	NI	Philosophy and history of the discipline of education. Evaluation and evolution of the criteria for educational research
Higher Education Funding Council for England (HEFCE)	1	4	5	4	
Information Society Directorate-General European Commission	NI	1	5	5	information and communication technology
Institute for Science and Education (IPN) Department of Educational Science	NI	4	5	NI	The IPN is interested in Education monitoring and method research, protection and advancement of the quality of scientific instruction and Innovative concepts in scientific instruction.
International Association for the Evaluation of Educational Achievement (IEA)	NI	5	5	5	
Knowledge Foundation (KKS)	NI	NI	NI	NI	
Max Planck Institute (MGI) for Human Development Center for Educational Research	1	5	5	2	
					continued on next page

Table 4.4: Research Interests (continued)

Organization	Quadrant				Notes
	1	**2**	**3**	**4**	
National Foundation for Educational Research (NFER)	NI	NI	5	5	(1) Assessment and testing 2) Behavior management 3) Careers education and guidance 4) Curriculum 5) Early years 6) Gender differences 7) International studies 8) Lifelong learning 9) Post-14 education and training 10) Professional development 11) Raising attainment and study support 12) School improvement 13) Special educational needs
Netherlands Organization for Scientific Research (NWO)	NI	NI	NI	NI	
Nuffield Foundation	NI	4	5	2	1) Memory function and cognitive development in hearing impaired pupils related to achievement in science 2) Enhancing work related learning through science/technology collaboration in the secondary phase 3) The relationship between young children's understanding of the concept of place value and their competence at mental addition and subtraction
Organization for Economic Cooperation and Development (OEDC) Directorate of Education, Labor and Social Affairs (ELS) Centre for Educational Research and Innovation (CERI)	2	4	5	3	• Develop and analyze Education Statistics and Indicators (INES) • Conceptualize and analyze the management of knowledge and the role of R&D in education, learning economies and knowledge societies • Identify significant innovations in education and evaluate "what works" • Analyze and evaluate educational and other innovative strategies for social inclusion • Information Technology
Swedish Foundation for Strategic Research (SSF)	5	NI	3	1	
					continued on next page

Table 4.4: Research Interests (continued)

Organization	Quadrant				Notes
	1	**2**	**3**	**4**	
Swiss National Science Foundation (SNSF)	NI	NI	NI	NI	
Wissenschaftsgemeinschaft Gottfried Wilhelm Leibniz (WGL)	5	5	5	5	

Figure 4.5 shows the number of organizations that have research in each of the four quadrants. Most of the Organizations specialize in research in Quadrant 2 (Psychology of Learning) and Quadrant 3 (Teaching methods and curriculum design). Historically, this has been the traditional domain of educational research. However, more recent programs tend to define educational research in a broader way and include brain research and also the study of large-scale educational reforms.
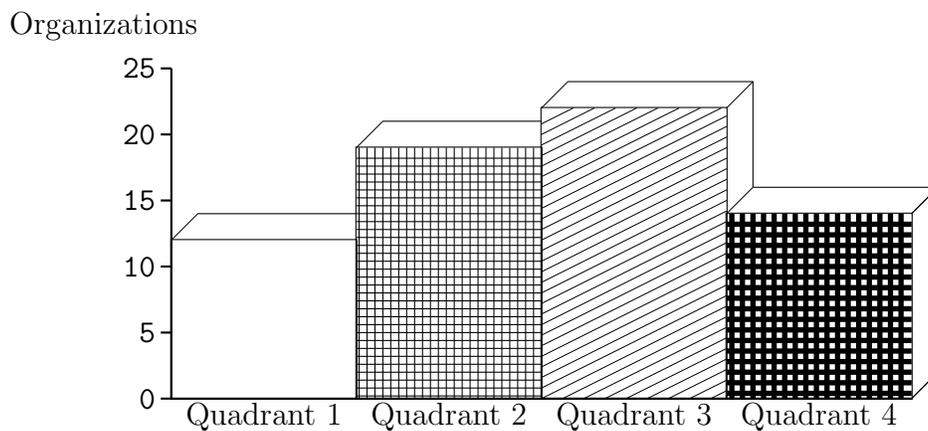
Figure 4.1 Distribution of Organizations by Research Area

Figure 4.5 on the following page shows the sum of the subjective ranking for all twenty seven organizations in each of the four quadrants. Again, quadrants two and

three have the most concentration of research while the research is less concentrated

in quadrants one and two.
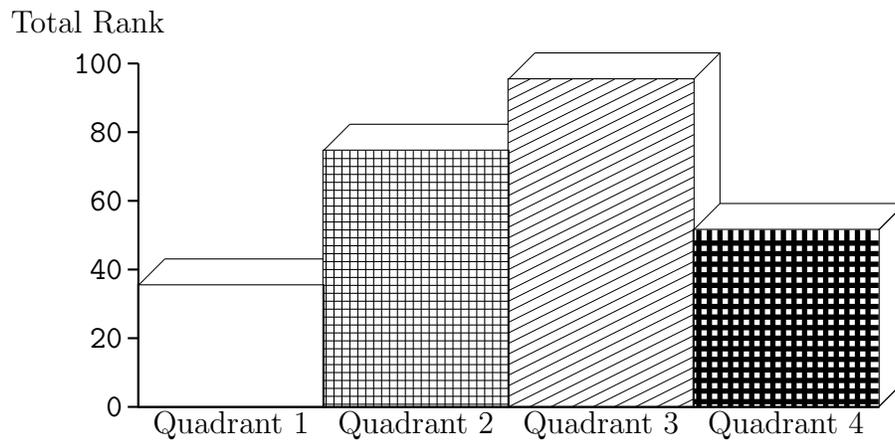
Figure 4.2 Distribution of Research Based on Subjective Ranking

Chapter 5

Conclusions and Recommendations

5.1 Conclusions

From our research on Western European organizations, we did not find anything surprising or unexpected. Research in Quadrant 3 (teaching and learning methods, curriculum design, and assessment methods) comprises the largest part of the overall educational research in the organizations we have studied. These studies are usually integrated with research in cognitive psychology (Quadrant 2), or educational policy (Quadrant 4), or both. Such arrangements correspond to the traditional definition of educational research.

Research in neuroscience and psychology have always been closely related. During the past quarter century there has been major research advances in the fields of learning. More and more findings in neuroscience are perceived to be relevant and important to our understanding of human learning. Many of the newly developed programs and projects are integrating neuroscience as part of the study on learning, similar to the ROLE program. At the same time, older organizations are also realizing the importance of this broader definition of educational research and many are expanding their research to accommodate this new definition.

Another trend that is affecting educational research is globalisation. We are witnessing the development of super-national structures such as the European Union. Individual nations surrender some of their sovereignty in order to achieve unity and improve economic competitiveness. In Western Europe there is more cooperation than ever in all fields of science. Large funding that could have never been provided by individual nations is now available for educational research programs in Europe.

In Western Europe the largest centers of educational research are Germany, the United Kingdom, and France. In these countries, major research organizations are Deutsche Forschungsgemeinschaft (Germany), Higher Education Funding Council for England, Centre National De La Recherché Scientifique (France). European Union is another major player, with a number of education research programs supported by its agencies and directorates within its Commission.

5.2 Recommendations

In this section, we will discuss our recommendations to the National Science Foundation (NSF), division of Research, Evaluation, and Communication (REC). However, some recommendations are not NSF-specific and can be used by anyone wishing to establish collaborations in educational research. These recommendations are based upon interviews with the REC staff, surveys of U.S. researchers, and our study of Western European organizations.

5.2.1 Enhancement of Communication and Information Exchange

Europeans, just as Americans, are interested in international collaboration. Both are exploring the possibilities of working together. Thus, in addition to active exploration, we recommend providing help and support to analogous projects in foreign countries seeking to establish collaboration with the United States.

One of the biggest problems we encountered in our project is the accessibility of relevant information. With advances in telecommunications and enormous growth of the Internet a huge amount of information is available in an instant. However this benefit is also the source of the problem — it is hard to find specific information. Web sites of organizations in both, the United States and Europe, often lack clear[1] organization, contain only a small fraction of available public documentations[2], and are out of date. Also, we were unable to find any web sites that serve as directories for organizations and programs in education research.

Based on our experience and suggestions from REC staff and U.S. researchers we recommend that the NSF:

- Organize more international conferences and workshops for the researchers.

- Organize international forums dedicated to discussion of each organization's programs, insights, and plans. Most likely, similar forums already exist in other

---

[1]Similar information can be located in completely different areas. Sometimes, one area contradicts another. Interface is confusing.

[2]In some cases content available online is limited to one function (for instance, public relations, proposal submission).

countries (or even in United States). Therefore, we recommend finding such forums and participating in them.

- Work with other U.S. and foreign organizations towards organizing a network of educational research web sites providing information for both researchers and organizations. These network should include a directory web site that can serve as a starting point for learning about the research directions, specific research, where and by whom this research is performed, organizations, programs, existing collaborations, and future plans for such collaborations. The directory web site should provide links to web sites of organizations, programs, and projects that provides more details. It might also be helpful to develop some advisory guidelines for the structure of the individual web sites.

  In addition, an educational research network might provide an area for discussion in form of a message board or a mailing list.

- Coordinate efforts with other U.S. Organizations. There are a number of organizations involved in educational research in the United States and many are interested in international collaboration. These organizations can be invited to participate in international forums on educational research programs. This will contribute to diversity of discussed research; thus, increase the benefits for all participating members and allow simultaneous exploration of collaborations on a *national* level. As mentioned above, other organizations can also be invited participate in creating joint web sites that can give road map of educational

research in the United States and, ultimately, around the world.

5.2.2   Possibilities for Further Work Based On Our Project

The concentration of our project was not so much on collecting the data, but rather, developing a foundation for a larger investigation of perspectives for international collaboration in educational research. We believe that we have developed a useful methodology for collecting and analyzing information about educational research organizations. We suggest that our methods can be used to obtain a more complete picture of research in education and learning around the world.

From our surveys of the U.S. researchers, we have collected data on foreign organizations outside of our original project scope. This information can be use for further exploration of educational research in other parts of the world, which, according to the surveyed U.S. researchers, are also very active in research on learning. In addition, we have collected the names and contact information of Western European researchers that can be contacted to get more information about development in field of education. This data is available in Appendix C and in the Excel tables accompanying this report.

Appendix A

Glossary

Anion — negatively charged particle; ion with negative charge

Axon — long fiber (part of the neuron) that conducts impulses away from the cell body of the neuron

Collaboration — to work together, especially in a joint intellectual effort

Cognition — the mental process, including aspects such as awareness, perception, reasoning, and judgment

Dendrite — short fiber (part of the neuron) that conducts impulses toward the cell body of the neuron

Hemoglobin — protein composed of heme and globin; its primary function is transportation of oxygen from the lungs to the body tissues and of carbon dioxide (CO_2) in the opposite direction

Ion — an electrically charged particle

Longitudinal — over an extended period of time

Mental — existing in the mind

Neuron — a cell that is specialized to conduct nerve impulses

Neurotransmitter — chemical that transmits nerve impulses across a synapse

Practice — to carry out in action

Purposive — having a purpose

Quadrant — any of the four areas into which a plane is divided

Social — living together in communities

Synapse — the junction between two neurons (usually axon-to-dendrite) or between neuron and muscle cell(s)

Systemic — affecting an entire system

Appendix B

Contact Information for Western European Organizations

Table B.1: Contact Information for Western European Organizations

Organization	Country	Contact information
Bertelsmann Foundation	Germany	Car-Bertelsmann-Str. 256 33311 Gutersloh Tel.: 0 52 41/81 70 http://www.stiftung.bertelsmann.de/english/ index.htm
Bundesministerium fur Bildung und Forschung (BMBF) Federal Ministry for Education and Research	Germany	Tel.: 030/28540 0 Fax: 030/28540 5270 http://www.bmbf.de/
Bundesministerium für Bildung, Wissenschaft und Kultur (Federal Ministry of Education, Science and Culture)	Austria	http://www.bmbwk.gv.at/en/index.htm
Centre for Research in Development, Instruction and Training (CREDIT)	United Kingdom	ESRC Centre for Research in Development, Instruction and Training Department of Psychology, University of Nottingham University Park, Nottingham, NG7 2RD U.K. Telephone +44 115 9515151 ext.5302 Fax +44 115 9515324 imj@psychology.nottingham.ac.uk http://www.psyc.nott.ac.uk/research/credit/
Centre National De La Recherché Scientifique (CNRS)	France	webcnrs@cnrs-dir.fr http://www.cnrs.org/
Deutsche Forschungsgemeinschaft (DFG) German Science Foundation	Germany	Mr. Christoph Muhlberg Telephone: +49 228 885 24 60 Fax: +49 228 885 25 50 michael.meier@dfg.de http://www.dfg.de/english/index.html
		continued on next page

Table B.1: Contact Information (continued)

