

EDITORIAL

Regina Panasuk

In this sixteenth issue of the Colloquium Journal I am very pleased to introduce our new authors from each of the Graduate School of Education programs, Leadership and Schooling, Language Arts and Literacy, and Mathematics and Science Education.

Laura Chesson, UML Leadership and Schooling Program, has conducted a research study on the nature of teacher leadership in one of the Boston Pilot Schools, Boston Arts Academy. Initiated in 1995, the pilot school model gives school communities autonomy over curriculum, staffing, budget, and other significant matters, and has been shown to be successful at closing the achievement gap that exists in urban areas between the students of upper and lower socio-economic backgrounds. Using a mixed methods design, Laura examined the nature of the choices that Boston Arts Academy had made that assisted its community in developing and nurturing teacher leadership. Examination and analysis of data demonstrated that the Boston Arts Academy staff reported a higher level of the characteristics of schools in which teacher leadership flourishes. The data also suggested that structural choices that the school had made, such as the creation of teacher-led curriculum and grade-level teams, team-taught writing courses, professional development partners, school opening professional development workshops, and a clearly articulated hiring process made significant contributions to the ability of this school to implement and nurture teacher leadership.

Michael Doherty, UML Mathematics and Science Education program, investigated and reported on the effect on daily reflective journaling on gains in conceptual understanding for high school students studying Newtonian mechanics. Newton's laws of motion, a central topic of introductory physics courses, are understood through the concept of force. Many students enter into a study of Newton's laws with an existing understanding of force that derived through the use of common sense. The commonly held and frequently scientifically inaccurate beliefs are the result of students' personal observations and intuitive thought processes. These understandings do not align with the Newtonian concept of force, can interact with the instruction, and are likely to modify the intended learning outcome. Reflective journal writing as one of the interactive-engagement methodologies that has a potential to contribute to conceptual understanding, is currently underutilized in physics instruction. The attributes associated with reflective journal writing include gathering and integrating facts and observations to arrive at an understanding as well as framing a justification for the understanding through the use of language. The article compares the measured gains in conceptual understanding for the treatment-control groups to other Interactive-Engagement instructional methodologies.

Rebecca Dean, UML Language Art and Literacy program, conducted a study that focused on the development and validation of assessment tool for higher order reading-based decision making behavior and meaningful learning. When it comes to learning and reading, there are three learning outcomes: no learning, rote learning, and meaningful learning. The cognitive processes of no learning or rote learning include remembering, as both recognizing (identifying) and recalling (retrieving). The cognitive processes and their sub-processes of meaningful learning include: understanding, applying, analyzing, checking and creating. Rebecca asked whether the decisions learners make regarding how they are going to use or not use a textbook have an impact on their use of that textbook and learning. The purpose of the study was to assess the degree to which training in the cognitive skills of reading-based decision making improves the level of cognition and meaningful learning of underprepared college students, who were originally denied acceptance into a state college in the northeastern United States because they did not meet state mandated requirements.

Edward Tonelli, UML Mathematics and Science Education program, has posed an interesting question about studying the Copernican Revolution in science class. Copernicus' work instigated a scientific revolution by challenging old view on the universe and proposing fundamental change in explanation how the universe works. Copernicus' work is an excellent example of persistence at logical proof, citation, review, criticism of resources, and critical thought. Ed suggested that many of today's science educators claim to support inquiry-based instructional methods, but they seem not to be using the Copernican Revolution in their classes. He claims that it is possible to teach effectively the Copernican Revolution in a short amount of class time using collaborative, inquiry-based scientific work. Ed examines the state, national, and international science learning and testing standards and asks why studying the Copernican Revolution is mentioned in the teaching standards, while at the same time apparently not being addressed in the world's classrooms.

Lisa Golobski Twomey, UML Language Arts and Literacy program, states that public and private schools in the United States are becoming increasingly diverse as enrollment in grades 9-12 increased 26 percent between 1993 and 2006 with numbers of students from different races, ethnic backgrounds, cultures, and beliefs. The increasing diversity in United States' schools has spurred a ubiquitous tension among adolescents. Lisa says that while many school systems have recognized a need for multicultural curricula and differentiated instruction that is sensitive to various cultural needs, there have been few efforts to help students understand the perspectives of their classmates and learn to prosper in a diverse social climate. She encourages educators to acknowledge and recognize that curriculum needs to engage students in culturally meaningful domains of conversation that connect with various disciplines. Lisa suggests that intergroup dialogue should be incorporated in high

school English curricula as it offers teachers a structure through which to engage students in meaningful dialogue in order to ameliorate social conflicts while simultaneously addressing many of the Common Core standards as well as 21st Century Skills.

Qing Zhao, UML Language Arts and Literacy program, examines Asian international students' issues involved in this process of adjusting to a new academic and social environment. She discusses the factors that may account for these adjustment issues including English language proficiency, background knowledge, cultural differences, acculturative stress, and racial and ethnic identity. Qing draws upon the perceptions and insights gained from Maria Conley, the director of International Students and Scholars Office (ISSO) at University of Massachusetts Lowell (UM). Qing emphasizes the important role social capital plays in helping Asian international students' academic and social adjustment. She also provides instructional and institutional suggestions for future research and practice.

I am deeply grateful to all contributors to this issues and invite all graduate students to submit papers to the next volume of the journal.

R. Panasuk

2011 Annual Colloquium Journal

The Graduate School of Education, University of Massachusetts Lowell

GUIDELINES FOR SUBMISSION

The papers submitted for the Journal must discuss psychological and pedagogical issues and trends related to educational research and practice.

WHEN SUBMITTING A PAPER, PLEASE USE THE FOLLOWING GUIDELINES:

1. Submit an electronic version of the paper, an abstract, approximately 150 words, and a biographical sketch, about 30 words. All pictures and diagrams must be submitted as a separate document.
2. Use double spacing with one-inch margins.
3. For references, tables, and figures follow the style described in the Publication Manual of the American Psychological Association (APA), Sixth Edition.
5. Paper must be submitted by December 1.
6. Authors will be notified about the status of their papers by January 15.
7. The Colloquium is scheduled in April.

A RESEARCH PAPER MUST INCLUDE:

- a) a rationale and an identification of the research question(s)
- b) a conceptual framework or brief statement of relationship to the literature
- c) an identification of research methodology

d) a summary of the analytical technique(s)

e) a summary of preliminary findings

The length of the paper length might be up to 30-40 pages, including pictures, tables, figures, and list of references.

A position paper for the *Educational Resources* section can be up to 20 pages. It must present new ideas and developments of major importance to practitioners working in the fields of mathematics and science education, language arts and literacy education, and leadership and schooling. It must reflect a variety of research concerns within the fields and deal with didactical, methodological, and pedagogical issues.

An abstract for a poster presentation can be about 150-250 words; must outline the major ideas of the research study (proposed or conducted), or a teacher education program.

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CONTRIBUTORS

Laura S. Chesson is a Theodore Sizer and Coalition of Essential Schools research fellow. She has been working as a teacher and administrator in urban, suburban, and rural schools in New York, New Mexico, and Massachusetts. Laura is a principal of the Maynard High School, Maynard, MA.

Rebecca Dean graduated in 2010 from *UMass Lowell* School of Graduate Education with a doctoral degree in Language Arts and Literacy and is currently an instructor and the director of The Reading Center at *Salem State University*.

Michael Doherty earned an Ed.D. from the University of Massachusetts Lowell. He also holds degrees from Tufts University and Salem State College. He is a certified teacher of Physics, Chemistry, Biology, Physical Science, and English. Michael retired from teaching in Massachusetts after a thirty-two year career at Andover High School, Winthrop High School, and the UML TEAMS Academy. He is currently teaching Physics and Pre-Engineering in Litchfield, NH. Michael was a Verizon GIFT Fellow for 2001 and a recipient of the Peter Farrelly excellence in teaching award for 1994.

