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Establishing the Field of Science Education Policy: In Analysis of Math and Science Initiative in U.S.

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ABSTRACT *This study analyzes the new science education policy, Mathematics and Science Initiative, which was released in the United State in 2003. The purpose of this study was to better understand how this new science education policy has been developed under social and historical context, to investigate how different actors and stakeholders have established the field of science education policy when they position themselves in relation to other actors through the "relational network," and to examine how the new policy treats disadvantaged marginalized students to position themselves in establishing the science education field and roles of the actors within the field. Data analysis employed a method of discourse analysis for examining the multiple ideas and intentions, which emerged from different actors involved in shaping the educational policy. Findings revealed that the players' position in the field of science education policy was intimately related to the other players' positions in other fields of education, state, and educational corporations, and shaping relational networks. The policy makers situated themselves as major players in the field of educational policy in empowering the policy. Their positions were found as reflecting the relative positions of the power inside and outside of the broader field of educational policy, highlighting the power relations between different actors and fields, making a rough ranking and hierarchies. Despite an advocate to improve the conditions of education for disadvantaged students as a persuasive means, the policy did not suggest how to solve the deep-rooted problems, which are intimately related to the social structure of race and class. Due to less consideration of the complex nature of race and class in the new school reform, the endemic reproduction of failure in boosting students' scientific literacy is likely to be repetitive.*

KEY WORDS: *science education policy, relational network, discourse analysis*

Introduction

In recent decades, nation-wide efforts have put on improving the quality of science education that would take critical roles to prepare for students' competency in global competition (American Association for the Advancement of Science [AAAS], 1993; Kennedy, 1998; National Research Council [NRC], 1996, 2000; Rutherford, 1998). According to national and international research (National Center for Education Statistics [NCES], 2001), however, most Americans turned out to not be adequately scientifically literate for full participation as productive citizens in the 21st century. Given the large concern about discouraging results, the federal government decided to launch a new five-year *Mathematics and Science Initiative* (U.S. Department of Education, 2003a) to revamp students' science and mathematics achievement.

This study analyzes the new science education policy, the *Mathematics and Science Initiative.* The purpose of this study is to better understand how this science education policy in the U.S. has been developed under social and historical context, to investigate how different actors and stakeholders have established the field of science education policy when they position themselves in relation to other actors through the relational network and in response to the new reform policy enactment, and to examine how the new policy considers and treats disadvantaged marginalized students to position themselves in establishing the science education field and roles of the actors within the field.

Identifying the Policy: Math and Science Initiative in 2003

The U.S. Department of Education (2003a, 2003b) has recently developed a new policy, the Mathematics and Science Initiative, which has the goal of improving students' mathematics and science achievement through reforming mathematics and science education. The aim of the proposal was to launch a major five-year Mathematics and Science Initiative. This new policy has an intimate relation to the No Child Left Behind (NCLB) legislation that contains four basic education reform principles: stronger accountability for results, increased flexibility and local control, expanded options for parents, and an emphasis on teaching methods. Based on these NCLB principles, this new policy establishes more detailed plans that are proclaimed especially for mathematics and science education.

This new policy focuses particularly on three major goals: (1) conducting a broad-based public engagement campaign, (2) initiating a major campaign to recruit, prepare, train, and retain teachers, and (3) developing a major academic research base.

First, the policy aims for conducting a broad-based public engagement campaign that draws attention to the need for better mathematics and science education in our nation's schools (U.S. Department of Education, 2003a, 2003b). The policy asks the public to engage in the enactment process. For instance, according to the policy, parents, students, and the public are asked to fulfill each of their responsibilities. Parents are responsible in that they should know what their children should learn in preparation for their academic success in a future world requiring more knowledge of mathematics and science. Students are responsible to understand the importance of the knowledge and acquire the essential knowledge and understanding for their future career. Finally, the public is responsible to realize that it is important for all students to know more advanced mathematics and science, in combination with technology, to acquire the competitive power in the global economy.

Moreover, the initiative emphasizes that we also need to closer work with each other in various areas. For instance, the professional organizations of scientists, mathematicians, engineers, educators, and researchers are asked to do several important things. They are: (a) define the important scientific and mathematic concepts that all students must master, (b) organize exciting events that help students build scientific and mathematical experience, and (c) connect science and mathematics professionals with schools to intimately work with students and teachers either at schools or at the scientific job site. The business community, federal departments, and policy makers are also asked to collaborate together to meet and strengthen the state standards in mathematics and science.