Organization	Country	Contact information
Economic and Social Research Council (ESRC)	United Kingdom	External Relations, ESRC, Polaris House, North Star Avenue, Swindon, Wilts SN2 1UJ E-mail: exrel@esrc.ac.uk http://www.esrc.ac.uk/ International Policy Contact: email: international@esrc.ac.uk tel: +44 (0)1793 413 057
Education and Culture Directorate-General European Commission	European Union	rue da la Loi 200, B-1049 Brussels Tel: 296.21.20/299.94.36 Fax: 295.72.95 http://www.europa.eu.int/comm/dgs/ education_culture/index_en.htm
European Association for Research on Learning and Instruction (EARLI)		PO Box 616, 6200 MD Maastricht The Netherlands Tel. ++31/43/ 388 48 07 EARLI@edit.unimaas.nl http://www.earli.eu.org/
European Educational Research Association (EERA)		c/o Professional Development Unit, Faculty of Education, University of Strathclyde, 76 Southbrae Drive, Glasgow G13 1PP Tel: +44 (0) 141 950 3772 Fax: +44 (0) 141 950 3210 email: eera@strath.ac.uk http://www.eera.ac.uk
European Science Education Research Association (ESERA)		Prof. Cécile Vander Borght Laboratoire de Pédagogie des Sciences Bâtiment Marie Curie, rue du compas, 2 B. 1348 Louvain-la-Neuve Tél 32/10/47 26 93 Fax 32/10 47 39 96 vanderborght@bani.ucl.ac.be http://www.summerschool.dk/esera/home.html
European Science Foundation (ESF)		1, quai Lezay Marnésia F-67080 Strasbourg Cedex France Telephone (main switchboard) : +33 (0)3 88 76 71 00 Fax (main fax number) : +33 (0)3 88 37 05 32 emal: esf@esf.org http://www.esf.org/
Fonds zur Förderung der wissenschaftlichen Forschung (FWF) Austrian Science Fund	Austria	Dr. G. Tebb Telephone: +43 1 505 67 40 60 Fax: +43 1 505 67 39 http://www.fwf.ac.at/index-en.html
		continued on next page

Table B.1: Contact Information (continued)

Organization	Country	Contact information
Fund for Scientific Research - Flanders (FWO)	Belgium	Egmontstraat 5 1000 Brussels Telephone +32 2 512 91 10 Fax +32 2 512 58 90 http://www.nfwo.be/
Higher Education Funding Council for England (HEFCE)	United Kingdom	Northavon House, Coldharbour Lane, Bristol, BS16 1QD Telephone 0117 931 7317 Facsimile 0117 931 7203 hefce@hefce.ac.uk http://www.hefce.ac.uk/
Information Society Directorate-General European Commission	European Union	Infso-Desk BU 24 -1/47 Rue de la Loi 200 B-1049 Brussels E-mail: Infso-Desk@cec.eu.int Tel.: + 32.2.299.93.99 Fax: + 32.2.299.94.99 http://europa.eu.int/comm/information_society/index_en.htm
Institute for Science and Education (IPN) Department of Educational Science	Germany	Professor Dr. Manfred Prenzel Tel.: +49 431-880-3110 E-mail erzw@ipn.uni-kiel.de http://www.ipn.uni-kiel.de/index_eng.html
International Association for the Evaluation of Educational Achievement (IEA)	The Netherlands	IEA Secretariat Herengracht 487 1017 BT Amsterdam Telephone: +31 20 625 3625 Fax: +31 20 420 71 36 Email: Department@IEA.nl http://www.iea.nl/
Knowledge Foundation (KKS)	Sweden	Box 3222 SE-103 64 Stockholm Tel +46 8 545 211 00 Fax +46 8 24 75 09 info@kks.se http://www.kks.se/
Max Planck Institute (MGI) for Human Development Center for Educational Research	Germany	Jürgen Baumert Telephone 82406-303/304 E-mail: Baumert@mpibberlin.mpg.de http://www.mpib-berlin.mpg.de/EuB/ EuB-home.htm
		continued on next page

Table B.1: Contact Information (continued)

Organization	Country	Contact information
National Foundation for Educational Research (NFER)	United Kingdom	The Mere, Upton Park, Slough, Berkshire SL1 2DQ. United Kingdom. Tel: +44(0)1753 574123 Fax: +44(0)1753 691632 E-mail: enquiries@nfer.ac.uk http://www.nfer.ac.uk/
Netherlands Organization for Scientific Research (NWO)	The Netherlands	Netherlands Organization for Scientific Research (NWO) Laan van Nieuw Oost Indië 131 P.O. Box 93138, 2509 AC The Hague Telephone +3170 3440640, facsimile +3170 3850971, e-mail nwo@nwo.nl Homepage: http://www.nwo.nl Foundation for Behavioural and Educational Sciences (SGW) Telephone +3170 3151905, facsimile +3170 3832841, e-mail sgw@nwo.nl
Nuffield Foundation	United Kingdom	The Nuffield Foundation 28 Bedford Square London WC1B 3JS Tel: 020 7631 0566 Fax: 020 7323 4877 Messages: 020 7580 7434 http://www.nuffield.org
Organization for Economic Cooperation and Development (OEDC) Directorate of Education, Labor and Social Affairs (ELS) Centre for Educational Research and Innovation (CERI)		OECD 2, rue André Pascal F-75775 Paris Cedex 16 France Main Switchboard tel.: +33 1.45.24.82.00 http://www.oecd.org/cer/index.htm
Swedish Foundation for Strategic Research (SSF)	Sweden	Box 70483 SE-107 26 Stockholm Telephone: +46 8 791 10 10 Fax: +46 8 791 00 76 E-mail: found@stratresearch.se http://www.stratresearch.se/
Swiss National Science Foundation (SNSF)	Switzerland	http://www.snf.ch/default_en.asp
		continued on next page

Table B.1: Contact Information (continued)

Organization	Country	Contact information
Wissenschaftsgemeinschaft Gottfried Wilhelm Leibniz (WGL)	Germany	Phone: +49-228-308150 Fax: +49-228-3081555 Email: wgl@wgl.de http://www.wgl.de/english/eportrait.html

Appendix C

Data for Further Investigation

U.S. researchers have suggested working with organizations that are in the United States or are outside of Western Europe. Overall nine organizations were specified. Since the scope of our project was limited to Western Europe we did not include these organizations in our main study. In addition, we collected the names of foreign researchers that can be contacted to obtain more information on educational research abroad. We hope this data will be useful for future projects.

Note: Some of the late survey responses were not integrated into this tables, because we could not verify the data within the time limit. See Appendix F.2 on page 122 for raw data.

C.1 Organizations outside Western Europe

Table C.1: Organizations Outside Western Europe by Type of Activities

Organization	Country	Funding of research	Execution of research	Coordination of research
National Key Center for School Science and Mathematics, Curtin University	Australia			
Weizmann Institute of Science	Israel		$\times$	
Technion, Haifa	Israel		$\times$	
National Science Council of Taiwan	Taiwan			
Society for Research in Child Development (SRCD)	USA			$\times$
				continued on next page

Table C.1: Organizations by Type of Activities (continued)

Organization	Country	Funding of research	Execution of research	Coordination of research
National Association for Research in Science Teaching (NARST)	USA			×
National Council for Teachers of Mathematics (NCTM)	USA			×
International Group for the Psychology of Mathematics Education (PME)	USA			
Cognitive Development Society	USA, United Kingdom			×

Table C.2: Research Interests of Organizations Outside Western Europe

Organization	Country	Quadrant[1]			
		1	2	3	4
National Key Center for School Science and Mathematics, Curtin University	Australia	0	4	5	0
Weizmann Institute of Science	Israel	4	5	3	0
Technion, Haifa	Israel	0	4	5	0
National Science Council of Taiwan	Taiwan	0	4	5	2
Society for Research in Child Development (SRCD)	USA	4	4	1	1
continued on next page					

[1]Quadrant 1: Brain research in connection with learning
Quadrant 2: Cognitive and developmental psychology of learning
Quadrant 3: Teaching and learning methods, curriculum design, assessment methods
Quadrant 4: Educational Policy and large-scale reforms

Table C.2: Research Interests (continued)

Organization	Country	Quadrant			
		1	**2**	**3**	**4**
National Association for Research in Science Teaching (NARST)	USA	0	5	5	4
National Council for Teachers of Mathematics (NCTM)	USA	0	5	5	5
International Group for the Psychology of Mathematics Education (PME)	USA	2	5	3	5
Cognitive Development Society	USA, United Kingdom	1	4	1	1

Table C.3: Contact Information for Organizations Outside Western Europe

Organization	Country	Contact information
National Key Center for School Science and Mathematics, Curtin University	Australia	Administration +61 8 9266 7896 Course Inquiries +61 8 9266 3365 Facsimile +61 8 9266 2503 E-mail: inquiry@smec.curtin.edu.au http://www.curtin.edu.au/curtin/dept/smec/
Weizmann Institute of Science	Israel	Tel: 972-8-934-2111 Fax: 972-8-934-4107 E-mail: webmaster@www.weizmann.ac.il http://www.weizmann.ac.il/
National Science Council of Taiwan	Taiwan	No. 106, Ho-Ping E.Rd., Sec.2, Taipei 10636, Taiwan, R.O.C. Tel:+886(2)2737-7992 99 Fax:+886(2)2737-7248 http://www.nsc.gov.tw/
Society for Research in Child Development (SRCD)	USA	University of Michigan 505 E. Huron, Suite 301 Ann Arbor, MI 48104-1567 Tel: (734) 998-6578 Fax: (734) 998-6569 E-mail: srcd@umich.edu http://www.srcd.org/
		continued on next page

Table C.3: Contact Information (continued)

Organization	Country	Contact information
National Association for Research in Science Teaching (NARST)	USA	Dr. David Haury NARST Executive Secretary The Ohio State University 1929 Kenny Road Columbus, OH 43210 USA (614) 292-6717 (voice) (614) 292-0263 (Fax) haury.2@osu.edu (E-mail)
National Council for Teachers of Mathematics (NCTM)	USA	NCTM Headquarters Office 1906 Association Drive Reston, VA 20191-9988 (703) 620-9840 fax: (703) 476-2970 Office Hours: 8:30 a.m. to 4:30 p.m. ET http://www.nctm.org/about/directory.htm
International Group for the Psychology of Mathematics Education (PME)	USA	Prof. Barbara J. Pence San Jose State University Dept. of Math & Computer Sciences San Jose, CA 95192-0103 USA Tel. office: +1 408 924 5142 Fax: +1 408 924 5080 e-mail: pence@mathcs.sjsu.edu http://igpme.tripod.com/
Cognitive Development Society	USA, United Kingdom	Executive Officer: Cognitive Science Society, Inc. c/o Prof. Colleen Seifert University of Michigan 525 East University Ann Arbor, MI 48109-1109 734-763-0210 Society Phone and Fax: 734-429-9248 Society Email: cogsci@umich.edu http://www.umich.edu/~cogsci/

C.2 Contact Information for Foreign Researchers

Table C.4: Contact Information for Foreign Researchers

Name (Last, First)	Contact Information	Comments[2]
Bussi, Maria Bartolini	Univeristy of Modena, Italy, bartolini@unimo.it	Interested in socio-cultural research as it relates to mathematics learning
Da Ponte, Joao Pedro	University of Lisbon, jponte@fc.ul.pt	Interested in teachers' professional knowledge
Dint, Reindey		Famous publication of bibliography of misconception research (a nice guy!)
Duschl, Richard	richard.duschl@kcl.ac.uk	Interested in collaboration
Elschenbroich, Donata		German Youth Ministry
Ganiel, Uri	992-8-9343894, uri.ganiel@weizmann.ac.il	Head Department of science teaching at the Weizmann. Although not western Europe, he would be a could contact
Gravemeijer, Koeno	Fredenthal Institute, Utrecht, k.gravemeijer@fi.ruu.nl	Interested in issues of learning and teaching mathematics
Gutierrez, Angel	University of Valencia, angel.gutierrez@uv.es	Interested in Spatial learning and geometry
Holbrook, Jack	icase@logos.cy.ne	A leader in ICASE
Hoyles, Celia	choyles@ioe.ac.uk	UK for math education & technology
Jaworski, Barbara	barbara.jaworski@edstud.ox.ac.uk	Interested in research on teaching
Jorde, Doris	011-47-22-85-41, doris.jorde@ils.uio.no	Oslo, Norway — a major collaborator with our project, well connected in Europe
Mesquita, Ana	Univ of Lille, ana.mesquita@lille.iufm.fr	Interested in the learning of geometry
Stinning, Keith		Scotland
Tiberghien, Andree	andre.tiberghien@univ_lyon2.fr	old-time French researcher in misconception — famous in France and Europe
Verschaffel, Lieven	University of Leuven, Lieven.verschaffel@ped.kuleuven.ac.be	Interested in eye-tracking and in young children's learning of mathematics
		continued on next page

---

[2]Made by US researchers

Table C.4: Contact Information (continued)

Name (Last, First)	Contact Information	Comments
Wulf, Volker	volker@uran.informatik.uni-bonn.de	Germany — mostly computer science related efforts

Appendix D

Questionnaires

D.1   Interviews

D.1.1   Interviews with REC Staff

Questionnaire ID:	1
Questionnaire Name:	Interviews with REC staff
Objective:	Familiarization with ROLE program and cooperation in education and learning research
Frame:	REC Employees working with ROLE
Sampling:	Purposive (according to suggestions from our liaison and other NSF employees)
Type:	Informational, Semi-structured

Introduction

We are Worcester Polytechnic Institute students working on a project dealing with the ROLE Program within the REC. ROLE seeks to collaborate with other organizations and programs. Our goal is to identify and analyze other organizations and programs in Western Europe that have similar interests as the ROLE Program. We are interested in identifying the potential joint activities between ROLE and these organizations. We believe such collaboration might result in reduction of redundancy in education and learning research, decrease the costs, and help global integration.