Richard Howarth has been teaching Science at North High School in Worcester, MA for the past 16 years, in addition to teaching part-time at Becker College. He earned his B.A. in Biology and Environment, Technology and Society from Clark University, a M.Ed. from Worcester State College, and a C.A.G.S. from Clark University. He is currently working on his dissertation proposal in the Math and Science Education doctoral program at UML.

Edward Tonelli first taught as an associate law professor, before moving to high school mathematics and physics, which he taught for 15 years. He enrolled at UML in 2009; his principle research interest is technology in science teaching.

Lisa Golobski Twomey is enrolled in the Language Arts and Literacy Ed.D. program and is working on her dissertation. She is currently an English teacher at Methuen High School.

Michael Wadness has been teaching high school physics for thirteen years in Medford, MA. Michael finished his dissertation last fall and is currently enjoying the extra time with his newly expanding family.

Qing Zhao began her graduate study at University of Massachusetts Lowell in 2006. She is currently a full-time doctoral student and a teaching assistant in the Language Arts and Literacy program.

New Feature

POSTER PRESENTATIONS

Richard Howarth

North High School, Worcester and Becker College

A Comparison of Massachusetts and Texas High School Biology Teachers' Attitudes Towards the Teaching of Evolution

Darwin's theory of evolution by natural selection is considered to be the unifying theory for all life sciences (American Association for the Advancement of Science, AAAS, 1990; National Academy of Sciences, 1998; National Research Council, NRC, 1996; National Science Teachers Association, NSTA, 2010) and as such, the biology topic has been established as a central learning standard by the National Science Education Science Standards (NRC, 1996).

The purpose of the proposed research study is to discern a deeper understanding of the factors contributing to the role biology teachers play in the process of learning about evolution as deficiencies among students in terms of their scientific literacy and understanding of evolution and biology continue to propagate as evident on many standardized exams. With the intention of understanding these factors, the goal of the study is to compare how Massachusetts and Texas high school biology teachers' attitudes toward the teaching of evolution differ, particularly among other biology topics. Texas offers a case where the teaching of evolution has been plagued with controversy, national media attention, politicizing and religiosity. Massachusetts has virtually been free of these influences.

A survey of experienced in-service high school biology teachers will be conducted in Massachusetts and Texas to help provide a sense of the phenomena surrounding biology teachers in respect to how their attitudes towards of teaching of evolution are shaped but such factors.

The possible findings of the proposed study may assist in identifying the needs of biology teachers, which then can be addressed by schools and districts, teacher educators, undergraduate biology teacher preparation programs and teachers in terms of professional development and preparation. In order for biology teachers to make informed, professionally responsible instructional and curricular decisions, they must possess a thorough knowledge of evolutionary theory and its place in the discipline of biology in addition to the nature of the scientific enterprise (Rutledge & Warden, 2000). This can only be addressed if there is a sense of the phenomena surrounding biology teachers in respect to how their attitudes towards the teaching of evolution are shaped.

Mike Wadness

Medford High School, Medford, MA

An Evaluation of the Particle Physics Master-Class as a Context for Student Learning About the Nature of Science

This research addresses the question: To what extent do secondary school science students attending the U.S. Particle Physics Masterclass change their view of the Nature of Science (NOS). The Masterclass is a one-day event in which high school physics students gather at a local research institution to learn about particle physics and the scientific enterprise. Student activities include introductory lectures in particle physics, laboratory tours, data analysis, and the discussion of their findings in a conference-like atmosphere. The mixed methodology design utilized repeated quantitative and qualitative measures. The results of the combined analyses suggested students' understanding of NOS may have changed after attending the Masterclass, specifically in the NOS tenets regarding indirect, subjective observations, use of imagination and creativity, collaboration, and the image of a scientist. Students' understanding of NOS did not appear to change in the NOS tenets regarding tentative yet stable social and cultural influences, no universal scientific method, and a comprehensive understanding of theory versus law. Although there are a number of outreach programs involving scientists in K-12 education, very few of them have been formally evaluated to determine if they provide adequate learning of NOS. Therefore, the significance of this study is that it provides data to support the claim that science outreach programs may be designed to address science literacy, specifically as a context for explicit NOS instruction.

The Nature of Teacher Leadership in a Boston Pilot School

Laura S. Chesson
University of Massachusetts Lowell

ABSTRACT

Using a mixed methods design, this study examined the nature of the choices that Boston Arts Academy has made that has assisted its community in developing and nurturing teacher leadership. Examination and analysis of the quantitative data collected demonstrated that the Boston Arts Academy staff reported a higher level of the characteristics of schools in which teacher leadership flourishes. The analysis of the qualitative data of the study suggests that structural choices that the school has made, such as the creation of teacher-led curriculum and grade-level teams, team-taught writing courses, professional development partners, school opening professional development workshops, and a clearly articulated hiring process have made significant contributions to the ability of this school to implement and nurture teacher leadership.

While not immediately generalizable to all schools, the study provides a “jumping off point” for schools seeking to implement the pilot school model and/or utilize teacher leadership within their school community.

In 1995, in an effort to stem the drain of students from its public schools to charter and private schools, Boston Public Schools, with agreement from the city of Boston and the Boston Teachers Union, authorized the creation of the first “pilot school” within its district (Gewertz, 2007). The pilot school model gives school communities autonomy over curriculum, staffing, budget, and other significant matters. Over the next ten years, the number of pilot schools increased to twenty. What is notable about these schools is that they are a model of school design that has been shown to be successful at closing the achievement gap that exists in urban areas between the students of upper socio-economic background and lower socio-economic background.

The success of the Boston pilot schools can be attributed to a number of elements of the design of these schools, but most noteworthy is their extensive use of teacher leadership. Their success in developing and nurturing teacher leadership raises the logical question: how are they able to do that? What is the nature of the choices they have made that has allowed them to use teacher leadership so effectively? This study gives insights into the answers to these questions by examining one of these schools, the Boston Arts Academy, more closely.

The Boston Arts Academy, like all Boston pilot schools, is unique in that it has significant autonomy in matters of budget, staffing, curriculum, scheduling and governance. The governance design is one of the lynchpin differences between this school and more traditional schools. The leadership structure is transformed from a traditional structure, in which all authority is formalized in the office of the principal, to a structure in which authority for decision-making and accountability for success is distributed throughout all stakeholders in the school, especially teachers.

The structure of teacher leadership at the Boston Arts Academy reaches far beyond teacher representation on the governance board, a structure similar to a site-based management team. The school community has deliberately chosen to implement structures which the results of this study suggest are supportive of teacher leadership. Teachers attend weekly meetings in a variety of configurations including Critical Friends Groups, grade level groups, academic content departments, and advisory groups. Each of these groups has a clearly articulated role in determining the “path” of the school. The teachers’ responses to the surveys and interview questions used in this study make it apparent that the responsibility for the success of the students and the school community goes well beyond the walls of the individual teacher classroom.

RATIONALE AND IDENTIFICATION OF RESEARCH QUESTIONS

Successful implementation of teacher leadership is predicated on the implementation of the conditions that support it. For another school to learn from the experiences of Boston Arts Academy it would need to understand what choices BAA has made in order to foster the conditions that support teacher leadership. Thus, it was the goal of this study to explore the nature of teacher leadership at the Boston Arts Academy, a Boston pilot school, to allow other educators to better understand the choices that the school has made that have resulted in the presence of the conditions.