Next, the policy aims for initiating a major campaign to recruit, prepare, train, and retain teachers with strong backgrounds in mathematics and science (U.S. Department of Education, 2003). For instance, since strong science content knowledge of teachers are believed to ensure the success in student academic achievement in science, the policy has a goal for increasing the number of new teachers with strong content backgrounds in science by having a campaign with universities, teacher training programs, school districts, and states, as well as promoting alternative routes to recruit and retain highly qualified teachers.

Third, the policy also aims for developing a major academic research base to improve our knowledge of what boosts student learning in mathematics and science in the classroom (U.S. Department of Education, 2003a). Scientifically based research needs to specify what teaching and learning strategies are effective in improving student achievement in mathematics and science. Researchers are recommended to provide teachers with a better understanding of student learning in mathematics and science, explanation of successful classroom interventions, and development of valid and reliable assessment tools to measure students' academic progress.

Given the policy designed to improve mathematics and science education, this study focuses particularly on science education fields to discuss its social and historical context as well as the impacts on shaping the main actors within the field and remaining particular group of disadvantaged students.

Analytic Framework

This paper employs the concept of the social "field" as an analytic framework. The concept of a field, suggested by Ladwig (1994), is extensively applied in this policy analysis in order to better understand how the various actors position themselves in making social relationships and connections to other actors. This framework is also useful to delineate multiple dialogues between different actors in various fields in enacting the new reform policy, the Math and Science Initiative.

Ladwig (1994) argues that in order to think of social actions within the arena of educational policy, the actions of players can be described within a field. The field can be a place that human actions take place "relationally." He argues:

> *"A field is seen as a micro-social structure made up of the objective relations among its players. These relations can be taken to be objective to the extent that they are inter-subjectively recognized; that is, they are taken as objective but the players within the field and acted upon in the everyday struggles of the field." (p. 344).*

Ladwig also defines a field as a "relational network configured by the multiple interactions between the actors" (e.g., Bourdieu, 1973; Ladwig, 1994). On one hand, the relations can be harmonious and collaborative through sharing intimacy among its players. On the other hand, however, the social field is also likely to have contradictions and competitions between the various perspectives and environments encountered among the actors. For example, in the sports field there are competitions between the rival teams. In the biological field, given the limiting natural resources, there are also Darwinian competitions to survive.

In the different social fields, it is noteworthy that there are conflicts, debates, and power relationships between different actors and various fields, such as the field of education, federal government, and educational policy. As Ladwig (1994) points out, there is possible autonomy in the field of educational policy in relation to the field of education. Thus, it is possible to assume that some players in the field of science education policy have more power than others in another field, such as K-12 schools and universities for improving science education. Interactions among the various fields tend to reveal hierarchical relationships.

This policy analysis attempts to make use of the concept of the field to analyze an individual actor's action and position postulated in the policy document. Through the individual actor's social relations and interactions to others, as Ladwig argues, individual groups of actors also reveal idiosyncratic dispositions to determine their social actions and shape their own inclinations toward a particular science educational policy. It is likely to happen, as opposed to social structure shaped by imposing figures. This paper identifies the various fields established in the *Math and Science Initiative (2003)*, and examines individual's social reactions to the policy enactment in making relational networks with other actors in the process of developing and enacting the particular policy of science education.

Method

This policy study was based on discourse analysis (e.g., Gee, 1990; Lemke, 1998) on a new science education policy document, the *Math and Science Initiative*, released in 2003. The analysis was designed to extensively examine the multiple policy documents released from the two summit meetings held on February 6, and March 13, 2003.

Discourse analysis was used to study the multiple ideas and intentions that emerged from different actors involved in shaping the educational policy (e.g., Sydney, 2002). The analysis began by acknowledging the socially constructed nature of problems and the presence of multiple realities in the field of science education (Annette, 1998; Sydney, 2002). To examine dimensions of power relations in various actors and participants in the process of policy development and initial enactment, the actors' uses of linguistic resources of a key policy documents were examined.

The data for this study included their verbal communication (i.e., remarks, presentations, summits, etc.) and written documents (summit proceedings, policy goals statements, policy planning documents, policy concept paper, etc.). These data were examined to see how the multiple actors were involved with reproducing and sustaining particular ideas to position themselves and determine other actors through the policy enactment process and interactions among each other. Their discourses were explored in relation to connecting micro-aspects of language use, such as lexis, with the social construction of knowledge, which were affected through their interaction with multiple science education policy actors. In part, this analysis aimed for revealing dimensions of power in education politics, and it identifies specific points of conflict and consensus across various interest groups (Croucher, 1997).