Questions

1. What are the areas ROLE is concentrating on. Can you give us more details? Examples?

2. What are the typical activities REC support when working together with other organizations?

3. What does "collaboration" mean in the ROLE's case?

4. How is ROLE's case different from other NSF international collaborations?

5. What kind of activities is ROLE looking to establish as part of the collaboration?

6. From your point of view what are the possible benefits of cooperation with other countries?

7. Are there any drawbacks?

8. Are there any current partnerships?

9. Do you have any organizations or programs in mind as potential partners? Can you tell us more about each organization (e.g. research scope, contact information)?

10. How extensive is the collaboration between researchers that received a grant under the ROLE Program and Western European organizations?

11. Do you have any researchers in mind that might be helpful to us?

12. What benefits can the researchers get as the result of collaboration?

13. Are there any drawbacks?

14. Can you advise us on who can provide us more detailed information (at NSF)?

D.1.2 Interviews with REC Staff (revised)

Questionnaire ID:	2
Questionnaire Name:	Interviews with REC Staff (revised)
Objective:	Familiarization with ROLE program and cooperation in education and learning research
Frame:	REC Employees working with ROLE
Sampling:	Purposive (according to suggestions from our liaison and other NSF employees)
Type:	Informational, Semi-structured

Introduction

We are Worcester Polytechnic Institute students working on a project dealing with the ROLE Program within the REC. ROLE seeks to collaborate with other organizations and programs. Our goal is to identify and analyze other organizations and programs in Western Europe that have similar interests as the ROLE Program. We are interested in identifying the potential joint activities between ROLE and these organizations. We believe such collaboration might decrease the costs, and help global integration. This interview is about 20 to 30 minutes long.

Questions

1. Can you tell us in brief about what you do here, at NSF?

2. Can you briefly describe the ROLE program?

3. What kind of activities is ROLE looking to establish as part of the collaboration?

4. From your point of view what are the possible benefits of cooperation with other countries?

5. Do you have any organizations or programs in mind as potential partners? Can you tell us more about each organization (e.g. research scope, contact information)?

6. Can you advise us on who can provide us more detailed information?

D.2 Surveys

D.2.1 U.S. Researcher Survey

Survey ID:	1
Survey Name:	U.S. researcher survey on perspectives for international collaborations within the ROLE program (final version)
Objective:	Collect opinions of educational research Community in the U.S.
Frame:	U.S. Researchers funded by ROLE or REPP
Sampling:	Purposive (according to suggestions from our liaison and other NSF employees)
Type:	E-mail and WWW

Introduction

We are students from Worcester Polytechnic Institute working on a project with the Division of Research, Evaluation and Communication (REC) at the National Science Foundation. REC is seeking to identify foreign organizations sponsoring or performing research similar to the research funded by its Research On Learning and Education (ROLE) program. Our objective is to identify these organizations as well as opportunities for collaboration.

You were selected based on recommendations from REC program directors. If you wish, your name will not be connected to your responses.

If you have any questions please feel free to e-mail us at iqp@ion.cx.

We appreciate any help you can provide. Thank you.

Sincerely,

Wei Fu
Gleb Ralka
Letasha Souffrant

Questions

Name:
First: _____ Last: _____
☐ Do not associate my name with my responses

1. Please, specify the names of foreign organizations, which you are aware of, that conduct educational research. Indicate the organization's level of interest in each of the following research areas. (These are the four main research areas supported by the ROLE program.)

   SMET = Science, Mathematics, Engineering, and Technology

   The scale is from 1 (very low) to 5 (very high), NA (not applicable)

   [Organization 1 through 7 (separate form for each organization)]

   Name: _____

   Quadrant 1: Brain research as a foundation for research on learning: • NA ○ 1 ○ 2 ○ 3 ○ 4 ○ 5

   Quadrant 2: Behavioral, cognitive, affective, and social aspects of learning: • NA ○ 1 ○ 2 ○ 3 ○ 4 ○ 5

   Quadrant 3: SMET teaching and learning methods: • NA ○ 1 ○ 2 ○ 3 ○ 4 ○ 5

   Quadrant 4: SMET learning in complex educational systems: • NA ○ 1 ○ 2 ○ 3 ○ 4 ○ 5

   Comments: _____
   _____
   _____

2. Please list the names of the foreign researchers whom you would suggest NSF to contact in order to obtain further information regarding educational research in Western Europe. (Please, provide as much information as possible.)

   [Researcher 1 through 7 (separate form for each researcher)]

   Name: _____
   E-mail: _____
   Phone Number: _____
   Comments: _____

3. What activities would you like to see REC organize and/or sponsor to promote international collaboration?

   _____
   _____
   _____
   _____
   _____

4. Additional Comments & Suggestions

_____

_____

_____

_____

_____

D.2.2 Foreign Organization Survey

Dear Sir or Madam:

We are students from Worcester Polytechnic Institute working with the Division of Research, Evaluation and Communication (REC) at the National Science Foundation (NSF) in the United States. REC is seeking to collaborate with organizations sponsoring or performing educational research similar to that funded by its Research On Learning and Education (ROLE) program (`http://www.nsf.gov/cgi-bin/getpub?nsf0017`). We are performing a preliminary study of Western European organizations involved in educational research.

ROLE is a brand new program that brings together multiple disciplines, such as neuroscience, psychology, economics, and policy research, to look at learning in a broader educational and social context.

As a result of recent advances in many fields of science, a new multidisciplinary science of learning is beginning to form. ROLE was created as part of an initiative to broaden the scope of NSF's educational research efforts. This program supports the whole spectrum of studies — from neuroscience to research on large-scale reforms in educational systems. Support is organized along four themes called quadrants:

1. Brain research as a foundation for research on human learning;

2. Cognitive, affective, and social aspects of learning (primarily cognitive psychology);

3. Research on Science, Mathematics, Engineering, and Technology (SMET) learning in educational settings (for instance, teaching methods, curriculum materials, technological tools);

4. Research on SMET learning in complex educational systems (for instance, large-scale reforms)

In particular, ROLE is interested in multidisciplinary research at the intersections of these areas.

More details about the ROLE program are available at `http://www.wpi.edu/~icrash/survey/role-brief.html`. The full Program Announcement is available at `http://www.nsf.gov/cgi-bin/getpub?nsf0017`.

If you can not answer the following questions can you refer us to someone in your organization who knows about the areas of research mentioned above?

Can you provide us with the following information:

1. What is the main goal of your organization (in two or three sentences)?

2. What are your major research areas?

3. What are 5 large agencies or organizations that you are partners with, have collaborated with, or are funding?

   -
   -
   -
   -
   -

4. Does your office:

   - Fund others to conduct research?　　　yes__ no__
   - Conduct research?　　　yes__ no__
   - Coordinate others who do research?　　yes__ no__

5. Does your organizations perform or fund research in:

   - Brain research in connection with learning?
     yes__ no__
   - Cognitive and developmental psychology of learning?
     yes__ no__
   - Teaching and learning methods, curriculum design, assessment methods?
     yes__ no__
   - Educational Policy?
     yes__ no__

6. Do you have any programs, projects, or divisions that are in these areas? Can you give us a web site address were we could find a list of them? Or, can you list them and briefly describe what they do?

7. What is the level of funding available for conducting or monitoring research at your organization?

8. Please provide us with a copy of your public organization chart for your research activities.

We appreciate any help you can provide. Thank you.

Sincerely,

Wei Fu
Gleb Ralka
Letasha Souffrant

Appendix E

Interview and Survey Subjects

E.1   Interviews with REC Staff

Name	Title
Eric Hamilton	Interim Division Director
Larry Suter	Deputy Division Director
Barry Sloane	Program Director
Elizabeth VanderPutten	Program Director
Kenneth Whang	Associate Program Director
Lee L. Zia	Program Director

Table E.1 REC Interview Subjects

E.2   Interviews with International Division Staff

Name	Title	Concentration
Rose Gombay	Program Manager	France, Ireland, UK, Switzerland
Mark Suskin	Program Manager	Austria, Denmark, Finland, Germany, Sweden, Iceland, Netherlands, Norway, Switzerland
Jeanne E. Hudson	Program Coordinator	Greece, Italy, Spain, Portugal, Belgium, Netherlands, Eurpoean Commission, European Science Foundation, NATO

Table E.2 International Division Interview Subjects

E.3   U.S. Researcher Survey

Table E.3 below shows the lists the U.S. researchers that we sent the survey to. Two respondents who chose not to dsclose their name are not listed.

Name	Telpephone	E-mail
Ricki Goldman-Segall	(604) 822–2086	ricki.goldman-segall@ubc.ca
Larry Hedges	(773) 702–6008	l-hedges@uchicago.edu
Yasmin Kafai	(310) 206–8150	kafai@gseis.ucla.edu
Joseph Krajcik	(734) 647–0597	krajcik@umich.edu
Dick Lesh	(765) 496-3673	rlesh@purdue.edu
Marcia F Linn	(510) 643–6379/642–4206	mclinn@socrates.berkeley.edu
Jane Phillip	(202) 334–3010	jphilip@nas.edu
Senta Raizen	(202) 467–0652	raizen@ncise.org
B. L. Ramakrishna	(480) 965–6560	bramakrishna@asu.edu
Leona Schauble	(608) 262–0829	schauble@facstaff.wisc.edu
Judith Sowder	(619) 594–6836/1587	jsowder@math.sdsu.edu

Table E.3 U.S. Researcher Survey Subjects

Appendix F

Interview Transcripts and Survey Responses

F.1 Interviews with REC Staff

F.1.1 Interview with Dr. Kenneth Whang

Questionnaire ID: 1 (see Section D.1.1 on page 84)
Questionnaire Name: Initial interviews with REC staff
Present: Dr. Kenneth Whang (KW), Wei Fu (WF),
Gleb Ralka (GR), Letasha Souffrant (LS)

LS: We would like to know more about areas ROLE is concentrating on, about the quadrants.

KW: The quadrants are really just here as their suggestive framework. Um . . . our intend in setting up a framework like that is just to give people a map so they can have some sense of what the tunnel scope of this program and where you fit in. But, but the intend is not to say you have to declare yourself to one quadrant to another . . .

GR: OK

KW: . . . because one of the things we are interested in is sort of at the boundaries for two different . . . like for neuroscience and psychology are really feeding off from each other, there is a lot of growth. Ah . . . part of the idea of having a program put everything under a big umbrella, with that, this way is someone has a great idea, but maybe it not exactly in this sub field and that sub field. Um, that doesn't mean that, um, it's probably more interesting that any one of these narrowly concentrating as research projects would have been. But, but if we didn't have the umbrella, um, we would have a hard time supporting them, because one program will say "oh this isn't my program, it must be someone else's program." Part of the intend to lay out the four quadrants is to be as inclusive as possible . . .

LS: Um, so we have a couple of questions to ask you.

KW: Um-hm . . .

LS: Um, the first question is what are some of the areas role is concentrating on, exactly . . . you basically explained to us, we want to make more clear hm . . .

KW: Well, let me . . . explain the program in turns of a diagram. Um, the scope of the program is to um, look at the, at a broad spectrum of research related

to learning and education from the level of underlining brain mechanism, to cognitive and behavioral affective social types of studies that are rooted, um in psychology related fields in, in, actually there is a lot of theoretical work that some of which even come from the sub-divisionary tradition. But, um, at any rate, hm, the fundamental studies like this is what we call the second quadrant. Third, what we call the third quadrant is what we call learning in educational setting. Um, largely in classrooms but also looking at um informal settings such as interviews . . . And then the fourth area is looking at the systems level, um at, particularly at what affects different policies have, looking at difference of standardized issues. And these are just um, examples topics, showing how there is a continuum of, of reach areas. So, at any rate, the scope of the program is to cover that entire continuum as best as we can, from biological and psychological bases we've found.

GR: What are the proportions of each area. What are the concentrations under each area of the program?

KW: Oh, um, neuroscience as a field is a large area, but neuroscience and psychology that are specifically directed at the learning and education is still a fairly small area. Um, in terms of what we find, I don't have the exact numbers, but um, the largest fraction is in the classroom area, um, some of this have to do with the studying um, learning in specific content areas. For example the, the field of physics learnings have been pretty well studied. And, and conceptual, certain items that are big conceptual her-els for all students that are learning physics for example, um, probably you all had to go through that for the last several years anyways, um, so this is the largest area in our program. I think it accounts for maybe half of the whole thing, maybe more. Um, we just gotten, we've only gotten a few so far, in the brain areas. Um, a least one of those proposals, one of those projects we are supporting, um, is even broader than the brain, it's more on the biological levels of, of in this case of early mathematical development, and some parts of that research has to do with the brain mechanism, and some parts of that project has to do with look at other species, so ah, I think um, we've only gotten a few, we've only done a few awards in this area. The largest area is quadrant three. The second largest area is quadrant two. And then quadrants one and four are a little bit here and a little bit there . . .

GR: In the future are that, um, going to approximately the same?

KW: Um, in the future . . . um, it depends on the kinds of proposals we receive. One of the reasons, there is, there is, a I guess a forward momentum you have in, in programs where by, because of the people, because of this is the area we supported the most in the past, they are also the ones people who are studying them are the ones that are going to know them. And the submit their proposals to us and get it funded. um, so as more people get to know the ROLE program, um, we'll start to get more proposals in the brain area and the

complex reform area. Um, but, so far, at least in the next round of proposals, we are still expected to see a large number of proposal in the quadrant three area.

LS: Um, also since ROLE is part of the NSF, REC, um what other different activities REC support . . .

KW: Um . . .

LS: Um, working together working other organizations . . .