While there are many research studies in the area of teacher leadership, most focus on examining the impact of teacher leadership (Dierks, 1988; Heller & Firestone (1995); Leithwood & Jantzi, 1999; Porter, 1986; Smylie, 1994), the qualities of teacher leaders (Hart,

1994; Snell & Swanson, 2000), or the different roles taken on by teacher leaders (Darling-Hammond 1995; Dierks, 1988; Paulu & Winters, 1998; Powers et al, 2001). Past researchers have sought to identify the aspects of a school and the formal leadership of a school that are supportive or detrimental to teacher leadership, but little is available that examines the nature of those elements in such a way to assist other schools seeking to utilize teacher leadership.

There were two questions that were the focus of this study. First, do the conditions that impact the ability of a school to foster teacher leadership indicated by current research exist within this school? Second, what is the nature of the choices the school has made in order to implement the conditions to support teacher leadership? The examination of the both question will be structured by the theoretical framework of the work in this area undertaken by York-Barr and Duke (2004).

RELATIONSHIP TO THE LITERATURE

TEACHER LEADERSHIP DEFINED

The definition of teacher leadership has evolved over time, much the way the definition of leadership itself has evolved over time (York-Barr & Duke, 2004). How teacher leadership evolved and the different phases that it passed through has been described in a variety of different ways from a variety of different perspectives. While some authors describe the evolution by examining the roles that the teachers played and the tasks they undertake, others describe it in a way that focuses on the type of power that is associated with leadership and who holds that power.

Teacher leadership is often synonymous with the concept of teacher empowerment (Bezzina 2006). This empowerment provides teachers with an opportunity to influence the work of others. Teacher leadership, when used effectively, can contribute profoundly to the sense of community within a school. Teachers can be given the power to initiate and contribute to change. But this empowerment does not come without consequence, along with the power comes the responsibility for whether or not the efforts of that which is done with this power is successful.

CONDITIONS NECESSARY FOR TEACHER LEADERSHIP

York-Barr and Duke (2004) contend there are three categories of conditions that impact a school's ability to foster teacher leadership: school climate, roles and relationships, and structures.

The category of roles and relationships is examined

by the empirical studies of Little (1988), Silva et al (2000), and Hart (1994). These works highlight the need for trust between teachers and their peers, as well as between teachers and administrators. Every good relationship is based on trust. This holds true for productive relationships within schools as well. The body of research exploring the concept of trust in schools points to the idea that trust is a two-way street, requiring reciprocity and vulnerability. Several of the most notable research studies in this area, undertaken by Tschannen-Moran and Hoy during the last decade, examine the trust between teacher and teacher, and teacher and administration in a wide variety of settings (Tschannen-Moran, 2001; Tschannen-Moran & Hoy, 1998; Tschannen-Moran, 2004). Collegiality and a perception of mutual responsibility are also included in this category of conditions.

The structures within schools where teacher leadership thrives are those that are supportive of distributed decision-making and participatory leadership. Studies in this category can be found in the works of LeBlanc and Shelton (1997) and Darling-Hammond et al (1995). When trust has been established through an educational environment rooted in professionalism and collegiality, the groundwork has been laid for the ability of the school to create a formalized structure to assist in the development and nurturing of teacher leadership such as professional learning communities or critical friends groups. Shirley Hord and the researchers of the Southwest Educational Development Laboratory (SEDL) followed staff members of a school over a four-year period, noting that the fact that the school community saw itself as a professional learning community – a community of learners working towards a common vision enabled it to work towards continuous improvement (Hord, 1997). This type of structure, when effective, provides an opportunity for collective inquiry that moves a school toward actions that are oriented for continuous improvement (Schmoker, 2006; Reeves, 2006; Fullan 2001; Reason & Reason, 2007). As everyone learns more, the organization learns more. The ability of the organization to solve its problems, to innovate, and to invent is increased (Tschannen-Moran et al., 1999).

The final category identified by York-Barr and Duke is school climate and culture. A school culture that is supportive of teacher leadership is one in which there is an acceptance of a general method of resolving conflict and an absence of isolationism. The research of Tschannen-Moran et. al (2003) demonstrates that school cultures that do not have an articulated plan for dealing with controversy are often unsettled. The traditional school setting is often characterized by culture of

isolationism (Burmeister & Hensley, 2004; Coyle, 1997). Teachers closing their doors and leaving the rest of the educational world outside is the antithesis of the collegial, professional learning community environment that supports teacher leadership (Bowman, 2004).

IMPACT OF FORMAL LEADERSHIP ON TEACHER LEADERSHIP

One of the structures that is so significant that it warrants examination on its own is that of the structure of formal leadership. The writings of Birky, Shelton, and Headley state that “a principal’s style and actions have great influence over teacher leaders’ motivation for performing teacher leadership roles” (2006, p. 87). By taking steps to establish a culture of trust between teacher and administration and teacher and teacher, a principal can take one of the first positive steps to create an educational environment where teacher leadership can flourish (Bowman, 2004; Barth, 2001). Once this environment has been established, the administration of the school can take steps to facilitate the creation of a professional learning community that provides authentic, substantive opportunities for teachers to take on leadership roles. Most importantly, principals must meet the challenge of changing their leadership style to that which is more transformational, collaborative, and relational in nature, since this is the leadership style that supports this type of school reform initiative (Ackerman & Mackenzie, 2006; Birky et. al, 2006; Ryan, 1999).

METHOD

OVERVIEW OF DESIGN

This study used a mixed methods design, beginning with a quantitative phase and ending with a qualitative phase. The quantitative portion of the study utilized four instruments that have established psychometric properties, including confirmed reliability and validity in previously undertaken studies. Each of these instruments focuses on the presence of a characteristic that is important to one or more of the conditions that support teacher leadership. The purpose of the qualitative portion of the study was to strive to provide a deeper understanding of the nature of teacher leadership by examining what choices the school has made in order to implement and nurture the conditions necessary to support teacher leadership, i.e., what does it “look like”? Data collection from this phase includes in-depth interviews with the headmaster, assistant headmaster, curriculum director, and four teachers.

STUDY SAMPLE

The Boston Arts Academy has 32 full-time teachers. Twenty of those teachers teach academic subjects such as science, world languages, mathematics, or humanities. Twelve of those teachers teach arts subjects such as visual arts, instrumental and vocal music, theatre, and dance. Of the 32 full-time teachers, 13 are male and 29 are female.

As this study sought to examine the overall climate of the school and not gain knowledge about individual teachers, all of the teachers in this school were invited to participate in the quantitative portions of this study in an anonymous manner. From this total group volunteers were solicited for the interview portion. The invitation to participate in the interviews was sent by email from the researcher, followed up by an email from one of the co-headmasters of the school urging teachers to volunteer. Ten teachers volunteered. The teachers chosen were thoughtfully selected in order to best ensure that the demographics of the subjects sampled mirrored the demographics of the full-time teaching staff of the Boston Arts Academy as much as possible. There were three female teachers and two male teachers interviewed. Three of the five teachers interviewed were people of color. The range of the teachers’ years of experience teaching at Boston Arts Academy was from 5 years to 13 years. Two of the subjects were art teachers, three were academic teachers. All of the teachers are a member of a pair of teachers who team-teach a Writing Workshop class.

INSTRUMENTATION

The instruments chosen for the quantitative phase of this study include the *School Climate Inventory and Organizational Citizenship Index* developed by Hoy, Smith, and Sweetland (2002), the *Hoy and Tschannen-Moran Trust Scale* (2003), *Kouzes and Posner’s Leadership Practices Inventory* (1997), and the *School Professional Staff as a Learning Community Scale* used by the Southwest Development Laboratory (Hord, 1997).

The *Hoy, Smith and Sweetland School Climate Inventory and Organizational Citizenship Index* examines the level of organizational citizenship of teachers within a school. Organizational citizenship is defined by Hoy et al as that which motivates an individual teacher to go the extra mile in order to assist the school with achieving its mission (Hoy, Smith, & Sweetland, 2002).