The data analysis focused on answering research questions of how the new policy in the U.S. has been developed under social/historical context, how different actors establish the science education policy fields when they position themselves in relation to other actors, and how the policy considers and treats disadvantaged students to position themselves in establishing the field.

First, the historical and contextual factors, which acted to guide the new policy, were examined through Secretary Rod Paige's remarks at summits. The Secretary's address, which debriefs the historical and social circumstances behind the policy, were useful to grasp the contextual factors since he apparently addressed the issue of the relationship between the historical impact on the development of the policy and the current work being investigated. Furthermore, historical documents, including curriculum materials and other relevant writings about the history of science education on developing science education policies in U.S. since World War II, were also used to analyze the historical and contextual influences on the development of the new policy in 2003.

Next, the actors' various ways of establishing the science education fields in enacting the policy were identified through summit proceedings presented by the policy advisory committee members, including Tom Loveless, John Marburger, Grover Whitehurst, Craig Barrett and Deborah Ball. These documents were useful because the members addressed the significant actors in the process of empowering the policy. Based on the analysis of the presentations, the multiple interactions among the various actors were analyzed in depth, and the various fields on which the actors acted were also examined in ways in which they make relational networks with different actors.

Third, the ways of considering disadvantaged students were examined through the policy goal statements and policy proceedings addressed by Secretary Rod Paige and Loveless. These presentations were useful to analyze their intentions of mentioning the disadvantaged because these documents contain the discussion of how the new science education initiative attempt to help the marginalized underclass students achieve successful science achievement.

Findings

Historical and Social Context in the Development of the Policy

After World War II, debate about the quality of the United States education escalated. John Dewey's ideas and the rhetoric of progressive education in the early 1900s were attacked for being anti-intellectual and emphasizing too many easy fundamentals, back to basics (Bestor, 1953). Many people called for reforms in science education to restore a quality of science learning that considered the way to achieve the intellectual rigor, excluding most of the social and technological applications from the science courses and focusing instead on the organized disciplines themselves (DeBoer, 1991).

After Sputnik was launched in 1957, the U.S. public was alarmed at the fact that their students were getting behind in the global competency in science education (Freundlich, 1998). Sputnik provided a turning point to resolve the debate about how the waned students' academic performance could be improved, putting greater emphasis on higher academic standards, especially in science and mathematics. Nationwide reform efforts in education initiated by the federal government were shortly followed in curricular development in the 1960s and the 1970s, focusing mainly on what was being taught and how, rather than who was being taught (Rutherford, 1998). It is noteworthy that to drastically improve science education, the federal government has been centrally managing and controlling all the development of educational reform policies, especially in mathematics and science. This particular enactment of the reforms focused extensively on developing the curriculum materials.

Many new curriculum projects were developed and accomplished through the close collaboration of teachers and scientists, aiming for revamping the quality of science education and supporting students' science learning with good curriculum materials with a high level of science content and disciplinary knowledge. For instance, the National Science Foundation (NSF) course development projects created exemplary science learning and curriculum resources, such as Biological Science Curriculum Study, Physical Science Study Committee, Chem Study, Elementary Science Study, and Science Curriculum Improvement Study.

During the 1990s, reform movements made obvious differences from the ones in 1960s and 1970s, even if the reforms across the periods generally aimed to improve students' academic achievement for being scientifically competent citizens in the future. For instance, science education reformers in the 1990s reintroduced the connections between the organized scientific content and their practical applications that had been part of the curriculum throughout the first half of the 20th century, but were removed during the reforms of the 1960s (Bybee & DeBoer, 1994; DeBoer, 1991).

Good indicators to show the changes in reform efforts can be found in several documents, such as Project 2061's Science for all Americans (AAAS, 1989), Scope, sequence, and coordination of secondary school science (National Science Teachers Association, 1992), and National science education to have standards (NRC, 1996). Throughout the national level, there have been multiple efforts to have a high national level of high standards. Some examples are Science for All Americans (Rutherford & Ahlgren, 1990) and Benchmarks for Science Literacy (AAAS, 1993). These were developed to achieve the national goal of scientific literacy. The National Science Education Standards (NRC, 1996) were also designed and disseminated throughout the U.S. Those standards are premised on a conviction that all students deserve and must have the opportunity to become scientifically literate, organizing the scientific content and disciplines around the main conceptual theme along with the consideration of students' developing practical applicability (NRC, 1996).

In spite of these strenuous efforts to revamp science education, there was still a concern that most Americans are not adequately scientifically literate for full participation as productive citizens in the 21st Century by preparing their future jobs in mathematics, science, technology, and engineering. For instance, according to the National Assessment of Educational Progress (NAEP), only approximately 20 percent of U.S. twelfth graders meet the National Governing Board's definition of proficiency in science (NCES, 2001).