GR: What does collaboration means in terms of REC and ROLE program in particular, what are the typical activities that . . .

KW: Oh-um, in the rest of the division? In the rest of the REC division?

LS: And ROLE in particular. Our project is to for ROLE to seek foreign organizations . . .

KW: Are you looking at, at the collaborations specifically at collaborations with international organizations or all sorts of other organizations?

GR: Well . . .

LS: All sorts of organizations . . .

KW: All sorts of organizations, OK. um, well, the. This is in no particular order, it's just from the top of my head . . .

GR: That's OK . . .

KW: The, um, the projects that we sponsor, some of, some of, um most of what we do is just projects by one or a few investigators. And the members involved might just be their university. We've also had a couple of project where we were working with associations or other organizations for examples um, we sponsored a series with the OECD, do you know OECD?

LS: yeah, organization for E . . .

GR: yeah

KW: And they were very interesting in looking at the relationship in brain science and education. And got together some, pretty high power people from the U.S., Europe and Japan, um, at any rate, a mix of neuroscientists and cognitive psychologists primarily, um and, and setup a series of conferences. I think one of them was in NY a couple weeks ago, the next one is going to be in France, and then Japan after that. Well, anyways, we've also worked with um, um, other organizations like the American Psychological Association, where we sponsored um, you know, again, it was a very small conference grant. One of the things that happen when we work with these organizations is, um, since they represent a whole group of people and they are able to bring in a whole community with them. Um, there are some other things that we, um, setup, um, which are research centers. They, we setup some centers based

on NSF support and in fact become their own organizations. Um, um, that do research, um, that, um, you know, disseminate results and make data, make data, things like that, available to the wide research community. They hold meetings, they . . . they run their own small grants programs to see small projects. One of the organizations that . . . that we support is called CILT, ci i el ti — its the center for innovation and learning technologies, I guess, maybe innovative learning technologies, I forgot, anyway they just had a meeting past week end in Washington, um, um, and they bring together primarily people who are doing classroom level research, people who are designing educational technologies, um, and, um, you know developing some really good stuff, um, and, although that is actually sort of an NSF sponsored entity, its sort of, you know, its a large thing so it becomes an organization of its own. Um, what else . . . what else can I think of in terms of organizations. So, we have international organizations, um, um, scientific societies within the United States, centers, um, and, and, I guess, other, you know, other other federal agencies as well. There is actually, um, something called the Inter-agency Education Research Initiative, which is a partnership between, um, it a joint program sponsored by NSF, the National Institute for Child Health and Human Development, which is part of the NIEH and the Department of Education, and, the three — this three federal organizations together are . . . are sponsoring, um, relatively large research projects or large in terms of dollar value of that are aimed at taking research-based educational interventions and, um, and implementing that on a larger scale. There are a lot of things that that have come out of, like the things that come out of this, um, of this types of studies . . . or maybe studies in maybe quadrant two and quadrant three, um, that have so far been, you know, that that show that they are, you know, that they are effective for improving learning in this, you know, sort of small experimental settings, and there is never any money around to, or until this program came around. there was never any money um, to actually take those types of interventions and try them out, and, you know, whole school districts, or whatever it might be, um, so that you can see, um, whether this is actually something that, that, that, that is practical, that is can um, that can be implemented nation wide, that sort of thing. um, another, actually, um, another set of um, of entities that we interact with, to some degree, especially those centers like CILT, that I describe to you. um, um, they interact with what are called the um, systemic initiatives. there is actually a whole division of, of, of EHR, um, that is, that, that works on what is called systemic reform, and the idea of that, is again, it's, it's sort of, it's sort of, um, um, similar and well, there are some parallels between, that, that work and, and what I described in the integration agency education research initiative, where, um, um, um you might have a good idea for intervention. right? um, and, and, and, it might even be something that under the right circumstances. um, would work for large numbers of students, right? um, but um, unless you have, unless you have the interventions coordinated with, for example, you know, the school district policies, um, with um, you know,

with, with having, you know, enough materials for, the appropriate materials for the student, that sort of thing. um, unless you do, um unless you have all those things that all different levels of the system, that, you know, the teacher training, so that teachers know how to use the material, all those sorts of things. unless you have all of those sort of things, sort of, coordinated together. um, then, um, you know, it's, it's, it's like an, it's like as if you had an air-plain, and 75% of the parts were working and 25% it will still crash and fail. so the systematic, so NSF has, over the past, um roughly ten years, has sponsored, um um systemic reform initiatives in a number of, they started of with a um, number of large school urban school districts. nu, and have, they have also done some things that are state wide. some with, um with more of a ROLE focus. 'cuase ROLE areas have their own um, specific issues that they can be difficult, for educational fund to take place. I mean, largely Because there's spaces, and and the, the you know, the teachers don't have as much contact with one another. all of that sort of thing. Um, so any ways, the um, there have also been linkages between some of the research projects, and the systematic reform initiatives, so that the, um, there is actually a center called LETUS, L-E-T-U-S. it's um, um, um, I forgot what it stands for. (chuckle) um, um, . . .

LS: Is this within the United States?

KW: that is within the United States. that actually involves the um, um, a group that Northwestern University and the University of Michigan, and they are actually working with the systematic initiatives in Chicago and Detroit. um, so um, so, so in other words, um, um, we sponsor certain projects, for example, done through the LETUS Program, we actually, there is actually a the LETUS Center there are also individual projects that we have sponsored through things like ROLE and the, the previous programs to ROLE. and then there, are um, um, and then there are these systematic initiatives. and, and um, when we have, you know, when, when we see something, where there should be a linkage between these types of organizations, we try to refoster it, if we can, because it can make the total affect of, of the best, you know, of, of it, much more successful.

LS: Successful? How?

KW: um, successful in terms of having impact, I guess. um, um that is um, um, um, if you have um, if, if you have, for example, if you had some new educational technology, right? and it doesn't make much sense to keep then in a lab. you want to be able to, you want to be able to um get them them out there. get, get kids to start using them, and and to be able to use that type of, of real world feedback. um to improve what you are doing, you know, that, that kind of thing. um, so um any ways, so the, the organizational connections are actually in pretty um in terms, of this, of this particular area of research, um, they may even be um, a little bit more important for the research itself, than,

than if, than if you were looking at just sort of, you know, real fundamental, fundamental chemistry, or something like that, where you can actually find either. you can sustain your lab, where, where all you have to do is, is, you know, do the experiment, find out what happen, and publish it, and that sort of sufficient, um but here, if, if you're not um, especially if your um looking at things at the classroom level, than if you're not interacting in an affective way with, you know, with other educational organizations then, um your impact would be much smaller.

LS: I have a question, I just want to still clarify collaboration. Um, did you, at all, have a say on our project at all. I am not quiet sure about that?

KW: what do you mean?

LS: In terms of, of what we need to do to write this final proposal on how ROLE should collaborate with other programs. Did you have a say in it, or is this something new to you?

KW: In your particular project?

LS: Correct.

KW: No, this is the first that I have seen of your project.

LS: Is this the first time you heard about it?

KW: Um, I just heard that you guys where going to be coming here to work on ROLE. I knew that there were some group from WPI that was suppose to come here. I didn't know, I didn't have a good sense of what you were going to be doing.

LS: Yeah. We just wanted to get a more sense of what makes our project different, to collaborate with other programs and organizations? What makes it distinct?

KW: Well um, well I think that um, um, I mean that it is not distinct that we had to reinvent the wheel to sort of figure out how to get collaborative relationships to work out. Um, um, there are some areas within this particular research area, where, um collaborations are very critical to a project success. um, and it may be the case that um, you know, it, there are some, there are lot of reasons for doing collaborations, I mean, one of the big reasons, that people get into international scientific collaborations in particular, is because um, certain type of, um, scientific projects is really, really expensive. Um, that is probably the biggest reasons that, you know, things like, big observatories, things like that, and the things shared. and, you know, you have these complicated international agreements. Um now in that particular case, um, you know, where you have a big facility, the um, n-e-ways, the results of the research and so forth, I mean, the research itself it's, it's still going to be directed at, at a specific question, that, that, maybe doesn't necessarily change that much, depending on, you know, um, this group of investigators can do it or some other group of investigators might do it, and, and the problem is

pretty much the same. but in order, to just pull the project off at all, you need a tremendous set of capital. Um, in this particular area of learning and education, um, the collaborations are sometimes more apart of the substance themselves. Without the collaborations, it's not a matter, like, in the previous example that I described. Um, if we just have five times the science founding as we have today, then we should be able to do it, you know. I mean, it's always nice to collaborate with scientists from other countries anyways. In this particular case, um, there's something that, that again is essentially different, if you, if you setup collaborative sets of projects or non-collaborative sets of projects, parts because you get the difference from different people working on different levels of the problem. Um, and, and then you will be able to get the kind of real world feedback that you would. I not sure if that's exactly getting into your, um, question, in the international case, um, we have a lot to learn. From how schools work in other countries. And, part of that is because, part of that is because we look at how students in the other counties do, they do a lot better than our students. Um, and that, um, there are questions about how are their teaching methods different. Um, are some of the difference deeper cultural differences that, that we can't really do much about or some of them just differences in professional culture of teachers themselves. Now, how um, you know just some of the day to day expectations of teachers in terms of how much um, how much they get to innovate in terms of their own teaching styles. And how much the, um, in some counties there is more of a tradition where um, where the teachers have a little bit of research responsibility in their own job, of examining their own practices, and, improving them. Um, there are some differences in terms of the material they use. Um, as you probably heard of TIMSS. Our teaching materials are often said to be superficial, um, and try to cover too many topics at once. Whereas most other counties have, for one thing they have more of a nationally coordinated curriculum, um, and the curriculum takes the students into a logical sequence. They don't worry about coving too much topics at once. So, that's another area where particularly international collaboration, or at least comparisons of international research results can be very important. There is actually something that I guess, um, Singapore has always had a good in terms of their student getting the better math scores . . .

LS: Yeah, it's Singapore.

KW: And, you know there are questions about is it culture that how the parents raise their kids or is it professional culture or the material. It turns out that, those text books have been translated into other languages. Some teachers in English speaking countries are using these, you know, these materials. The material is just so much better then what they have. These are just some of the examples of the kind of things international comparisons could be quite interesting. One questions you can ask, is are we, are we teaching our teachers the right things? Just the variations there, makes it very valuable sometimes

for international comparisons.

LS: Um, you talked about the OECD, are there any other current partnerships right now?

KW: Um, the ones I could think of is the center for international conferences. The OECD ... I'm not aware of any others.

LS: Um, OK.

KW: There's actually a whole division of NSF that deals with international relations. It's actually, it's actually on the ninth floor, um. There are um, besides OECD, there are counter parts organizations for the NSF. In Japan I think it's called the um, it's something like the ministry of science arts and culture. It's actually pretty extensive. There's also, there's a similar organization in Germany, I forget how things are structured in the UK. Anyways, in addition to the OECD, there are other government organizations and um, probably there are some localized, non-government organizations, but I don't really know this.

GR: So, um, as I understand it, the collaborations that ROLE is looking for is basically like joint workshops and joint sponsorship of projects with other organizations. Is this the kind of collaborations that ROLE is looking for?

KW: Um, I guess so. I cannot really speak for the program on this particular point. Um, you know, for the sake of our program goals, we backed that from projects that looked at internationals issues. We backed that from workshops that bring American researchers and researchers from other country together to discuss all sorts of issues. We benefit from looking at, um, learning how other counterpart organizations sponsoring the same work and, and, know what they learned from a program management level to benefit from joint sponsorship of projects and programs potentially. So those are different levels of internationally focused collaborations.

GR: Do you think contacting U.S. researchers sponsored by ROLE would be a good idea to find out about other organizations?

KW: Um, yeah, I think you should ask Eric about the procedures as far as that goes. There's actually a survey that we do each year on all of the investigators who receive ROLE awards, and if there's a question on that survey that deals with international collaborations then you might actually have everything in a database that you can get to right away. If there is not, then you might want to talk to um, you know, folks from selected contacts that might look interesting. There's probably only um, you know, it's probably only 1 in 10 projects that you'll find, that would have a bunch of international components in it.

LS: We will be doing a final presentation during the last week that we are here, and you are more than welcome than to come if you would like.

KW: Oh, that would be great.

LS: Thank you very much for your time.

GR: Thank you.

WF: Yeah, thank you very much!

KW: Oh, you're welcome.

F.1.2   Interview with Dr. Larry Suter

Questionnaire ID:	2 (see Section D.1.2 on page 85)
Questionnaire Name:	Initial interviews with REC staff (revised)
Present:	Dr. Larry Suter (DS), Wei Fu (WF), Gleb Ralka (GR), Letasha Souffrant (LS)

WF: Can you describe to us, like, briefly what your job is here at the NSF?

DS: Well its been going through a transition, so it's hard to describe my job. I used to be the Deputy Director of the division and and I was a director of the division for a while. So, I've been here the longest: I've been here for ten years, so, I've [pause] Lets explain it this way: this division, this directorate has a division of research, but it hasn't always had a division of research. Research was sometimes conducted within the implementation divisions because this whole directorate was created after Sputnik to say "all right, how are we gonna create education system in science and math that will produce people that will become scientists in the future." So that's what NS . . . so we figure we've got to work with education system, so, they did not know how, so we spent lots of time. So they did experiments sort of in the country of how you prepare teachers to teach? Well, but all the time everybody says "oh, we've got to evaluate those programs." And, when we do evaluation, we began asking the big questions: "Well, what's really behind all of this anyway?" So we sort of, over time, developed a research program and we brought it all together in one place. So, I was here when we brought it all together, and, um, I came here because my job was to produce indicators reports. So, I will . . . these two reports here, indicators of science and math . . . take a look at those. I have . . . we have a few copies of that. And than we also produce, um, this report here, which is, um, which also has a chapter in it, um, elementary and secondary education, that I oversee. This . . . this . . . this book here, "The Science and Engineering Indicators," comes out every two years at NSF. And I am a statistician, and I am really . . . I know the data from . . . throughout the government, so, my job has been a kind of, um, direct. And then I found research related to that, and especially the international studies have been one of my goals.