The *Tschannen-Moran and Hoy Trust Scale* measures the five facets of trust as outlined by their conceptual model. These five facets are: (a) benevolence, (b) reliability, (c) competence, (d) honesty, and (e) openness (2001).

The *Kouzes and Posner Leadership Practices Inventory* measures five key educational practices of school leaders. These practices are defined as: (a) challenging the process, (b) inspiring a shared vision, (c) enabling others to act, (d) modeling the way, and (e) encouraging the heart. Kouzes and Posner have identified these practices as those that contribute to the effectiveness of an organization through qualitative and quantitative research.

The *School Professional Staff as Learning Community Scale (SPSaLC)* was developed by Shirley Hord of the Southwest Development Lab. This scale addresses the five characteristics that make up Hord's conceptualization of a learning community. These characteristics are: (a) supportive and shared leadership, (b) shared values and vision, (c) collective learning and application of that learning, (d) shared practice, and (e) supportive conditions.

PROCEDURES

Each of the instruments was administered over a four week period. Due to time constraints, the school requested that the first two instruments be administered on-line. The second two instruments were administered during a weekly staff meeting. While this study did not seek to analyze the correlations between an individual's response between instruments or between subscales, a coding system was used that would allow opportunity for future research.

DATA ANALYSIS OF QUANTITATIVE DATA

The Statistical Package for the Social Sciences (SPSS) was used in order to analyze the data. Descriptive statistics such as frequency distribution, mean, mode, median, and standard deviation were examined for each item on each instrument to ensure that all of the requirements for subsequent data analysis are met (e.g. heterogeneity of variance, no extreme skewing etc.). For each instrument three tests were done if the appropriate data were available. The student t-test for independent samples was used to test whether or not there were statistically significant differences between the means of the study sample and the normative sample. The Hartley F-max test was used to test whether there was a statistically significant difference between the variances of the study sample and the normative sample for each subscale of each instrument. The Fisher Z-test for testing the difference between two independent correlation coefficients was used to assess whether the Cronbach's alphas of the study and normative samples were statistically the same.

In addition to the testing above, researchers who developed the Trust Scale and the School Climate and Organizational Citizenship Index provided the appropriate information and methodology to convert data collected into standardized scores in order to better compare the normative and sample population data.

INTERVIEWS

The interviews were designed to be directed, open-ended, intensive interviews that probe the understanding of the heads of school regarding the use of teacher leadership to support the initiatives at the school. The structure of the interview included what Charmaz describes as initial open-ended questions, intermediate questions, and ending questions. Initial open-ended questions were questions such as "Could you describe some of the roles that teachers take on within this school?" Intermediate questions were those such as "What structures are in place to support teachers in those roles?." Finally, participants were asked ending questions. These are questions such as "How do you think the willingness of teachers to take on such roles has changed over time" These questions provided a first blush understanding of the perspectives of the co-headmasters regarding teacher leadership at the school, that is, how it is used, how often is it used, whether all teachers are equally involved, how teachers are prepared to be involved, etc. Each co-headmaster was interviewed first. Then, the five teachers were interviewed. Finally, the co-headmasters were interviewed a second time.

The teacher interviews and the second co-headmaster interviews were structured the same as the first set of co-headmaster interviews with initial, intermediate, and ending questions. However, they were designed to more deeply probe the nature of teacher leadership in these schools based on the data that resulted from the first round of interviews from the co-headmasters and the results of the four quantitative instruments. For example, one of the co-headmasters described that over time teachers were more reluctant to take on "optional teacher leadership roles," so the question, "Can you describe how you think teacher involvement in the leadership team of the school has developed over time" was asked of the teachers. As a result of the quantitative study it appeared that the level of collegial leadership was not quite as high as had been expected. So the intermediate question "What actions has the principal taken that might deter a teacher from being comfortable in participating in the leadership of this school" was added.

DATA ORGANIZATION AND ANALYSIS OF QUALITATIVE DATA

The qualitative data collected was organized using QSR's NVivo 8. The interviews were digitally recorded, then transcribed by the researcher into Word files, and later imported into NVivo. These data were then organized into a format called a "tree." Each "branch" of the tree, called nodes was organized around the four themes that have previously been discussed – administration leadership style, structures, roles and relationships, and school culture. On each of these branches or nodes, sub-branches, called sub-nodes were added. For example, to the roles and relationship tree node sub-nodes were added that correspond to the sub-variables measured by the quantitative instruments in this area, such as one for trust between teacher and teacher, one for trust between teacher and administrator, and one for collegial leadership. This was done in order to allow for the development of insights able to be gleaned from both quantitative and qualitative sources regarding the area of trust.

In order to analyze qualitative data it was "coded" or grouped to the node (or branch) and/or the sub-node (sub-branch) of the tree it is logically related to. These interview transcriptions were initially coded based on the four themes previously seen in literature – administrative leadership style, school climate, trust, and presence of professional learning community. The second round of coding was to examine each of the interview transcripts again for data which would relate to the sub-nodes – collegial leadership, organizational citizenship, etc. Then the data that had been collected under each of these sub-nodes was examined to see if additional themes had emerged.

RESULTS

QUANTITATIVE RESULTS

The purpose of the quantitative portion of this study was to confirm the presence of the key general characteristics that the literature reports are necessary for schools which wish to implement and nurture teacher leadership. The statistics for kurtosis and skew were examined to ensure that the assumptions that would be made about the data in order to conduct the student t-tests, Hartley F-max tests, and Fisher z-tests had been met. For the majority of the sub-scales the assumptions regarding kurtosis and skew were met.

The examination of the data found a statistically significant difference between the means of the normative database and the study sample ranging from $p < .05$ to

$p < .001$ for the all the subscales for the *Tschannen-Moran and Hoy Trust Scale*, four of the five subscales of the *School Climate and Organizational Citizenship Index*, two of the five subscales of the *Kouzes and Posner Leadership Practices Inventory*, and all five of the subscales of the *School Professional Staff as a Learning Community*. Wherever there was a statistically significant difference between means, it was found that the sample study means for all of these subscales were higher than those of the normative databases in all of these mean comparisons.

Examination of the Cronbach's alpha for the study sample for each of the subscales in relationship to the same statistic for the normative database found that in for all but one of the subscales there was not a statistically significant difference between those of the study sample and the normative database. With the exception of three subscales, all of the Cronbach's alphas were above the normally acceptable limit of .70. Of the three measurements that were below .70, two were extremely close, .667 and .668. As the size of the study sample is so much smaller than the size of the normative database, this difference is not unexpected.

The examination of the variances for each of the subscales found more mixed results. Of the three subscales for trust, it was found that one had a statistically significant different variance ($p < .05$) than the variance of the normative population. The variance of the study sample was higher. Of the five subscales which measure school climate and organizational citizenship, one of the subscales was also found to have a variance which was statistically significantly different than the variance of the normative population ($p < .05$). Again, the variance of the study sample was higher than the variance of the normative database. None of the variances of the study sample data for the subscales which measure leadership practices was found to have a statistically significant difference from the variances of the same subscales for the normative database. Of the five subscales which measure the degree of implementation of a professional learning community, three had a variance for the study sample which was considered to be statistically significantly different from that of the normative database ($p < .05$). However, for these three subscales the variance of the study sample was less than the variance for the same subscales for the normative database. Despite these findings, it should be noted that a few deviant responses of 3 to 5 study group teachers in the 26 study group teachers from whom data were collected could have produced the differences in variances found. Overall, the differences found were neither numerous