Furthermore, student achievement scores often fell below international standards, implying that their knowledge and understanding did not meet the levels needed for being competent in the global economic markets. For example, the Third International Mathematics and Science Study (TIMSS) results for mathematics and science reveal another concern about U.S. students' academic performance. The performance of U.S. students is not competent compared to their counterparts in the other countries. The relative standing of the U.S. declined from fourth to twelfth grade. By the end of secondary school, the U.S. out-performed only two other countries, Cyprus and South Africa (NCES, 2001).

The historical context to come up with science education policies, since World War II, was based on the "pendulum" movement, which kept swing between teaching for students' practical ability to link their individual knowledge into the real world experience and teaching for high level of the organized scientific disciplines themselves. The historical pendulum over debates in science education has swung across the period from the early 1900s through the late 1990s. The movement, though, significantly varied depending upon what the public believed was most valuable as a goal in science education, along with the actors and agencies.

Given the historical context, which influenced the development of the various science education policies in U.S., the major social context can be identified as the public's aspiration for developing reform policies to be able to reach the overarching science educational goal to improve students' scientific literacy. The policies were particularly bound up with strong societal demands and needs to enhance the global competency in science compared to other countries. These demands for preparing highly competent future citizens in science have been a major force to create educational policies and curriculum policies since the 1960s. The needs and demands were enacted as the social context to shape and frame the multiple reform policies in science education. Nevertheless, the question in implementing the overarching goal in science education remained: how and who could make it "drastically" happen?

The major force to take a lead of the development and enactment of the reform movement was the federal government and the U.S. Department of Education as major actors in the implementation, as well as the authors in the stage of developing and proposing the policies with specific ideas. Those two agencies have proposed various science education reforms under the urgency that there is a crucial necessity to develop effective plans and strategies (e.g., curriculum policies, higher level of content standards, etc.). In 2003, the agencies proposed another science education policy reform entitled the Mathematics and Science Initiative, which re-emphasizes the overarching goal of reaching scientific literacy for *all* Americans, and seems to attempt to resolve unsolved problems in science education over many years. In the next section, this paper examines how the new policy establishes the particular field in science education by positioning themselves in reaction to other actors and interest groups.

Establishing the Field of Science Education Policy in Positioning Various Players

A. Recognition of the Primary Author in the Policy

The Math and Science Initiative documents allow us to look into the field of science education policy. In discussing the field, this article first examines how the authors the policy position themselves in the policy. The primary actors revealed in this policy enactment are agencies in the U.S. Department of Education. A representative of the authors is Secretary Rod Paige (e.g., the Department of Education, 2003a). Looking at the Secretary's stance laid out in the Initiative, we can see that the Secretary takes a major lead in the policy development and enactment, not only suggesting three main goals of the policy, but also indicating himself as being a major policy maker. For example, the Secretary addresses in his opening statement in the Summit:

> *"We will gather again to continue the process of implementing the goals of this Initiative. I have designed a team at the Department of Education – led by Dr. Susan Sclafani – to focus solely on this. And, we need the best minds helping us as we develop the action plan to achieve our three goals. … I urge you to fill out the form in your packets or contact Susan or any member of our team directly. The President and I want your help. … So I thank each of you for coming to this Summit. … And I look forward to working with you in the months ahead, as we work to make our nation's schools places of high expectations and places of high achievement.*
>
> *We must give our mathematics and science teacher better tools to teach. Which lead me to the third and final aim of this initiative. We must build strong research about how children learn mathematics and science, and use it to strengthen classroom instruction (Secretary's remarks at Summit, 2003)*

From these statements, the Secretary unfolds two things. First, the policy makers in the Initiative have an important mission to improve the quality of U.S. mathematics and science education for both teachers and students. Second, the Secretary defines themselves, the policy makers and agencies, as significant figures in the important mission, since they position themselves as major initiators and leaders by objectifying themselves in the documents compared to other people, such as parents, teachers, and students.

As Ladwig (1994) argues, though, it is possible to assume that the players' position in the field of educational policy is intimately related to the other players' position both within the field of educational policy and between other fields, such as state and education. In our consideration of the relational network between the players, therefore, the Secretary makes apparent distinctions between themselves as primary policy makers (providers) and other ordinary people (consumers or clients), such as teachers and parents. Since, he often uses a lot of "We" in the Summit, it implies that other policy makers and federal government agencies are included in the same community, making separation of themselves from the other people and clients. In doing so, the policy outlines a unique realm as opposed to other ordinary people. By establishing the dichotomy between provider and consumer, this policy document itself sets up the boundary between the two separate fields: the field of educational policy and the field of education.