WF: So are you directly related to the ROLE program? Um . . .

DS: Yes, I am now acting, I guess, I am sort of a program director in the ROLE program.

WF: So what kind of activities is ROLE looking for in a collaboration with other organizations?

DS: What kind of collaboration . . . well . . .

WF: like such as workgroups, study groups, I mean, conferences

GR: workshops

DS: Um, within the other countries?

WF: yeah, with other countries, organizations . . .

DS: What makes your ask that question? I guess that's what I want to know.

WF: Because . . .

DS: Because I do not think that is explicitly stated somewhere. So, someone must have given you idea that that's a good question.

WF: The collaboration?

DS: Yeah.

WF: Because, um, part of our goal is to seek programs and organizations that would like to collaborate with NSF?

DS: I got it.

GR: Specific ways in which they can collaborate, so, we have to define specific details of collaboration.

DS: I see. [pause] Well, I . . . I think that the reason this this is a project is because Eric, and you need to talk to Eric probably more than anyone, because, um, Eric wrote the program, the the program statement, which kind of integrates the research program, that I was generally describing, across a broader set of disciplines, that have never been defined before. And we found, I do not really know how he found this [laughs], is that sort of the same things were going on at the OECD and Britain. So, he thought may be there were other countries doing this. Um, he then would like to see some collaboration since people are sort of seen the same problem the same way, like . . . And the problem that he saw was how do you get into some of the basic sciences, the sciences that are dealing with perception, cognition, neuroscience. How do you get those involved with think about how do you improve education. And and, so that's . . . that would be the big question that any kind of conference might do, or, any . . . so I would say conferences. I tell you I was out at an international conference last year, that . . . and I know a little bit from that meeting about [pause] what other countries are thinking. I am looking for a set of journals on my shelf, looks like they moved. It might be those little journals down there in the end. [long pause] And, um, behind you there should be a . . . unless I gave it to Eric and he kept it, which he may have. [pause] There is a conference that was held, that would be of use to you guys if I can find it. I do not see it though. And I am thinking there used to be a little book . . . [long pause] I do not, I just do not see it. Probably Eric must have it. But there was a very nice conference that I attended. Um, which there is a European organization, whose job is to think about cognition in education. This is the journal, um, the journal of European Association for Research on Learning and Instruction. Um, and I can loan you these except I really want them back. Um, they also have a web site by the way. Um, and none of these issues have anything in it

about the conference. The only thing it gives you is some names of people, who are editors, and gives you names, and directions, and what countries they are from. But I think, um, in a way this conference, this organization is dealing with some of the same issues we deal within ROLE. I think those ... of course there is some differences. So that would be one way I would suggest that that the ROLE, Americans are to participate in their biannual conference. And people there ought to be invited to our conferences or maybe some special organizations. Do you know, do you guys know about AERA, the American Educational Research Association?

WF: No.

DS: AERA is the largest American research association for education researchers. Very large! However it's also very broad. So it includes the kind of things that European organization does plus lots of other things. Um, and that's what makes our organization a little bit difficult because it's too big and too, too broad. And they are focused a little bit more. Their's their group is organized by psychologists and, in fact, the funny thing was it was organized by an American, who was in Europe, Dick Snow. And Dick Snow saw that there were Europeans working on some of these issues and he, um, helped establish this organization. It might be worth your time if you had time to read some of his work by the way. His name was Richard Snow. He was at Stanford. Very unfortunately died a couple of years ago from cancer. But he wrote an outstanding review of education research that's relevant to us. It occurs in the "Handbook of Educational Psychology." This is a new handbook of ed. psych. And I do not have a copy here. I wanted to buy a copy. So I do not have one to give to you. But if you can find a copy, that that is ... I think his review article is quite good and it includes a lot of European work. There is another article in the same handbook by Europeans, which also review some of their research. There is two or three article in there.

[Interruption (around one or two minutes)]

DS: So your question is what? Your question is what kind of collaboration could we have, right?

WF: Right, right.

DS: All right. And so the first thing is I would say that you could start with those international associations and and make sure that there are sessions organized with shared research. But some of our ROLE, some of people who are in ... who are doing a ROLE ... have a ROLE award and are doing a research project funded by us are to apply to the international association to present their results to the European community. And some of the ROLE people could in turn invite some of the Europeans to come to conferences here. Now what are those conferences? Thats the part that maybe you guys could think

about. Should there be some conferences in America that invite Europeans doing similar things? And if so, how would we find them? Where are they? And I am suggesting you can find some of them by looking at this journal and through this association. And if you guys have other ways, think about it, too. Certainly there are other funding agencies . . . there aren't many though . . . some funding agencies like us funding things. So I know some of the . . . I talked to the people in Germany after Eric was over there. And, what they were interested in was learning what we were doing so they can do the same thing. They do not already have people who are necessarily doing things the same. They do not think of things the same way. So I am not sure you gonna find a funding agency funding things like ROLE. So there is not gonna be like a set of people that look like our Principal Investigators already in Germany. Not necessarily.

GR: The DFG funds international research as long as the primary investigator is German. They can fund any conferences. They can actually fund foreign researchers and their projects. So its more flexible than in the United States.

DS: aha

GR: They also are looking for establishing the conferences.

DS: Who have you t . . . who have you talked to?

GR: It's out of the German notes.

WF: yeah, we also . . .

DS: By one of the lenders, or is it out the government.

GR: Its DFG, NSF analogy in Germany.

WF: German National Science Foundation. We've got a chance to review Doctor Hamilton's notes.

DS: OK, yeah. DFG. He has . . .

WF: Yeah. So we know a little bit about it.

DS: Well, thats more than I know. So I do not know how to . . . I know some . . . I know some of the German researchers, but I do not know how the National Science Foundation researchers that are . . .

GR: We also plan on talking to the researchers, U.S. researchers and maybe some foreign researchers, to find out what they think about the . . . what we can do as part of the collaboration.

DS: Yeah. You know, honestly, I think that my suggestion that you look at those handbooks, those are really good one, because you will see that one of the things that I thought was very interesting was by asking a European to do a review of research on a topic that they have to than find the European research and than to find American research. You getting European kind of looking back toward us. They . . . they bring the depth of knowledge from

there and they write it in English and they try to integrate it with ours. And
it . . . and it . . . I thought it made a very large contribution. So that's one
thing. Asking . . . asking for someone to do the synthesis. Look at your stuff,
look at ours and synthesize it for me, tell me who is doing what. I mean
that's what we need more of. We need more synthetic work pieces. It's very
hard to do. [long pause] The hard part . . . well, there is several hard parts
about it, but one . . . one of the hard parts about it is knowing the right people
even in Europe because European communities do not keep up to each other
necessarily. That's . . . that's why I like the association because it tries to do
that. These meetings by the way occur mostly in English. So there is a
common language. But not all research is done in English of course. So you
have lots of document in lots of languages that are hard for people to follow
even within Europe, so, they don't. So, I don't know . . . I think its different.
Sweden has a hell of a lot going on. Sweden, Norway. But actually all of the
countries probably do.

WF: Can you think of any organizations or the names of the organizations?

DS: No, gee, I know the organizations that conduct the survey research. But that's
all I know. I probably have the document up here that has their names. I can
show you that. You might want to look at those. But I am not sure that will
give you what you are looking for. And I do not know them. Dick Snow, um,
got a lot of credit at this meeting, a kind of post death award. Was there as
a . . . I believe it was actually funded by the Department of Defense. And he
lived in London. And he traveled throughout the U . . . the the Europe and
realized that psychologists were doing similar things. He, [laughs] . . . put it
together, but it took him several years to find the different researchers. And
I don't really know who else is doing that. Um . . . um, there are some great
people. One, one guy in stock hold would be fun to talk with. His name is Sjehl
Harnquist. Sjehl is, you know, is, is Swedish spelling: S-j-e-h-l, I think and
Harkfest, H-a-r-n-q-u-i-s-t, I think. I don't know if I am perfectly spelling it
right. But Sjehl, um, us to be the president of, um, the University of Goteborg
and he is now, kind of a, maridise. He's getting old, um, and he would because
he was part of the original group. Actually there is a guy, that organized this,
um, Eric, um, I don't know if his name is in here or not. Erik, um, (pause) Erik
is actually a really good guy, to know for your job here, Erik, um, Erik, (pause)
Decort, here it is. Erik, E-r-i-k, Decort, senate for in-structural psychological
and technology at the University of Luven, L-u-v-e-n. In Vilenstruc, this is in
Belgium. Um, now Eric is not that old, just a little older than I am, and he
and I were at Stanford together, couple years ago. I got to know him, I think
he's, uh, very well informed about the centers of Europe, and could probably
could understand our work, and somebody should probably contact him. I
may have his email address, I don't see it here, but again I think, that you'll
find it, if you can find the web address for this organization. uuuuu, here is
the web address for the journal. (pause) I don't see it in here, so I not quite

sure how to find it. I could look around, a little later, in my own journal.

GR: So overall do you think that, uh, we should, uh, talk to some people in Europe for, and ask them to review our research, here in the U.S. Right?

DS: Right. I mean, that I don't know what you could do, but these are kinda, general ideas, but somebody should, uh, we should, we should, have somebody create a group to do a synthesis of research that is world related research and we should have some of that organized by the European, selected Europeans, instead of by the Americans. And have the Europeans do their own research, and they would actually look back toward American research because because there is so much more American research. After all our country is about five times the size of most European countries, so just by shared volume, we have more volume, and it is also, in English. Almost any field that you look at, you will find a lot American research, and they'll have it anyway, but the problem is getting, the ideas out of there. Um, I know a nice gentleman, um, in Belgium who, um, who's job, he felt, he created encyclopedias in French, and his job was to find the research the research in English, and translate them, so that French speaking people could learn them. Now, unfortunately, he's probably old and I am not ever quite sure, I think that he is too feeble now to talk, but it would be interesting to find other people like him, in Europe who tried to do that translation and find, um, if they have some good ideas too. I don't know any other secrets. One of the other thing that is too bad is that we have very few joint projects, so somebody might try to think of a joint research project that would be jointly funded by, by agencies in two or three countries on a specific learning thing. Now our international studies do that. Um, but they don't get very deep into the psych or into other aspects of behavior. They sort of stop at one level and in fact, they are American oriented procedurally, analytically, and every other way. So, it would be kind of interesting to get into depth and have different kinds of experiments. The different kinds ... you see you need to have a model in mind of what causes personal behavior, or student behavior, or teacher behavior, and you'd try it out in various of cultures on a common basis. I don't know any body really doing something like that.

GR: We went to a conference on, uh, TIMSS and the second part of the conference was about cultural differences ...

DS: You went to the conference this week?

WF: Last week.

DS: Last week, ok, thats right, yeah, last week, there was discussion of that there ...

GR: Joint projects, as I understand, NSF can not sponsor foreign researchers directly who are working on foreign projects?

DS: That is right. But the American could collaborate and maybe that part of your job and trying to figure out the way to make a collaboration. But, that

would be a meconium to try to fund them together, but also to try to manage them and carry them out. One of the organizations that tries to do that is OECD where there, where there is all of the federal governments gets a part of the many and then its managed through one center. That is one way of doing international collaborate research. I actually like not to use big organizations I think you get messy research you do it otherwise. But if you ... i'd like to invest in researchers, the best researchers in each countries in a field. Pick a field, pick a subject and let them figure out how to work with other people. What you get when you do that is , um, a very individualistic oriented research, approach to a research problem and therefore you are more likely able to get more ideas than if you were to go through this visualizations where you would have to structure everything, so formulate ahead of time. Then you have to agree on languages; you would have to agree on procedures, all that. Then you spend years, and years, and years trying to understand, "now what do you mean by students?". You, know, a student have to be enrolled in a school. In Switzerland, students don't have to be enrolled in school they just come and go. What is school anyways? You spend two years discussing what is a school. But, but if you get down to an individual people, you could sort of agree on a problem more quickly, but then the problem becomes richer. See, you got complicated problems.

WF: Can you advise us on anybody that we should talk to that could help us on this project?

DS: You mean in NSF or anywhere?

WF: Yeah.