Table 1
Key Elements of Teacher Responses Regarding Four Characteristics

	Roles & Relationships	Supportive Structures	School Culture	Formal Leadership
Teacher 1	Trusting, collegial, based on mutual respect. Conflict resolution accepted. Intensive work time together. Many roles outside classroom	True learning community. PD week very important. Faculty learn together. PD partner structure important. Bi-annual reflection helps. Many teachers not interested in leadership team.	Teachers take personal responsibility for student success. Continuous cycle of improvement.	Inconsistent in treatment of individual staff.
Teacher 2	Teachers are supportive, sharing, trusting. Many roles outside the classroom. Strong mutual respect.	Bi-annual reflection and goal setting important. PD week critical. Process of hiring teachers important. Teacher led teams. Not interested in leadership team.	Teachers take personal responsibility for school and success of students. Long hours for teachers.	Has changed. Not accessible. Co-headmaster role a problem.
Teacher 3	Collegial, yet challenging. Very trusting. Mutual respect. Roles design to support work. Teachers not interested in leadership team.	Roles defined to support conversation. Retreat is important. Future principal training is important.	Teachers take personal responsibility for student success. Conflict resolution common.	Co-headmaster model a problem. Major change in leadership style. Not accessible.
Teacher 4	Approachable. Lots of time w/each other. Teacher led teams. Teacher not interested in leadership team.	Content teams important. Hiring process supportive. Retreat important. Teacher led teams.	Teachers take personal responsibility for students. Comfortable pushing each other.	Co-headmaster model a problem. Lack of access is a problem.
Teacher 5	Very positive relationships. High level of interaction. High level of trust. Many roles outside the classroom	Dept and staff mtg important. Hiring process important. PD week important. PD partners important.	Teacher take personal responsibility for students success. Unique school.	Co-headmaster model a problem. Ability to create vision still exists.

enough or large enough to affect the statistical testing or to say that the study group was not similar to the norming group in terms of reliability or variability of results.

KEY FINDINGS OF THE DATA ANALYSIS OF THE QUALITATIVE PHASE

Table 1 displays the key points reported by the teachers for each of these four major categories of roles and relationships, supportive structures, school culture and climate and formal leadership.

As can be seen from Table 1, the responses from the teachers interviewed were consistent in their description of the relationship between the teachers in their building in positive terms. Teachers verified the high level of trust that had been self-reported in the *Tschannen-Moran and Hoy Trust Scale*. This high level trust allows them to challenge each other to be better. They also described the significant number of roles that teachers take on outside of the classroom such as mem-

bers of the content team, grade level team, and advisory teams.

The teachers were also fairly consistent in their description of the supportive structures that allowed the school to utilize teacher leadership. All teams are led by teachers. The professional development week prior to school and the retreat allow teachers to share practice and to discuss teaching and learning deeply. The requirement for teachers to act as a professional development partner for one of their peers is a structure designed deliberately to get teachers into each others classrooms. The teachers also reported that the hiring process had been designed to increase the likelihood that new hires would fit into the school culture and would be enthusiastic about the teacher leader roles that are required by the school's design. New hires were interviewed by teams of teachers. The additional expectations for teachers outside of their classrooms were spelled out clearly in the interview process. Candidate

finalists were required to teach a demonstration lesson with members of the interviewing team present.

The teachers of this school reported that each and every staff member believed he/she was personally responsible for the success of students. Teachers were willing to do whatever it took in order to make this happen, whether it be working longer hours, reaching out to parents, or even helping a student find medical care. The culture of the school is deeply rooted in this belief. Teachers describe how their colleagues are constantly reflecting how they can improve their practice in order to increase student achievement. It is an accepted practice for teachers to turn to each other for assistance when they feel they have come up short in this regards.

When describing the formal leadership of the building teachers became less positive. Lack of accessibility to the co-headmasters and the change in leadership structure to the co-headmaster model were issues raised by each interviewee.

As can be seen from Table 2, the co-headmasters echoed in their interviews many of the sentiments expressed by the teachers regarding the roles and relationships within the building. They agreed that teachers have a very trusting and collegial relationship with each other. They confirmed that teachers help each other a great deal and see each other as a very valuable resource. Both co-headmasters commented on the change in the relationship between the administration and the teachers. However, they attributed this change to the “election to work agreement” dispute that had happened several years ago, something not mentioned by any of the teachers interviewed. They believed that this incident, which resulted in more accountability and formalized procedures in the building, is at the heart of the results from the survey in which teachers reported only an “average to above average” level of trust in their administrators while reporting an “extremely high” level of trust in their peers.

Both of the co-headmasters commented that the structures which provide leadership opportunities for teachers are critical to the success of the school. All of teams in the building which include teachers, except for the leadership team and the governance board, are teacher led. They also both reported that the leadership team mission and structure was changed in order to allow the team to focus on issues which were about teaching and learning. They also both talked about the retreat as being a structure that supported teachers’ efforts to bring forward issues that they felt should be raised.

Both co-headmasters reported changes in the school culture which they believe can be tied back to the issues regarding the “election to work” dispute. Teachers are now being asked to account more for the time when they are not in the building, such as taking sick time for a doctor’s appointment. In the past teachers were less accountable for when they arrived at school and left for the day. But, despite these changes both reported that teachers still felt a personal sense of responsibility for student achievement and were willing to do whatever it took to help students be successful.

Finally, both co-headmasters acknowledged that the change to the co-headmaster model had been a challenge. They supported the teachers’ responses that issues of accessibility to the administration have been a problem. They also both acknowledged that they have very different leadership styles and that with one of the out of the building frequently handling fund-raising efforts and other external issues, the responsibility for the day to day operation of the building had become the responsibility of the co-headmaster left behind. She may or may not handle things in the same way as the co-headmaster who in past had been the sole headmaster.

Table 2
Key Elements of Co-Headmaster Interviews Regarding Four Characteristics

	Roles & Relationships	Supportive Structures	School Culture	Formal Leadership
Co-Headmaster 1	Recent changes affected relationships. Organization has growing pains. Increased accountability caused rifts. Teachers still trust each other.	Structures deliberately designed to support teacher leadership. Leadership team now focuses on teaching and learning. Retreat is important.	Changes are due to “election to work” dispute. Schism in trust. Teachers feel personally responsible for student success.	Sr. Management team put in place to make policy decisions. Co-headmaster change necessary. Division of duties causes roadblocks.
Co-Headmaster 2	Teachers collegial. Multiple roles for teachers outside of classroom.	Leadership team essential for teaching and learning decisions. Retreat important.	Teachers have strong sense of personal responsibility for student success.	Teachers want more accessibility. Different leadership styles of co-headmasters.

DISCUSSION

CONNECTIONS BETWEEN QUANTITATIVE AND QUALITATIVE FINDINGS

In analyzing the data from the study sample provided by the four instruments administered and the interviews conducted for overall general trends, the researcher saw that the Boston Arts Academy faculty report a higher level of those elements that are supportive of the utilization of teacher leadership such as trust between faculty members, shared vision, time, and resources, as well as those elements that are synonymous of teacher leadership such as recognition of collective creativity, exemplary levels of teacher professionalism, and high levels of organizational citizenship. When looking at the results in terms of the four major categories of factors that can influence a school's ability to utilize teacher leadership – roles and relationships, school climate and culture, supportive structures, and formal leadership style, one can see evidence to support the overall finding that the conditions do exist within the Boston Arts Academy in each of these areas to support teacher leadership. Teachers actively lead teams focused on improving teaching and learning. It is widely accepted that teachers are personally responsible for the success of their students and are willing to do whatever is necessary to assist with achieving that goal. Supportive structures such as professional development partners, team-teaching, and professional development weeks contribute significantly to the school's ability to support and nurture teacher leadership. There is one possible exception of a condition that is missing and that is of a strong transformational leadership style of the formal building administrators.