The authors in the U.S. Department of Education situate themselves as major players and actors in the field of educational policy, particularly by empowering the policy acts for the clients, such as parents, teachers, and students in local schools. In this regard, we can see that there are power relations between different players or actors among the different fields. Some players in a certain field, such as the authors in the Department of Education exhibit more power than other players. For instance, this policy document postulates that the federal administration launches the initiative to improve mathematics and science achievement, focused on the three goals discussed above. Based on their proposals and master plans addressed, the document then cordially requests other consumers to agree on and then follow the established goals and action plans, as described in their description of the Initiative (2003b):

> *We need to conduct a broad-based "public engagement campaign" that draws attentions to the need for better mathematics and science education in our nation's schools. (U.S. Department of Education, 2003b)*

The dichotomy outlined by the authors in the field of educational policy can be understood as strategies by which players defend or advance their dominant positions over other actors. Given the nature of the power relationship in this policy document, the other potential actors' ways of positioning themselves in the field and responding to the policy are discussed in the next section.

B. Potential Players in Relational Networks

This section examines how this policy defines and distinguishes the other players in the different fields and discusses to whom this Initiative is addressed. The identified potential players in the document were other influential policy makers, state or federal government, clients, such as teachers, parents, and students, and the educational corporate. The ways of positioning these players are discussed (See Figure 1).

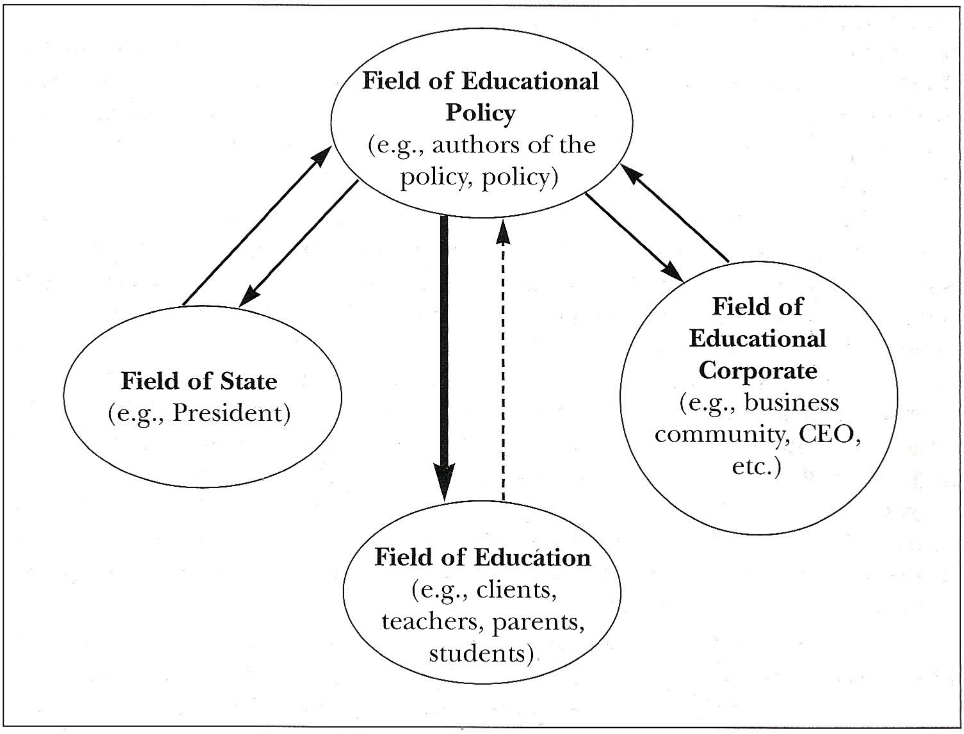

Figure1. Framing the Fields of Science Education Policy

Besides the primary author in the policy, other policy makers framing the detailed enactment plans are identified in the document. In shaping the field of science education policy, it is noticeable that based on the goal statement the Secretary Rod Paige initiated, he influences on what actually happens in schools by guiding all of the policy actions and promulgations along with other policy makers and advisory committee. Under the guideline and initiation led by the Secretary, the policy document acknowledges several other policy makers as main players, such as John Marburger, Science Advisor to the President, Tom Loveless in Brookings Institution, and Craig Barrett, the CEO of the Intel Corporation. Based on their presentations and talks at the Summit, the documents address that they make a good harmony and collaborations among the policy makers within the field. For instance, in the presentations, all of them expressed that their ideas are aligned with the Secretary's three goals: engaging the public, training high quality teachers, and developing an academic research base.