DS: Umm. Have you gotten to know the International Division much? They probably ... it wouldn't hurt to talk to some people upstairs, but I don't know how to approach them. Um, their job is to ... the, the, well honestly I was thinking about the individual program officers. There are program officers who are organized by country. So, you might want to talk to ROSE Gombay runs programs in the U.K. and um, I forgot, this other lady who does eastern Europe and there is somebody else who does Japan. Larry Weber right now is doing Japan. Um, if you talk to those people, and tell them sort of what you are doing, they tend to know the research communities. In modern education, they are interested in science and technology. So, they tend to know who the researchers are, or are a little out of touch with the social scientist. or maybe not be. They certainly would know the research centers; they might be able to answer you questions about that. There are some research centers that you ought to know about. Maybe that would be a good idea, we ought to try to get you upstairs. They are exactly one floor above us. Um, so that would me my advice. Um ... I don't know about any large American research centers that specifically worry about international or Western Europe. Everybody probably does to some degree on their own ... let me see if I can think of ... just I am

trying to put together the places, where would I go ... [long pause] ... see Stanford would of been a good place, so Dick would of been a good guy to talk with. But, even Dick's students are not even carrying out the international work. Um, Columbia use to have people. There is still an international center there ... I really ... you know the area of technology is probably something that you should your base your attention to and um, we do have one project, um, that is from, by Bob Causena at SRI international which is in California. That is trying to find out what kinds of technology is being used in schools in different countries of the world, and they are taking videos of the example of technologies in schools. Now, that is an interesting thing. One of the things that I have always wondered is that is there research projects in other countries that are trying to evaluate the use of technologies in schools that we don't know about because every country in the world is spending millions of dollars putting computers in classrooms at all levels. And, the other countries are just, ask the same questions that we do. Does this pay off. If so, how? And so somebody out there is doing research evaluation on the use of technology. Well, how, where, who are they? Um ...

GR: It might not be at an agencies or in a ...

DS: No. It might be very local thing, it could be a local school district.

GR: Yes.

DS: But maybe somebody is trying to synthesize a bunch of those or maybe there is a web site or we sites or some other thing, I don't know. But it seems to me that you might want to nose around in area of technology and education in research to find out if there is some way of finding a group of researchers that are dealing with it ... [phone rings] ... excuse me, it scared me ... [long pause].

GR: Well, thank you for your time.

WF: Thank you.

LS: Thank you.

DS: You're welcome.

F.1.3   Interview with Dr. Finbarr Sloan

Questionnaire ID: 2 (see Section D.1.2 on page 85)
Questionnaire Name: Initial interviews with REC staff (revised)
Present: Dr. Finbarr Sloan (FS), Gleb Ralka (GR),
                              Letasha Souffrant (LS)

FS: Hello.

LS: Hello my name is Letasha Souffrant. I am a WPI student, Worcester Polytechnic Institute, from Massachusetts. I'm a junior, Electrical Computer Engineering.

GR: My name is Gleb Ralka and i'm computer Science major at the same university, and I am originally form Russia.

FS: Where in Russia?

GR: Moscow.

FS: I played soccer there many, many, many years ago. I got my ass kicked, but ... [all laughed] ...

GR: So, how much do you know about our project.

FS: Very little.

GR: OK, so basically, the idea of our project came from Eric Hamilton. And our objective is to, ah, find possible international collaborations that ROLE can do with other organizations, primarily with Wester European, but not necessarily. So we want to establish ways in which, ah, organizations can work with ROLE, what kinds of activities in particular, and, ah, that is what we are here for.

FS: Has anybody talked to you as a group about talking to Rose on the ninth floor?

GR: Yes

FS: OK, good because we talk to her over lunch the other day.

GR: Well, as I understand, we have a meeting set up with her.

FS: Good, it would be interesting to see how all these, these set of ideas, converge, or diverge, which is the case here.

GR: Um, can you briefly tell us what is your job here and what do you do?

FS: Um, in my former job, i'm a research statistician. Um, I have had experience in bio medics education at the university. My particular position here, is, is a program officer, everybody has the the same sort of title, and in that role, ah, one does three different things. The first is paper push. The second is paper push, but associated with projects that you personally, um, are monitoring, so, in the second component, there is a psychological reward, for, for the, I mean it is pretty much, it's clerical, but it is important clerical work, and that sorts of understates it. When u say that it is important, it's important

because without getting that work being done, um, grants, applications don't get reviewed, um, handbooks don't get put together, projects don't get funded, and things don't reach a completely, um, research doesn't, doesn't reach an actually conclusion. Um, that's it, and there is still a lot of paper that gets floated around. I think that the third component, of the ROLE, particular position, [phone rings] I am trying not to say the word ROLE. Excuse me just a second . . . [answers the phone, long pause] . . . Somebody else is coming up, so . . . but the third part of the job, as I see it, is to provide leadership and direction in the field. So, to think about where the field is, where it might be going, and how do you encourage a grant sent that might be considered risky, in a traditional sense, or, ah, how do you encourage change in the field? That's sort of one component of it. How do you bring, um, rigger, or an elevated degree of rigger to the field? Educational researches are difficult to do well because there are too many moving parts. It's not, um, an engineering product. Uh, you would have sort of, in, in order to build certain networks, you'd build prototypes and try them out. But, you can't take kids out of school, and do that with them, or take children in schools and do that with them easily. Um, also there's, there's a moral aspect to that even if you could do it easily. Is if fair to do it for some children and not for others? So how do you, under those constraints, bring rigger to the research domain? My specific role are a number of large projects that I have, that I am accountable for. They include, um, here everybody uses there Acronym and I don't know what, you know people go to meeting and it's yadie . . . I have no idea what they all are talking about. One is TIMSS, and TIMSS was the third International Mathematics and Science Study. It's going to stay with the name TIMSS. As it appears, it was FIMSS, SIMSS, and TIMSS, and now they are trying to do trends. So, so, those initials will stay, but it will be a trending study as it will be conducted more regularly. And, one of the goals there is to, make the material that's being accessed, richer. So instead of it being simply multiple choice type questions, that there would be some form of performance assessment questions. And how do you do that across multiple countries at the same time under similar conditions is quite difficult. And, the second piece of that puzzle is, instead of it being just a ranking phenomenon, how do you capture other data sources, so that you could get as to why children achieve more hight, or what are the structural components of an educational system that support high achievement on the part of more children. Um, and embedded with that, there's, there's a series of video studies, that go on as well. so, how, how do you . . . personally I am not particularly interested in having a random sample on the video studying. What I would be much more interested in is a non-random sample of classrooms where children do achieve highly, but where there is a lot of mix, so countries where you have tight government control, and like the U.S. where there isn't, relatively schools are vocally administer. When I say mix, I would like a teacher in Atlanta who might be sitting in inner city Atlanta to be able to at the end of the next video set of studies, to be able

to pull up a classroom that look like his or her's, so they could put in a set of conditions into a set engine, and pull up a set of videos where children, like the children that person is teaching, in the same types of conditions are being successful. I think the first piece of the puzzle, if you want the results of this work to influence change that if you want to convince the person who you want to change that it can be done. So, when you say Japan out scores the U.S. well everybody here will say that "they are culturally different, the kinds of resources that there are there are different, the teachers are differently trained, and all of those things are correct. Um, that is sort of what I am after, at the back end, there is a sort of non-randomized study. Is that I could sort of, I can, I, as somebody using an electronic system, can gain access to a situation that looks like mine where children are doing well which forces me to ask why? which then sort of comes back into this other piece of the study under why do children do well and how is that supported . . . [knock on the door, long pause] . . . then reverted to that, there is a very very large organizational group that is called IERI, and IERI is the Interagency Education Research Initiative and basically you have the NSF, the Department of Education, and N-I-H-E . . . well there is a part of the National Institute for Health that is associated with child development, so I think that it is N-I-H-C-D, again I don't know these letters, there is a lot of disadvantage for not knowing letters because I have to explain what I am saying. And basically, a lot of educational research tends to be very focus on narrowed questions. On questions you can, from a research perspective, get a tighter handle on, but then when you take results from that type of research, and try and use it more guardedly, it falls apart, because the constraints that was associated with the narrow conceptualization of the problem don't function the same way as, as you, as that get bigger, so will those things work with more divers teachers? Will those things work I a more diverse populations. As, as you make the problem more complex, then things fall apart or don't work well together as you thought they would in the smaller study. At the same time, you could build a model of a bridge, or you could build a model to support a computer system. Then when you got more people using it, and you anticipate it, all hell breaks loose, so the issue is as you gain that information, what do you do to the system? Does it mean that you have to start from scratch? Or it, when I say system in this content, I am thinking about that computer system thats, thats being built. Do you have start from scratch or do you do things in parallel, um, to allow you to get around the sort of over use? And, and you know it's not a great example, but it gives you a sense for the complexity to some degree. There are lots of moving parts in educational systems. Um, so those would be the two major projects that I am involved in. The IERI piece probably has a budget thirty to thirty-five million and growing. Now it's shared. It's budget that is shared by the NSF, by this group at NIH, and by the Department of Education. Also the international study component is also a shared budget between NSF and NCES, which is the National Center for Educational Statistics. Um, so I see

myself being involved in . . . although I also when I run the panels, the other ROLE panels, which there are a couple a year, and the career panels. Um, my specific role would be more sort of macro and bigger issue when I sit down. That is probable why it reflects why they have, ah, statisticians, because it isn't doing one on one interviews with children. Um, now Ken on the other hand, is, is sort of probably very macro relatively to the brain, as complicated as any of the other things that I have been talking about. But it's sort of the ending workings of a person verses the ending workings of, of a lot of people working together and that is where his area of expertise come into play. Elizabeth's area of expertise is associated with teaching Larry Suter's area of expertise is associated with, um, methods, organizations, and sociology as a phenomenon. And Lee is associated with content, rich content. Eric's background would be in content and in technology. So as a team, you sort of have a portfolio of people with different skills that brings some sort of balance and often much argument to every question, which is a good thing. Um, this is a reasonable place to stop because I have this other lady coming in, in that it is a coherent place to stop. But, I am here for the rest of the afternoon so if you want to come back in a half an hour. Feel free too. Is that ok?

GR: Yes

LS: Yes

FS: Thank you.

[long pause]

FS: Ok, so we were talking about micro and macro people having different skills in a sense. One thing we should keep in mind, when I use these terms I don't mean macro as being just bigger. Um, it is bigger but it isn't bigger in terms of importance. What Ken is doing, in terms of neuroscience is as important . . .

GR: So it is similar to micro/macroeconomics?

FS: Yes and no. Micro/macroeconomics patrician economics as, ah, micro as sort of between industries, and macro is between countries. The goals are similar, but the way in which it is different, is that it is a combination of the two in a sense if your interested in how does macro components influence micro components? So you are not just interested in industry-to-industry, but you are also interested in how, how the broader system affects each on of those and then how they affect each other.

GR: So, ah, in applications with the ROLE Program, what kind of collaborations with foreign organizations can be useful from your point of view?

FS: Um, mostly, almost any. Um, and I think that it depends to a degree what Eric's goals are. What I mean is that there are ways in which we can help a lot of organizations and what you'll find when you go upstairs, is that Germany has developed a German equivalent of the NSF. Ireland is beginning to develop

one and in fact the folks who are in from Ireland are here trying to generate support to get proposals reviewed because they don't have a critical mass of people in the Republic of Ireland to the reviewing. So in that aspect, how, how does ROLE help others, and then the other aspect, how does others help ROLE. So in terms of our understanding, how does other educational system work? Um, what is the influence of government on curriculum? Um, do child of the same age groups attend school at the same time? Is curriculum ordered in the same way? Now to all of those questions I know the answers to them is that they are different, but, but the devil is in the detail. So, I know that they are different, but I don't know in exactly what way they are different, and I think that that way would be important.

GR: So we would have to formulate in a language . . .

FS: In a simple language . . . Um, how does teachers train from country to country, how is that different? What do teachers look like before they go into training, before they are trained? Are they very different in terms of their experiences? So, in the U.S., and I use this loosely, as far as elementary school teachers generally don't have double majors, they're the major of elementary school teaching. In many other countries, an elementary school teacher would have a major in the content area as well, or might have a major in the content area and then take graduate courses to become a teacher. So those kinds of differences have critical affect on making changes or looking at, someplace somewhere else and say that "that would be very interesting here", but then, you don't have the same kind of people supporting the product or process that you are trying to put into place. So, it's more developed in that type of understanding. Um, and I also think, um, it sort of crosses projects, richer, deeper, and gets more complicated . . . [interrupted by some one at the door, long pause]

GR: So, ah, so do you think that this could be done to conduct conferences, comparative studies, and um, what else can you think about?

FS: Yeah, those are things that require, in the conference sense; it requires people to meet with each other . . .

GR: Much more frequently?

FS: Yeah, but meeting, some of that meeting, I mean I think that some of meetings can be virtual. What I thing, I would broaden that up. So, Eric for example, is I think teaching for an open university this year

GR: How can that relate to our goal?

FS: I would sort of embed on, as you start putting recommendation together or your thoughts together, is not to undervalue the future value of technology because I think we have at least a century, lived in a very technologically rich environment. But, the way to change the technologies and the impacts, immediacy of the impact of those technologies on people, is just is just an increasing explanations. I think of my parents' lives. I think of, my dad is

eighty-one, in a different country. My, my parents still haven't dealt with the notion that you could make calls out with a telephone as well as just receiving them inward. My, my point is that technology has influences in every piece of life and will continue to. I think that in richer and sort of more probative ways. Um, don't be scared to be futuristic in how you attempt to answer each questions. So, you have some people interaction, you have knowledge interaction, and you have people and knowledge interaction, which crosses many interesting questions. So, the issue is I think trying to get at what are the common questions? And how they intersect in common or uncommon ways? Um, doesn't help you a lot, it just frames some things. And then having the right detail so that the conversations are optimized in terms of their meaningfulness.

GR: Um, do you have any organizations or projects, with the researchers, in Western Europe?

FS: Yeah, I could, but I would have to generate a list. There is a lot going. So why don't you give me a week, well let me right it down or other wise I will forget it.

[long pause]

LS: Ok. Thanks you.