While the data showed that the teachers of the Boston Arts Academy reported positively in all areas dealing with teachers, the responses regarding areas of leadership were more mixed. The data indicated that teachers did feel the formal leadership had a vision for the school and could lead the school towards that vision. They also reported that the school conditions that would support the staff working together as a professional learning community were in place to a very high level of implementation. These conditions include such things as time being allocated and committed to staff interactions as well as procedures set in place to encourage staff communication. These conditions are very much under the control of the formal leadership of the building, so while they are not directly attributed to the formal leadership in a positive way, they are indirectly connected. However, they reported that the level

of collegiality in the leadership style of their administrators was only average and did not report a frequent use of three of the five broad areas of leadership strategies normally associated with transformational leadership. These results suggest that while the formal leadership can positively impact teacher leadership by committing the appropriate time and resources, supporting the procedures that encourage teachers to communicate, and by helping to develop and sustain a shared vision, an average level of collegial leadership on the part of the administration has a neutral effect on teacher leadership.

LIMITATIONS OF THIS STUDY

The study had limitations that should be noted. First, the size of the sample for both the quantitative and qualitative portions of the study was very small. With only 18 respondents for two of the instruments and 26 respondents for the other two of the instruments, the ability to extend the findings of this portion of the study is limited. Similarly, only five of the teachers from the school were interviewed, along with the two co-headmasters. In order to more deeply understand the nature of teacher leadership within the building, the size would need to be expanded.

The second limitation is not only were there a small number of respondents for the quantitative instruments, there was an even smaller number of respondents (13) that took all four of the instruments. This makes it extremely unlikely that findings across instruments can be revealed.

The third limitation is that Boston Arts Academy is a start-up school and, as such, the formal administration was able to hire teachers from the onset that were prepared to be part of a school where teacher leadership would be integral to the design of the school. While additional faculty members have been hired over the last ten years, the ability of the school to hire initial staff members that agreed with the mission and the vision of the school provided a basis for the success of teacher leadership which does not necessarily exist in a school which chooses to implement teacher leadership many more years into its history. Therefore it would be difficult to directly apply lessons learned from this study to existing schools.

The fourth limitation is the unique mission of the school in this study. The Boston Arts Academy is a public high school for the visual and performing arts. Its mission is different from most other schools. The uniqueness of its mission affects the teachers who seek to work there and the students who seek admission to the school.

Finally, with the exception of the co-headmasters, each of the other interviewees was only interviewed once and all of the teachers were interviewed on the same day. In order to get a deeper understanding of teacher leadership at the school and increase the ability to generalize the findings to other schools, additional interviews of teachers, spread across a period of several months might be of assistance.

CONCLUSION

As the use of teacher leadership structures increases across the field of education, the need to more deeply understand the nature of the choices a school can make in order to increase the likelihood of these structures positively impacting student achievement also increases. While implementation of the structure of teacher leadership may seem straight forward, the development of the culture necessary to foster teacher leadership is not as straight forward. Principals traditionally hold the seat of power within a school. Teachers see their domain as their individual classrooms and see themselves as the master of that domain. The choices made by the Boston Arts Academy have resulted in a school in which the leadership and the educational community are much different than this traditional model.

Examination of the results of the quantitative instruments and interviews clearly evidences a school where teachers work together as a professional learning community, taking personal responsibility for the nurturing of school that operates in a continuous cycle of improvement. Teachers trust each other deeply. They make teaching and learning public. They voluntarily work long hours and challenge each other to be better at what they do each and every day. While there is no perfect answer for other schools seeking to create the same educational environment for their community, there are some lessons which can be learned from the work of others. The most important lesson that can be learned is that providing teachers with the time and space to discuss teaching and learning is critical to the implementation of teacher leadership. However, in order for these conversations to have an impact on students, they must be combined with the clear expectation that teachers will then use the fruits of those conversations to positively impact student achievement

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Development and Validation of Assessment Tool for Higher Order Reading-Based Decision Making Behavior and Meaningful Learning

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ABSTRACT

This study sought to describe the levels of reading-based decision making behavior and the levels of meaningful learning when reading an expository text. Within the context of an experimental quasi-random pre-test/post-test control group design (Shavelson, 1996), two instruments were developed and validated: the first measured a cognitive view of reading-based decision making behavior (Sternberg, 1985), and the second measured levels of conceptual understanding (Ausubel, 1978; Mayer, 1987). The instruments were used to assess the degree to which the instructional intervention improved the level of cognition and conceptual understanding of an expository text among underprepared college students. The data collected on the decision-making and meaningful learning instruments are promising and suggest that the instruments are worthy of further research.

INTRODUCTION

The purpose of this study was to assess the degree to which training in the cognitive skills of reading-based decision making improves the level of cognition and meaningful learning of underprepared college students, who were originally denied acceptance into a state college in the northeastern United States because they did not meet state mandated requirements.

Reading-based decision making training had been used as an instructional intervention aimed at helping students effectively use expository texts for successful goal attainment. This training focused on helping students become aware of themselves in relation to effort and ability, and the instruction of cognitive strategies and usage. Changes in the effective use of expository texts were measured with pre and post test reading passages. These tests helped to measure not only the outcome of applying the reading-based decision making model, but also identify when there is a breakdown in the reading-based decision making process.

A cognitive view of reading-based decision making (Sternberg, 1985) and meaningful learning (Ausubel, 1978; Mayer, 1987) provided the theoretical base and support for the instruments used in this study which was designed to increase the effective use of reading-based decision making skills to achieve meaningful learning for underprepared students in the higher education setting.

METHOD

The experimental design used in this study was a quasi-random one-way ANOVA pre-test post-test control group design and a general linear model analysis (Shavelson, 1996). This design was employed to investigate the effects of cognitive skill instruction in reading-based decision making on level of cognition and conceptual understanding. Intact classes of up to 15 students in each class were assigned to be either experimental or control according to their course schedule. A pre-test and a post-test was given to both groups along with a pre-treatment and post-treatment questionnaire. The pre-test was given during the first session of class and the post-test during the final session of class. In between pre- and post-test, the students were instructed, and engaged in a number of text-based strategies that helped them learn from college level expository texts. After the pre-test was given, a pre-treatment questionnaire was given to students. Similarly, a post treatment questionnaire was given to the students after the post-test.

PARTICIPANTS

The subjects (N = 72) in this study are underprepared college students who were admitted into a summer transitional program at a State College in Massachusetts and are taking Literacy Lab, a required non-credit course for these students. The underprepared students were entering college freshmen who did not meet the state requirements, but whose high school GPA was at least a 2.0 on a 4.0 scale and whose combined Critical Reading SAT scores were below 800, which is the college's minimum SAT requirement.

For all of these students, this was their first experience in higher education. The primary focus of the lab course is on using textual macrostrategies to enhance students' reading and study skills. The sample includes about one-third of the total enrollment in the Literacy Lab. The experimental group consisted of three intact classes with up to 15 students in each class. The control group also consisted of three intact classes with up to 15 in each class. Participating students were randomly assigned to an experimental or control group with each group having about 35 students, who were similar to

Table 1
Analytic Scoring Criteria of Meaningful Learning Test

Criterion 1 Identify	
Criterion 2 Classify	The student has used textual macrostrategies to decide on the known information and the objective of the problem.
Criterion 3 Apply	The student makes decisions using textual macrostrategies that uses important definitions, concepts, theories, and so forth, and key visual formation of the material to develop an answer to the question.
Criterion 4 Organize	The student has used textual macrostrategies to decide on a strategy or plan to address the issue asked in the question.
Criterion 5 Evaluate	The student has made valid deductions using textual macrostrategies and presents an effective evaluation of a concept presented in the text.
Criterion 6 Generate	The student makes decisions using textual macrostrategies that uses important concepts and theories of the material to generate problem-solving ideas. Each of these six criteria corresponds to one item of the meaningful learning test.

other students enrolled in the Literacy Labs. Assignment to any Literacy Lab, and in particular to the researcher's Literacy Lab, was based only on the student's schedule and not because of test scores, eligibility, or any demographic variables.