The next player identified in the policy is the federal government. In the opening statement, the Secretary acknowledges his intimate interactions with the federal government, indicating another field, a field of state. The main actor in the field of state documents is President George Bush, who has impacted this policy enactment. The documents show the strong view the President held on the new policy. For instance, the Secretary mentioned that the President rallied a bipartisan consensus in Congress to pass the No Child Left Behind (NCLB) Act of 2001. Based upon the President's call, the policy explicitly expresses that this new policy continuously attempts to be part of the main components of the NCLB: stronger accountability for results, increased flexibility and local control, expanded options for parents, and an emphasis on teaching methods. The Secretary added, this policy "would follow the governmental decision and hopeful vision on the educational improvement." Thus, we consider that the players in the both fields of educational policy and federal government are interlinked in harmonious and agreed stances. In developing this particular policy, the perspectives and opinions of a field of state seem to be especially influential as the Secretary addressed above.

With respect to the field of educational policy, which consists of policy makers, Ladwig (1994) argues that the positions of different policy makers may have as much to do with the strategic struggles and debates among other policy makers themselves within the field, as it does with any specific player's influence on what should be considered in the particular policy enactment. Especially among policy makers, they might have taken difficulties, debates, struggles, and competitions among other players in the process of tuning up the policy. However, there is no clear evidence about their inner relationships drawn in these documents released for the public audience. Ladwig (1994) also discussed this situation, pinpointing that it is hard to get real evidence to see the debates and competitions between the policy makers in the policy enactment process. Even, if there might be some struggles or conflicts among policy players, it is unlikely that people in a field of educational policy would release the real process to advance, protect, or defend their positions within the field to others.

It is crucial to consider "to whom the science education policy is addressed." As the Math and Science Initiative stresses, the primary target audiences are teachers, parents, and students. At the same time, though, these people are also expected to act as significant players in the policy enactment, delineating another important field, the field of education.

In the field of education, these groups or individuals significantly influence the enactment of the policy. The policy expresses expectations to each of those groups and players, such as teachers, parents, students, school officials, and the public. All of them are viewed to take significant roles in successfully implementing the policy. For instance, regarding teacher involvement, one of the three goals of the policy is to activate the extensive campaign planned to recruit, prepare, train, and retain high quality teachers who have strong content knowledge in math and science. The individual teachers are recommended to be actively involved in professional development programs to boost student achievement. The policy's view of teacher involvement suggests that the teachers are the fundamental force to facilitate the enactment process. For parents, the policy explicates that it is their responsibility that they must know what children should study for their future success by acquiring a greater knowledge of science and mathematics. For students, they are considered as central actors who actively take the benefits of careers in mathematics and science. The public also needs to be aware of the necessity for the students to get the competitive ability in the global economy. Thus, the documents frame the field of education, considering teachers, parents, students, and the public as significant players, not only as consumers or clients, but also as critical players in the process of enactment of the policy.

Finally, there is another field of the educational corporate. The policy defines another important player, creating another crucial realm focusing on economic rationales. The field of the educational corporate is mostly consisted of the business community. The new policy defines the players in this field as being concerned about continued growth and prosperity in national economy. For example, Craig Barrett, CEO of Intel, addresses:

> *Comparable investment is also needed if we are going to get the comparable desired results. Yes, we are experiencing hard times in the economy but we simply cannot afford the luxury of doing little or nothing... This cannot be achieved through NSF grant alone... Industry is ready and willing to help – as long we don't approach this as "business as usual." (U.S. Department of Education, 2003a)*

From this statement, we can see that there is a clear recognition of the primacy of economic rationales. For them, the primary purpose of schooling seems to be to prepare future productive citizens who contribute to the national economy by having competent ability in science and mathematics (Labaree, 1997). As Barrett argues, the business field cannot be separated from the field of education and of educational policy. All of the fields are interconnected in ways that each field influences others and also is influenced by others.

In particular, given the various fields and relationships in framing the field of education policy, we also have another interesting finding uncovered. The idea of the "relational network" emerges in the relative interactions among the different players among the various fields. The relational network was configured within the field, by the multiple interactions between the actors. Social and human actions within the area of educational policy take place "relationally" (Bourdieu, 1973; Ladwig, 1994). That is, the relational network influences the establishment of the field of educational policy.