GR: Thanks!

F.1.4 Interview with Dr. Elizabeth VanderPutten

Questionnaire ID: 2 (see Section D.1.2 on page 85)
Questionnaire Name: Initial interviews with REC staff (revised)
Present: Dr. Elizabeth VanderPutten (EV), Gleb Ralka (GR), Letasha Souffrant (LS)

GR: So, basically the situation right now is that there are a lot of information circling around about, um, programs and and organizations in Europe. Eric Hamilton went on a tour and he collected quite a few, uh, a lot of information. Uh, we have tried to collect it and put it together and we also try to get around to more people and see what they think and finding specific ways in which we could work together. Um, so my question, my first question would be can you tell us a little bit more about what do you do as a program direct in ROLE? What is your line of work here?

EV: Well, ok then, in ROLE, you know we share all the programs. Have you had some one explain what ROLE is to you.

GR: Yes.

LS: Yes.

EV: Within ROLE, the area that I am personally most interested in teaching and learning. You know, how do we connect the kinds of instructional practices that we like? Whether that is teaching or or soft ware etc. to deep learning of the different parts of how to reset learning and how to redevelop models for really understanding what a teacher does or what a school system does and to execute that learning. I was a teacher for a long time. I am also a program director for the TIMSS-R study. three of us work on that. I guess you have talked to Larry? And that has been very big because that is starting to come out. I am mostly program director for the video study internationals. Has he talked about that?

GR: Umm, yeah ...

EV: Well there is a man in California named Jim Stigler, S-T-I-G-L-E-R. For the TIMSS studies, he did videos in three countries, science and mathematics and they became very popular. There are two sets of films. One of public use films where people could see Japanese teachers and American teachers teaching fundamentally different, and there is there is the national sample so you could could statistically analyze films. Interesting process. Well this year, they are going to be doing seven countries in mathematics and in science. NSF is paying for the science videos. The Department of Education is paying for the other part. so, this is trying to get, it's it's a very interesting technique of trying to do statistical analysis of qualitative data. The first question that you have to ask is what is the segment? What does it mean if you are looking for, um, experimental truth, or, um, inquiry. What does it mean in a cross cultural situation? And, now these were the national samples, not what they

call purposive samples, they just found a hundred schools to participate in it. They didn't try to find a hundred schools teaching geometry to seventh grade students. That would be of interesting comprises. They also didn't try to find a hundred samples of very good teaching. It's a fascinating study. The film, the original one had great impact, so that is one of my international projects. There is another project, funded, which is Teachers Induction and they are looking into three countries about how to teach, how do, how do the countries help the teachers in that first or second year that they are out there, France, China, and Japan. We are the only country in the world that just sort of drop teachers in and say go teach. It's more of a formal movement for these types of countries. There are also three international studies that I have most direct contact with.

GR: Um, what are the other organizations that is involved in this . . . in TIMSS or the other studies that you have mentioned because we are trying to collect the names of organizations and try to see what else they could do to get together?

EV: Well, the primary organization that we work with for the TIMSS study is the National Center of Education Statistics which is in the Department of Education. They are the prime and the second is their parent organization which is the Office of Educational Research and Improvement. Um, OERI, the parent organization, support research and a whole bunch of other things. Um, NCES, is a statistical gathering agency, educational data gathering agency. So, they do huge amount of internationals studies. Plus the national assessment of educational progress, the high high school and beyond studies. Any, any, if you have heard of any statistic about any elementary or secondary education, NCES collects them. So, they are the primary people running TIMSS and TIMSS-R. But we do it, we have a joint management, inter agency management committee to oversee it. And it is actually conducted by the IEA, the International Educational Association, through Boston College, so I mean that is just a big complication just by itself.

GR: So, it of course goes through, it probably goes through other foreign organization to do that too?

EV: They do. Each country pays their own share of participating in TIMSS-R except for what we call World Bank countries, World Bank actually funds participates of some countries like Iran, Indonesia, who might not be about to afford to participate on their own.

LS: You said that IEA conducts it through Boston College, so what ROLE does Boston College play . . .

EV: Boston College is the actual contractor. They are the ones who gets up, set up the questionnaires. Make sure that the samples are appropriately selected in ever country. They train the people who are doing the data collection. They do the analysis. They produce the report. Now they also work with some contractors who like educational testing services. but they are the prime

contractors. Boston College they actually do the research. They do conduct the survey.

GR: So, uh, from your prospective, um, primary benefits of this corporation are, uh, the fact that we could actually see the difference between educational systems all over the world. Now, is there any other way that ROLE could work with other projects except just than compare, comparing studies?

EV: In, within the international . . .

GR: Yes.

EV: Well in one way that we have done it of course is by bringing reviewers to our panels to look at our proposals and us serving on their panels. Um . . . well because it is also the literature. I mean it's like a joke that it travels around the world fast and so does research. I was was in Korea and Melasia when I heard the death of our researchers and there was this Melasia person that was all upset, so I mean, it is just making sure that we, that our researchers . . . remember that we don't do research here . . . that the people that do our research publish internationally. So, under many of our grants, we support traveling to international conferences.

GR: Do you actually set up any international conferences?

EV: Actually no. We will set up conferences which people from other countries are invited. Not actually international conferences. You've got to be careful how one says that. But, we'll, it is most likely that we will support conferences and make sure that people who are experts, although they are in different countries, will come to it. Sometime we beg them to come, but . . .

GR: Well, can you advise us to any researchers or some people that could provide us more information about our subject?

EV: Um, that you have not already talked to . . .

GR: Yes . . .

[pause]

EV: You know that the meeting that you went to, those are THE big researches in this areas. So, I mean in terms of research, those are the main folk. We might, if we able to, have you talk to Colet Shabow, who is . . . she'll be here actually . . . she is the director of the Board of International Corporative Studies in Education, BICSE. She might have a broader sense. I don't know how much that would really focus on your subject. Um, you know that . . . are you going to be here on December 6th?

GR: Yes.

EV: You know about Liping Ma?

GR: No

LS: No

EV: Ok. That person us up there ... Liping Ma has, has one of the leading researchers on, in mathematics and what she has done is work with um...Chinese teachers and what do they need to know ... what kind of mathematics do they think you need to know in order to teach young children and it's very interesting. It is a profound understanding of simple concepts as appose to talking a taking a class in calculus. It doesn't really help, about calculus when you are trying to teach kids relationship of fractions, but most people don't understand the relationship between fractions. So, Liping Ma is coming here to give a talk and it is really that kind of deep research into some other cultural understandings. So, she will be her; you should defiantly go to that talk. This woman is doing a study, I think I have her card here ... is in the elementary and secondary education ... [pause] ... well one person you should talk to is John Earld, E-A-R-L-D who is in elementary and secondary. Another person is doing a study on Japanese teaching ... [pause] ... Kate Scantelbury who is the program director in that area is doing some studies in Japan. I am pretty sure that it is on teacher ...

GR: We want to talk to some researchers funded by ROLE. Do you thing that would be helpful? Do you think it might be useful for them to organize international conferences?

EV: The person that would know the most about that would be Senta Reyes. Have you gotten her name from anybody yet?

GR: No.

LS: What is her name?

EV: Her first name is Senta, S-E-N-T-A, R-A-I-Z-E-N. and that is her last name and her phone number, email ... I can't remember. Senta has been around the international research community forever and ever. I can't think of how old she is. She takes off every other week and travel around the world.

LS: What is her last name again.

EV: Raizen, R-A-I-Z-E-N. And, she is the one, she the principal investigator on the teacher induction study I mention. The problem is finding her, I mean that may be difficult. Um, you might want to be more focus on your questions with her, I mean, but your questions are pretty good. If I were to interview her, I would ask her "what do you think are the three things that the National Science Foundation research program can best do in order to promote" ... or maybe "what are the three best reason to have an international studies" ... you know somewhere where you are really getting her intellectual thoughts. So what have other people told you? We might be passing a lot of the same things, many of the same things?

GR: Actually, not that much. Since you focus on different areas, each one, each person has a different background and uh, and has been here for different number of years, and each person contributes their own opinion and it is somewhat different.

EV: And what is this focus group that you want to do?

GR: Basically to gather information that makes sense to every...

LS: For instance, we had specific questions on what do you mean by collaboration. We can't find a place where it is clearly defined. Um, there's different opinions and it is used in different ways, so if we could get a focus group to talk about, like, bringing it together and coming up with a particular idea, or key sets of definitions. or something like that.

EV: You do know that we have a program at NSF called INT, International Program Division. They are the supplement of our project so that it's sort of a collaboration. They have a researcher in another country and we pay for the travel so that they could work together, we'll do the the researchers in different countries. There are two other research projects that are being done that have an international component and that I think are very exciting. One is by Katharine Lewis, which she has studies in a series of grants, was what you called Japanese study lessons. Japanese teachers are expected every two to three years to teach a class in front of their peers and they ask their peers to evaluate them in terms of things like "how often do I call boys and girls?" "Do I have enough wait time"? "Do I explain questions clearly"? um "Does boys answer questions more than girls"? I mean research questions. They teach the class and they could have as many as hundreds of people sitting around. This has gotten . . . This is how Japanese developed lessons plans and to the Japanese, a lesson plan is a very sacred thing. They work at it. They hold it and then craft it. It's a teacher's job to implement it, but not to develop it. Unlike in this country, a teacher has to develop a lesson plan and have to figure out to make it work with a particular group of kids they have. So she studied this. There is an article that she wrote that is really great; "A lesson is like a swiftly flowing river" is the title of it. And Tia Fernandez who teaches at the college of Columbia. Got a grant to work in an American school and a Japanese language school in this country to see whether or not Americans can adapt and adopt this kind of professional development. And actually I am hoping to go on Tuesday to see this but I am going to have to work it in. It's a very powerful way for teachers who in this country who are isolated. Teachers really don't get to see another teacher teach. They rely have time to sit down and plan a lesson together. By three o'clock they are so tired that they want to leave. They really have time to work together with other teachers. So, this is . . . well they are doing this demonstration on Tuesday there's three hundred teachers from around the country coming in to see it. They are so interested in this. It is a cultural; it's a method in Japan that we might be able to learn to

adapt and adopts to represent our culture. Not in the same way of course, but we are studying not only a lesion, but how it was changed within the culture we have. There are important research kinds of issues. How, how as you study educational systems of our country, how do you learn to pull from those and use things that might be helpful within the culture of this country.

GR: So you are trying ... well the results don't come up right away ... but you can start observing ... but uh, you can't transfer the stuff that others do directly ...

EV: It would never work. They'd reject it. Its like heart transplant. It's got to fit. It's more than an international. I think personally that international studies give you a lens to look back at yourself and allow you perhaps to question some of your own practices in a way you might not. But you never just adopt it. Japan kids always bow down to their teachers. So, all right lets get kids getting up and bowing. But that bow is part of a whole cultural thing, so it might not be a bad thing to get kids to stand up and bow to their teachers. I mean when I was in school you stood up when the teacher walked into the room. That's is an American way that may actually make sense. Or the moment of silence before school, class begins so that we could focus our energy on it, maybe the equivalent. We forget sometimes we cultural ways of doing it and when you look at some place else you might begin to think of what we would do. I'll tell you a story when I teaching social studies high school kids once I was in Japan, my husband was there visiting, we discombobulate everything because he sat in the right chair. He didn't read the clues where he was suppose to sit. Everybody had there assign seats, so if he sat here, well that meant that this person had to sit here and they all had to jump around. So, we don't have anything like that in this country, we don't have assigned seats, that is silly. Well of course we do, but of course we do and if you really, if you are a teenager, and you really want to goof things up, sit in the drivers seat, well of course you can't do that, or even sit in the passengers seat. That's for the parents and the parents would probably thought that it was threat to their authority if you sat there with out asking.

GR: Actually in school, we have assigned seats. People you know sit in the same seat. People sit in their seat and it changes everything ...

EV: Yeah. Teachers sit in the front of the room. Why it doesn't have to be, they could tech in the back of the room. I mean there is no particular reason why, but we have our own way of doing things ... So what else can I tell you?

LS: Well that is all the questions for now.

GR: Thank you very much.

EV: Ok. You are welcomed. Good luck.

LS: Thank you.

F.2   U.S. Researcher Survey

Note: empty fields are not listed. "Undisclosed 1 and 2" are the two researchers that chose not to disclose their name. "Indirect 1–3" are replies from people who some U.S. researchers have forwarded our survey. Their names were not specified.

F.2.1   Dr. Yasmin Kafai

Organizations

Organization	Quadrant				Comments
	1	2	3	4	
ESPRIT	NA	4	4	NA	I know too little about ALL the programs sponsored by ESPRIT so it is very well conce ivable that they sponsor research in the other program areas as well.
Deutsche Forschungsgemeinschaft	NA	3	3	NA	same as above
Bundesministerium for Forschung und Bilding	NA	4	4	NA	same as above
Bertelsmann Stiftung	NA	NA	4	NA	Mostly technology-related efforts are sponsored by them.