Assumed groups equivalencies are based on reading ability. Group equivalency in terms of the core variables was checked prior to data analysis and the experimental and control groups were found to be equivalent and no statistical adjustments needed to be made. Two-thirds of the sample were female, two-thirds white, with 90% having one or more eligibility characteristics.

DEVELOPMENT OF THEORETICAL FORMULATIONS FOR MEANINGFUL LEARNING TEST

PRE AND POST MEANINGFUL LEARNING TESTS

Two meaningful learning tests were written by this researcher and were designed to measure conceptual understanding (defined in this study as "meaningful learning") of a chapter from a college level textbook. Scores on these tests were analyzed to determine whether the intervention positively influenced the level of conceptual understanding (meaningful learning) of underprepared college freshmen. A counter-balanced design for administering the tests was used, so that some subjects received one form of the test as a pre-test and others received it as a post-test. The target text and questions on both meaningful learning tests were different, but were based on content from the same textbook and were constructed separately from each other. In order to determine the reliability coefficient of the pre- and post-test, the equivalent-forms method was used. On both tests, students were directed to use the textbook selection in order to answer the questions. Each

question was based on designated chapter readings photocopied with permission from the publisher from the college introductory level text. The Culture, Society, and Education (CSE) Meaningful Learning Test was based on Chapter 10 of the text and the Equal Education Opportunity (EEO) Meaningful Learning Test was based on Chapter 12 of the text. A Flesch-Kincaid Grade Level test was conducted to check the reading demands and potential equivalency of the two texts. For the CSE Meaningful Learning Test passage the Flesch-Kincaid Grade Level was 14.7. For the EEO Meaningful Learning Test passage the Flesch-Kincaid Grade Level was 14.5. Since the difference between the two grade level scores was only 0.2, the two texts were determined to have equivalent reading demands.

Item analyses and Guttman scaling analyses were conducted based on the pilot testing to determine if the items on the tests were reflecting conceptual understanding of the chapter in relation to the levels of meaningful learning. To summarize the findings of the pilot studies, it appears that the revised versions of both meaningful learning tests function adequately as measures of conceptual understanding of this textual material. The results of these analyses are described in detail below in analysis section.

Meaningful learning scoring process. A subject was able to earn points on the pre and post-test according to the *Analytic Scoring Criteria* (Carifio, 1997). Scores increase when subjects fulfill the criteria for answering questions that are cognitively higher in the levels of meaningful learning. The criterion for performance on the pre and post-test corresponded directly to the levels of meaningful learning theory (Table 1).

Rating codes and scoring criteria for meaningful learning test. The ratings for meaningful learning category ranged from 0 – 4 depending on the degree to which the subject's answer met the scoring criteria and

Table 2
Scoring Criteria for Meaningful Learning Test

Code 0	Only negative indicators are present. A rating of 0 is given when the subject's answer indicates the criterion has not been met.
Code 1	No indication of indeterminate. A rating of Code 1 is given when it cannot be determined if the criterion has been met. Either there is no evidence or the subject's answer does not relate to the specific criterion being applied.
Code 2	Only a few positive indicators are present. A rating of Code 2 is given when the subject's answers indicates the criterion has been met to a very limited degree. The subject may appear to understand some of the terms or one of the relevant strategies but does not appear to have enough knowledge to make a significant effort to answer the question.
Code 3	Mostly positive indicators. A rating of Code 3 is given when the subject's answers almost completely satisfies the criterion. The subject appears to know all but one of the strategies but does not appear to have enough knowledge to make a significant effort to answer the question.
Code 4	Indicators are all positive. A rating of 4 is given when the subject's answer fully meets the criterion.

the codes are shown in Table 2 (Carifio, 1997). In order to train the two people who did the scoring of the meaningful learning tests, exemplars from the pilot testing were used to model what constitutes an acceptable response for each scoring level for each question. The exemplar item chosen was Question 3, which asks subjects to explain why the author included a section about bullying in the chapter.

Scoring process. While the scoring for the pilot study was done by the researcher, for the actual study, two individuals were trained to score the meaningful learning tests (and the reading-based decision making questionnaire). The scorers were staff from the Learning Center who were knowledgeable about teaching study skills to freshman students and were familiar with the type of students who use the services of the center. The scorers did not know the students personally and were minimally compensated for their efforts. All scoring was done at the end of the intervention period.

PSYCHOMETRIC PROPERTIES OF THE MEANINGFUL LEARNING TEST

The characteristics of these two instruments were examined twice, first during the 2-phase pilot testing with a small sample ($N = 20$ and $N = 20$) and then again with the full sample of the 72 subjects who took part in the formal study for the dissertation.

TWO PHASE PILOT STUDY

A two-round pilot study was conducted in order to determine the equivalence between the two tests based on the scores of the pre and post-tests. Initially subjects were given the pre-test on the CSE chapter, and a week later the post-test on the EEO chapter. Based on the findings from the first round, modifications to the test were made and then another set of 20 students were

given the revised instrument in the same manner as before.

FINDINGS

TEST EQUIVALENCY

The revisions to the test consisted of rewording the directions and allowing students more space to respond to each question. The alternate forms correlations were .51 for the first Pilot Round group and .80 for the second Pilot Round group. The moderately high correlation for the revised test provides adequate evidence that the two forms of the instrument are measuring the same thing.

TESTING EFFECTS (TEST-RETEST RELIABILITY)

A paired samples t-test was also conducted with the second group to examine the possibility of testing effects. A slight increase in scores was observed from the pre- to the post-test. But the t-test value was $-.67$ ($N=19$), which is not statistically significant. This suggests that there was only minimal, if any, impact on post-test performance simply due to taking the pre-test.

As noted earlier, the scoring for the pilot study was done by the researcher. While the test retest reliabilities were adequate, the researcher examined the questions more carefully to determine if the items could be improved upon in terms of clarity or in terms of appropriateness as indicators of reading related reading-based decision making skills. Consequently, a series of Cronbach Alpha item analyses and Guttman Scale analyses were conducted for both Pilot Round 1 and Pilot Round 2.

RELIABILITY

INTERNAL CONSISTENCY

During the pilot study, a test for internal consistency was conducted and Cronbach's alpha was found to be .601 for the Pilot Round 1 CSE pre-test and .537 for the Pilot Round 2 CSE pre-test, .688 for Pilot Round 1 EEO post-test and .661 for Pilot Round 2 EEO post-test. The item analysis based on Cronbach's alpha suggests that most of the items on the scale for both the Culture, Society, and Education (CSE) test and the Equal Education Opportunity (EEO) Meaningful Learning Test are measuring a similar construct. Only one item, 4) Organize, is distracting from the overall internal consistency of this scale for both tests. Thus, if this item were deleted or revised the scale would be improved, but only slightly. A close examination of this item indicated that it was consistently rated higher by the scorer, even when subjects received a low score overall on the test. The reason for this could possibly be that during the pilot study, the researcher responded to Pilot Round 1 feedback from the subjects about this question. The subjects thought the original question of including supporting details was too complex. Therefore, the researcher changed the question on Pilot Round 1 to exclude this component. After looking at Cronbach's alpha for this test question, the researcher worded the question in its original format.

CONSTRUCT VALIDITY

COEFFICIENT OF REPRODUCIBILITY FOR MEANINGFUL LEARNING SCALE

To determine the quality of the test in terms of meaningful learning, a Guttman scale analysis was done during pilot testing during the full study. The pre-test was used for the Guttman analysis to minimize the potential impact of the test-retest procedure. The Guttman's scale analysis used the pre-test results of meaningful learning tests in order to determine whether or not the questionnaire establishes a one-dimensional continuum for the higher level cognitive concepts in the reading-based decision making process (Trochim, 2006). When conducting the Guttman analysis, only responses that were given a 3 or 4 were counted. The reason for is that responses that were given a 0, 1, or 2 did not meet the criterion of a full accurate response while responses that received a 3 or 4 met the criterion.