An interesting finding was that the relations and networks between the players are mainly determined by how the policy makers position themselves in ways of defending or advancing in response to other potential players in the different fields. Their positions in educational policy may be seen as reflecting the relative positions of the power inside and outside of the broader field of educational policy. The Initiative strongly emphasized the importance of the roles and responsibilities of the other actors such as parents, teachers, companies, and the public. However, the policy documents were unlikely to view those players in the field of education and of the educational corporate as dominant players among other fields. Rather, they suggest that the role of the policy makers in the federal government is visibly dominant in positioning themselves as main leaders and initiators of the policy enactment.

The policy makers, as main actors, position themselves as taking a main lead to accomplish the desired goal in the policy through holding the administrative and executive power over the other players. The rationale of contriving power is based on the social demands and needs to rescue the Nation Still At Risk and revamp the weakness of U.S. education (A Nation at Risk, 1998). For instance, the Secretary's remarks at the Summit remind the audience of the facts that U.S. students are less prepared for their mathematical and scientific literacy compared to their counterparts throughout the rest of the world. The Initiative document includes statistical reports: 83 percent of 12th graders are not proficient in mathematics and 82 percent of 12th graders are not proficient in science. Based on these reports, the policy makers advocate the mission to rescue the Nation at Risk by persuading the audience that the new policy is crucial and they need the administrative power to enact the mission. In the Initiative documents, the governmental power certainly seems to the audience to be an effective way of breaking through the difficult educational problems.

With respect to Ladwig (1994)'s argument, this way of justifying their relative autonomy can be interpreted as governmental efforts to gain and hold more power over other players in the fields. On one hand, the power relations dominated by policy makers may promise the effectiveness of enacting the Mathematics and Science Initiative through establishing more central control from the beginning of the policy. On the other hand, however, the players in the field of educational policy seem to get the most advantage, since a rough ranking and hierarchies are generated between the fields and between the different players.

Making Use of the Disadvantaged to Position Themselves

The Initiative describes a call to improve the conditions of science education for children who are economically disadvantaged, racial minorities, women, cultural minorities, and the handicapped. In the documents, the policy illuminates how the policy makers considered the disadvantaged and minority students to enhance their math and science achievement scores.

For instance, the Initiative first brought up the evidence that there had been the lack of progress in computation skills particularly in African-American students that could be regarded as an important indicator for mathematical and scientific literacy. The black-white achievement gap expanded in every computation skill area in the 1990s, including all the sub-clusters, such as addition, subtraction, multiplication, division, whole numbers, fractions, percentages, decimals, and percentages. The gaps occur from age seven to seventeen.

In establishing this science education policy, the policy attributes the reason why the gap has been augmented between the two racial groups solely to the lack of basic skills in math and science education. In arguing that basic skills are crucial to advance in math and science, they assert that basic skills would also serve equity. The Initiative develops an argument to persuade the audience and the public that the new policy could help minority students enhance their achievement scores by increasing these basic skills.

The Initiative explains that the gap between white and colored students occurred, because of colored students' lack of the basic skills. Ironically, though, the proposal of providing the basic skills as a solution of reducing the academic achievement gap is totally contradictory to the math and science policies established earlier in the 1960s and 1970s. After the Sputnik launch, the whole U.S. mathematics and science education policies tried to revamp the low quality education by requiring K-12 students to gain a high level of standards and content. At that time, the policies advocated that focusing on teaching basic skills to students would ruin students' academic ability. Rather, they insisted that gaining high-level knowledge and skills in math and science would be a powerful way to prepare them to be future citizens with academic competency. As for now, the new policy emphasizes the critical importance of basic skills again, reminding us of the "pendulum" shift in social and historical context.

As Lipman (1998) argued, there is an endemic problem in addressing the issue of marginalized class in the proposal of emerging educational policies. While the Math and Science Initiative speaks up to boost the marginalized students' achievement, the policy does not seem to consider solving the deep-rooted problems of the issue, which is related to the social structure of race and class. Rather, the policy suggests that we need to enhance the quality of science education for the particular class of students as well without elaborating the idea to improve the situation. The initiative does not address how the complex nature of race and class can be viewed in the new school reform. Without clearly articulating the complexity in the policy, O'Connor (1999) and Lipman (1998) argued that it is less likely to change and improve the current structure and problems of race and class due to multiple contradictions in societal problems, such as unemployment, growing impoverishment, lack of adequate health care and housing, etc. Given the complexity and difficulties in helping the minority groups of the students enhance their achievement score, the policy makers do not propose how the new policy can be supportive in making systemic consideration of restructuring and tremendous efforts to overcome the inherent factors and constraints (Stanton-Salazar & Dornbusch, 1995), going beyond simply suggesting that inclusion of basic skilled content would be a possible solution on that issue.