Foreign Researchers

Name	E-mail	Comments
Volker Wulf	volker@uran.informatik.uni-bonn.de	for Germany – mostly computer science related efforts
Celia Hoyles	choyles@ioe.ac.uk	for UK for math education & technology

F.2.2   Dr. Joseph Krajcik

Organizations

Organization	Quadrant				Comments
	1	2	3	4	
Weizmann Institute of Science, Israel	NA	4	5	3	My guess is that the Weizmann also does research Quadrant 1 but this isn't my area of interest and I don't know colleagues in this area.
National Science Council, Taiwan	NA	4	5	2	My guess is that the Natianal Science Council my have interests in Quadrant 1 but this isn't my area of interest and I don't know colleagues in this area.
Technion, Haifa, Israel	NA	4	5	NA	Again, my associates do research primiarly in quadrants 2 and 3.
National Key Centre for School Science and Mathematics, Curtin University, Australia	NA	4	5	NA	

Foreign Researchers

Name	Tel.	E-mail	Comments
Richard Duschl		richard.duschl@kcl.ac.uk	Interested in collaboration
Jack Holbrook		icase@logos.cy.ne	A leader in ICASE
Uri Ganiel	992-8-9343894	uri.ganiel@weizmann.ac.il	Head, Department of science teaching at the Weizmann. Although not western Europe, he would be a could contact.

Activities

Fostering more interdisciplinary research between countries. This would take the form of providing seed grants for travel and small conferences. Funding also to provide more substained co llaboration would be of great value. For instance, I recently had two post-docutoral students from Israel. While in the US, we did some excellent work in quadrants 3 and 4. However, because of lack of funding we have not been able to continue are associations.

F.2.3   Dr. Leona Schauble

Organizations

Organization	Quadrant				Comments
	1	2	3	4	
EARLI	NA	5	4	5	This is the European variant of AERA.
Cognitive Development Society	1	4	1	1	Mostly concerned with "basic" cognitive development
Society for Research in Child Development	4	4	1	1	
National Association for Research in Science Teaching	NA	5	5	4	
National Council for Teachers of Mathematics	NA	5	5	5	

F.2.4   Dr. Judith Sowder

Organizations

Organization	Quadrant				Comments
	1	2	3	4	
Psychology of Mathematics Education	2	5	3	5	This international organization meets yearly at some site around the world. Researchers from all countries attend and report on their research. This is a very active organization with pro bably about 600 members. The names below are all from PME.

Foreign Researchers

Name	E-mail	Comments
Maria Bartolini Bussi, Univeristy of Modena, Italy	bartolini@unimo.it	Interested in sociocultural research as it relates to mathematics learning
Koeno Gravemeijer, Fredenthal Institute, Utrecht	k.gravemeijer@fi.ruu.nl	Interested in issues of learning and teaching mathematics
Angel Gutierrez, University of Valencia	angel.gutierrez@uv.es	Interested in Spatial learning and geometry
Barbara Jaworski, University of Oxford	barbara.jaworski@ edstud.ox.ac.uk	Interested in research on teaching
Ana Mesquita, Univ of Lille	ana.mesquita@lille.iufm.fr	Interested in the learning of geometry

Name	E-mail	Comments
Joao Pedro da Ponte, University of Lisbon	jponte@fc.ul.pt	Interested in teachers' professional knowledge
Lieven Verschaffel, University of Leuven	Lieven.verschaffel@ ped.kuleuven.ac.be	Interested in eye-tracking and in young chilren's learning of mathematics

Activities

Sponsor young researchers to attend PME; offer small grants for researchers to travel and work with researchers in other countries.

Comments

NOTE: Why do you seek names only from Eastern Europe? Mathematics education research is very stron g in Israel, Australia, Brazil, South Africa, Japan, to name but a few other countries.

F.2.5   Undisclosed 1

Organizations

Organization	Quadrant				Comments
	1	2	3	4	
University of the Air, Makuhari, Japan	NA	2	4	2	
Tsukuba University	NA	1	4	1	
All-Japan Science Teaching Association	NA	1	4	1	
Max Planck Institute	NA	4	4	NA	
German Youth Ministry	NA	2	2	2	

Foreign Researchers

Name	E-mail	Comments
Donata Elschenbroich		German Youth Ministry

Activities

Classroom teachers in Japan are very active in classroom research, and the partnerships between classroom teacher-researchers and university-based researchers show some fruitful models not often found in the US. Hearing about the nature of these partnerships and supports for them would be productive.

F.2.6 Undisclosed 2

Organizations

Organization	Quadrant				Comments
	1	2	3	4	
IEA	NA	5	5	5	I am only vaguely aware of the organization–although many of its publications–I know there are boards that oversee this type of research at NSF and NCES–but not sure of their names

Activities

Learn the names of more people doing research similar to RECSponsor an international meeting on research — that is non-TIMSS relatedBuild closer internet access to different programs in other countries

F.2.7 Indirect 1

Organizations

Organization	Quadrant				Comments
	1	2	3	4	
CERN	3	4	1	1	
Cognitive Science UK ESRC Center for Research in Development, Instruction and Training	5	4	2	2	
ACM	2	5	3	3	features work from intl. groups

F.2.8   Indirect 2

Organizations

Organization	Quadrant				Comments
	1	2	3	4	
ESERA (European Science Ed. Research Assoc?)	1	3	4	4	"European NARST"
EARLI	1	3	4	4	

Foreign Researchers

Name	Tel.	E-mail	Comments
Doris Jorde	011-47-22-85-41	doris.jorde@ils.uio.no	Oslo, Norway — a major collaborator with our project, well connected in Europe
Reindey Dint			Famous publication of bibliography of misconception research (a nice guy!)
Andree Tiberghien		andre.tiberghien@ univ_lyon2.fr	old-time french researcher in misconception-famous in France and Europe

Activities

Please fund explicit collaboration of our project with European researchers; fund their start-up projects that implement our work in their system, their language. We and they are ready for this now.

F.2.9   Indirect 3

Organization	Quadrant				Comments
	1	2	3	4	
European Science Education Research Association (ESERS)	1	2	5	3	
European Association for Research in Learning Instruction (EARLI)	1	3	5	3	
Cognitive Science	2	3	3	3	Europe in 2001

Foreign Researchers

Name	E-mail	Comments
Keith Stinning		Scotland

Appendix G

Social Exchange Theory and the Total Design Method

G.1   Social Exchange Theory

The Social Exchange Theory (**SXT**) states that any human interaction can be viewed as a social exchange. In order for that exchange to occur, for each individual's perceived costs must outweigh perceived benefits. Each person asks himself/herself two questions: "What's in it for me?" and "What can I lose if I say it?" SXT proposes that cost/benefit calculation happens automatically in the mind of each individual. If the cost is higher than the benefits, there is a high chance that the person will lie or will not participate in the interaction at all. If the benefits are high, the social exchange (e.g. interview or survey) will go smoothly.

G.2   Total Design Method

The Total Design Method (TDM) is a way to implement SXT by maximizing the perceived benefits, while minimizing the costs. It involves a continuous cycle of planning and mapping of every aspect of a given social exchange, identifying potential weaknesses through a series of pretests, and correcting any weaknesses that emerge during the pretests. The guidelines for the design process can be summarize in the acronym MICAP, which stands for:

- **M**ethod — the procedures that will be used for the SXT (e.g. primary and backup plans and criteria for deciding when to switch to backup plan).

- **I**nstrument — things that will be used to perform SXT (e.g. specific goals, schedules, questionnaires, pretests, etc)

- **C**ollection — Participants: Who? How many? How selected? (frame, sampling method, protocol of exchange, mechanics, timing).

- **A**nalysis — How will the collected data be analyzed?

- **P**resentation — In which way will the results be presented?

References

Arbib, M. A. (Ed.). (1995). *The Handbook of Brain Theory and Neural Networks.* Cambridge, MA: The MIT Press.

Berg, B. L. (1998). *Qualitative Research Methods for the Social Sciences.* Boston, MA: Allyn & Bacon.

Berliner, D. C., and Calfee, R. C. (Eds.). (1996). *Handbook of Educational Psychology.* New York: Simon & Schuster Macmillan.

Borko, H., and Putnan, R. T. (1996). Learning to Teach. In D. C. Berliner and R. C. Calfee (Eds.), *Handbook of Educational Psychology.* New York: Simon & Schuster Macmillan.

Bradford, H. F. (1986). *Chemical Neurobiology: An Introduction to Neurochemistry.* New York: W. H. Freeman and Company.

Churchland, P. S., and Sejnowski, T. J. (1992). *The Computational Brain.* Cambridge, MA: The MIT Press.

Derry, S., and Lesgold, A. (1996). Toward a Situated Social Practice Model for Instructional Design. In D. C. Berliner and R. C. Calfee (Eds.), *Handbook of Educational Psychology.* New York: Simon & Schuster Macmillan.

Dillman, D. A. (1978). *Mail and Telephone Surveys: The Total Design Method.* New York: John Wiley and Sons.

Education Funding Research Council (EFRC). (1996). *Guide to Federal Funding for Education* (Vol. 1). Arlington, VA.

Ehrlich, E. (1988). Business is Becoming a Substitute Teacher. *Business Week*(134-5, 19).

Encyclopedia Britannica, Inc. (Ed.). (2000, December 13). *Educational Psychology* [Online]. (Available at http://www.britannica.com/)

Eysenck, M. W. (1984). *A Handbook of Cognitive Psychology.* Hillsdale, NJ: Lawernce Erlbaum Associates, Publishers.

Glover, J. A., Ronning, R. R., and Bruning, R. H. (1990). *Cognitive Psychology for Teachers.* New York: Macmillan Publishing Company.

Graham, S., and Weiner, B. (1996). Theories and Principles of Motivation. In D. C. Berliner and R. C. Calfee (Eds.), *Handbook of Educational Psychology.* New York: Simon & Schuster Macmillan.

Green, A. (1997). *Education, Globalization and the Nation State.* New York: St. Martin's Press.

Green, M. F. (1997). *Transforming Higher Education: Views from Leaders Around the World.* Phoenix, AZ: Oryx Press.

Greeno, J. G., Collins, A. M., and Resnick, L. (1996). Cognition and Learning. In D. C. Berliner and R. C. Calfee (Eds.), *Handbook of Educational Psychology.* New York: Simon & Schuster Macmillan.

International Study Center at Boston College (ISC). (2000a, November 20). *International Study Center at Boston College* [Online]. (Available at http://www.timss.org/)

International Study Center at Boston College (ISC). (2000b, November 20). *TIMMS Homepage* [Online]. (Available at http://www.timss.com/TIMSS1/about_main.html)

Kandel, E. R., Schwartz, J. H., and Jessel, T. M. (Eds.). (1991). *Principles of Neural Science* (3 ed.). Norwalk, CT: Appleton & Lange.

Kearns, D. T., and Doyle, D. P. (1988). *Winning the Brain Race: A Bold Plan to Make Our Schools Competitive.* New York: Kampmann.

Kinnell, M. (1990). *The Learning Experiences of Overseas Students.* Bristol, PA: RHE and Open University Press.

Lindzey, G., and Aronson, E. (1968). *The Handbook of Social Psychology.* Reading, MA: Addison-Wesley Publishing Company.

Long, R. E. (1984). *American Education.* New York: The H. W. Wilson Company.

Long, R. E. (1991). *The State of U.S. Education.* New York: The H. W. Wilson Company.

Maynes, M. J. (1985). *Schooling in Western Europe.* New York: State University Of New York Press.

Microsoft. (1998). Psychology. In Microsoft (Ed.), *Encarta Encyclopedia* [CD-ROM]. Seattle, WA: Microsoft.

Microsoft (Ed.). (2000, December 13). *Educational Psychology* [Online]. (Available at http://encarta.msn.com/)

Mowrer, O. H. (1961). *Learning Theory and Behavior.* New York: John Wiley & Sons, Inc.

National Center for Education Statistics (NCES). (2000, November 20). *TIMMS-R: More About the Project* [Online]. (Available at http://nces.ed.gov/timss/timss-r/more.asp)

National Commision on Excellence in Education (NCEE). (1983). *A Nation at Risk: The Imperative for Education Reform.* Washington, DC.

National Science Board (NSB). (2000). *Science and Engineering Indicators 2000.* Arlington, VA.

National Science Foundation, Directorate for Education and Human Resources (EHR). (2000, November 30). *Ehr Home Page* [Online]. (Available at http://www.ehr.nsf.gov/)

National Science Foundation (NSF). (1996). *Research on Education, Policy and Practice (REPP) Program* (Tech. Rep. No. NSF 96-138). Washington, DC.

National Science Foundation (NSF). (2000). *Research on Learning and Education (ROLE) Program Announcement* (Tech. Rep. No. NSF 00-17). Washington, DC.

Paris, S. G., and Cunningham, A. E. (1996). Children Becoming Students. In D. C. Berliner and R. C. Calfee (Eds.), *Handbook of Educational Psychology.* New York: Simon & Schuster Macmillan.

Pechura, C. M., and Martin, J. B. (Eds.). (1991). *Mapping the Brain and its Functions.* Washington, DC: National Academy Press.

Phye, G. D. (1997). *Academic Learning: Perspectives, Theory, and Models.* Boston, MA: Academic Press.

Ravitch, D. (1995a). *Debating the Future of American Education: Do We Need National Standards and Assessments?* Washington, DC: The Brookings Institution.

Ravitch, D. (1995b). *National Standards in American Education.* Washington, DC: The Brookings Institution.

Robitaille, D. F., Beaton, A. E., and Plomp, T. (Eds.). (2000). *The Impact of TIMSS on the Teaching & Learning of Mathematics & Science.* Vancouver, Canada: Pacific Educational Press.

Shepherd, G. M. (1988). *Neurobiology* (2 ed.). New York: Oxford University Press.

Simpson, J. A., and Kenrick, D. T. (1997). *Evolutionary Social Psychology.* Mahwah, NJ: Lawremce Erlbaum Associates, Publishers.