Thus, on the basis of the policy's ways of approaching to the problems on disadvantaged and minority students' low achievement, the policy seems to consider the issue of the disadvantaged students on the surface, and gain the audience's supports and laudatory remarks on the newly initiated policy. Yet, it does not seem promising to have the actual success in improving the education of marginalized students because of the lack of the layout of detailed plans of resolving the fundamental problems (Alexander, Entwisle, & Bedinger, 1994; Ogbu, 1990). In spite of the policy statement, therefore, the minority, underclass, and colored students would be less likely to get advantaged. Rather, it would more likely that we face the endemic reproduction and repetition of school failure in helping the disadvantaged students.

Conclusions and Educational Implications

This science education policy study employs the concept of a social "field" to analyze the relative actions of players within a field outlined in the Mathematics and Science Initiative. The primary actors are agencies in the U.S. Department of Education. The players' position in the field of educational policy is intimately related to the other players' position in other fields of education, state, and the educational corporate. They make relational networks through their interactions in a field. The policy makers situate themselves as major players in the field of educational policy in empowering the policy acts for the clients, such as parents, teachers, and students.

This article highlights that there are power relations between different actors among the various fields in the enactment of the policy. There are rough rankings and hierarchies between the fields and between the different players. The relations between the players are mainly determined by how the policy makers position themselves in ways of defending or advancing in response to other potential players in the different fields. The process of justifying their relative autonomy or dominant power can be interpreted as governmental efforts to gain and hold more power over other players in other fields. Their positions in educational policy were found as reflecting the relative positions of the power inside and outside of the broader field of educational policy.

This paper also describes that this new policy advocates a call to improve the conditions of education for disadvantaged students. However, the proposal did not suggest solving the deep-rooted problems, which is related to the social structure of race and class (O'Conner, 1999; Ladwig, 1994). Since the Initiative did not consider the complex nature of race and class in the new school reform, it does not seem to carefully consider the marginalized students for the improvement of their achievement. Rather, the endemic reproduction of failure would likely be repetitive (e.g., Alexander, Entwisle, & Bedinger, 1994; Ogbu, 1990).

The study contributes to our understanding of the ways that the different actors seek to position themselves in the field in response to the new science educational policy. The players in the fields are all intimately related to another through relational networks in making multiple interactions in a field. The analysis in this study reveals that even at the inception of the policy enactment, there are immense responsibilities that the policy makers need to initiate and facilitate for the effective enactment of the particular policy. This study especially highlights the central role of the policy makers as a determinant on the success of the policy. Depending upon how they position themselves, the influence would be immense on school systems.

When the policy makers, as main actors, situate themselves as being authoritative figures imposing structure on the public setting, dichotomize their roles and positions in relationship with other actors, and persuade the public to accept the new policy onto the extant ones, our concern is that it would be less likely to accomplish effective enactment of the policy through active interaction with the practitioners' involvement and participation in the education field for several reasons. First, it is critical for the policy makers in science education to deeply consider fundamental aspects of societal problems rooted in the educational issues, such as low academic achievement, rather than rhetorically speaking up those issues as the means to allure the audience to conceive the new policy as the panacea to cure all of the problems in science education. Second, it is also important to consider practitioners' perspectives in developing new policy on the actual practice in the education field. Considering that the practitioners, including parents and teachers, are the core people enacting the proposed policy, it is imperative for the policy makers to seriously consider what the practitioners can and can not do, what they think about the new policy idea, and how they could practice in a given context, condition, and constraints. As Cohen and Hill (1998) and McLaughlin (1987) argue, individual implementers tend not to respond as anticipated. It is hard to make something happen primarily because policymakers cannot mandate what matters to individual consumers at the local level.

Given the fact that this policy has been just launched as an Initiative, the following research is needed to examine the impact of the policy on students' science achievement later on, and to investigate the influence on the marginalized and minority students. Furthermore, it especially draws our attention to the need to better understand the nature of underclass students' difficulties and problems in their science learning, and the ways in which we can support the disadvantaged students, so that future science education policy makers can have the opportunity to develop better systems and policy needed for improvement of students' successful scientific literacy. We need to be aware that policy implementation problems are too complicated to solve. Rather, they usually evolve in a multistage, iterative process. Given the challenges we face, we need to make our efforts to have science education policy localized and specialized to context, and consider individual practitioners' capacity and will, in response to the suggested science education policy, aim for students' successful scientific literacy as competent future citizens. This position premises on a socially constructed educational policy. Science educational policy is not only a means for improving the delivery of educational services in the educational systems, but also that it plays a significant role in shaping how we perceive social and educational problems, and how social power and resources get established and distributed.

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