DEVELOPMENT OF THEORETICAL FORMULATIONS FOR READING-BASED DECISION MAKING QUESTIONNAIRE

PRE-/POST-TREATMENT

Pre-treatment and post-treatment questionnaires were written by this researcher and were designed to measure the level of cognition used when using the expository textbook and were analyzed to determine whether the intervention positively influenced the level of cognition of underprepared college freshmen. The reading-based decision making questionnaire was given during the first session of class after the pre-test and

Table 3
Test Development Phase of Meaningful Learning Test

	Round I	Round II	Validation Study
Internal Consistency (Cronbach's Alpha)	.601 (Ch.10) .688 (Ch.12)	.537 (Ch.10) .661 (Ch.12)	.575 (Ch.10) .511 (Ch.12)
Item Analysis for Counter Balance Design			Pre .445 (Ch.10) .526 (Ch.112)
			Post .660 (Ch.10) .481 (Ch.112)
Guttman Scaling Analysis Pre Test Used	.86% (Ch.10) .90% (Ch.12)	.88% (Ch.10) .88% (Ch.12)	38% (Ch.10) 51% (Ch.12)
			Question 3 Eliminated 70% (Ch.10) 62% (Ch.112)

again during the last session of class after the post-test. The questionnaire consisted of 7 questions corresponding directly to the levels of Sternberg's reading-based decision making theory and 4 Sensitive Data questions that were included to determine if students were simply giving socially desirable responses to the questions (Carifio, 1997). Students were asked to respond true or false to each question with 'true' indicating that the student used the strategy and 'false' indicating that the student did not use the strategy. Thus, scores for each question are 0 for 'false' or 1 for 'true' with a potential maximum score of 7 for the entire questionnaire. In an effort to minimize the likelihood that students would give socially desirable responses, the questionnaire for the Post-treatment differs from the Pre-treatment version as it requires subjects to support and justify their answers with examples from the text. If subjects answered False to a question, they needed to explain why. If subjects answered True to a question, they needed to provide examples from the text that provides evidence that they used a decision that the question is asking about. Students had 5 – 10 minutes to complete the questionnaire. During the pilot testing, the test was reviewed by academic staff to assess the degree that the questionnaire captured reading-based decision making strategies of college students. The staff members determined that the test reflected reading-based decision making strategies expected to be used by successful college students. The characteristics of the Pre-and Post-Treatment Questionnaire are described below in the Psychometric Characteristics Properties of Pre- and Post-treatment Questionnaire.

Table 4
Pre-Treatment Questionnaire Scoring Criteria

Code 1	No decision was made. Student responded False to the question.
Code 2	A decision was made. Student responded True to the question.

Table 5
Post-Treatment Questionnaire Scoring Criteria

Code 1	No decision was made. Student responded False to the question.
Code 2	Decision was made but comments do not support the response of True. Example of a Code 2: "I just reread everything."
Code 3	Decision was made but comments weakly support the response of True. Example of a Code 3: "I used a study strategy."
Code 4	Decision was made and comments support the response. Example of a Code 4: "I used headings, subheadings, and initial paragraph headings to locate where in the text I might find the answer."

READING-BASED DECISION MAKING SCORING PROCESS AND TRAINING OF SCORERS

The following is the scoring process that was used on the questionnaires. In order to assist the people who were scoring the questionnaires, question 3 was used as a sample question. This question asked subjects if they decided to select and read parts of the text that were useful for the assignment. All examples given will be in response to this question. Please note that the scoring process on the pre-treatment questionnaire was easily determined by a True or False response. However, the scoring process on the post-treatment questionnaire was not as easy as the scorer must determine whether or not the subject provides examples and justifies their True responses with evidence that supports the decision that he or she said they made. The training for the scorers was similar to the training provided for the scoring of the meaningful learning tests described above in the Scoring Procedures for the Meaningful Learning Tests. Learning Center individuals scored both the meaningful learning tests and the reading-based decision making questionnaire.

RATING CODES AND SCORING CRITERIA FOR PRE AND POST-TREATMENT QUESTIONNAIRE

As with the meaningful learning test, Table 4 and Table 5 detail the scoring criteria for the pre-treatment questionnaire and the post-treatment questionnaire.

Table 6
Test Development Phase of Reading-Based Decision Making Questionnaire

	Round I	Round II	Validation Study
Internal Consistency (Cronbach's Alpha)	Pre -.223	Pre .352	Pre .325 Post .481
Guttman Scaling Analysis	Pre .84	Pre .82	47% Question 4 Eliminated 75%
Test Retest	.74	.63	N/A

PSYCHOMETRIC PROPERTIES OF THE PRE AND POST-TREATMENT QUESTIONNAIRE

The characteristics of the questionnaire were examined twice, first, during the 2-phase pilot testing with a small sample (N = 20 and N = 20), and then again with the full sample of the 72 subjects who took part in the formal study.

A TWO-PHASE PILOT STUDY

The same two-round pilot study that was used for the analysis of the conceptual understanding test was used to examine the reading-based decision making questionnaire. It should be noted that the response option wording on the pilot test questionnaire was 'yes' and 'no' rather than the 'true' and 'false' that was used in the final version.

There is no obvious reason for the negative Cronbach's alpha for the Round 1 pre-questionnaire. There does not appear to be any coding error, nor does the researcher think that there was a problem with the instructions during Round 1. (To investigate the matter further, additional item analyses were conducted with the Round 1 post-questionnaire and the alpha was small, .09 but positive.)

Given the inexplicable negative Cronbach's alpha for Round 1, only the item analysis for Round 2 was used to evaluate specific items. Thus, on Round 2 only one item, 6 Receive, was distracting from the overall internal consistency of this scale. The positive responses on this question may be due to a level of social desirability or to what subjects think they do, but actually do not. The addition of comments on the post-test may have helped with the negative values found in the item analysis for Round 1 and the outlier score for item 6.

INTERNAL CONSISTENCY

For the validation study sample, a test for internal consistency was conducted and Cronbach's alpha was found to be .325 for the Pre-treatment Questionnaire

and .481 for the Post-treatment Questionnaire. The item analysis based on Cronbach's alpha suggest that most of the items on the scale for both Pre- and Post-treatment Questionnaire are measuring a similar construct.

DATA ANALYSIS OF SOCIALLY DESIRABLE RESPONSES ON POST-TREATMENT QUESTIONNAIRE

Social Desirability looks at the way in which subjects respond to the questions being asked, especially those questions that are in the True/False format (Carifio, 1997). Socially desirable responses are those responses that subjects give because they believe it makes them look good. They answer questions according to how they think they should answer the question in order to be viewed positively by the instructor. There were 4 items on the Post-treatment Questionnaire that were designed to assess social desirability.

During the data analysis process, one of the Sensitive Data questions, Question 6, was determined to be a weak question and was eliminated from the data. This question asked the subjects, "I did not understand some of the concepts the author presented in the passage." Only 18 subjects responded True to this question and most subjects responded "False" to this question because they believed they understood all concepts presented in the chapter. Because this question resulted in an overwhelming amount of "False" responses, it was eliminated by the researcher when determining the respondent's social desirability rating.

A chi square analysis was done on the remaining 3 items to examine the relationship between the frequency of socially desirable responses and treatment condition. The observed chi square value was 2.22, p value >.05 with one degree of freedom (Table 7, next page). Thus, even though more experimental group subjects gave socially desirable responses, the results from the chi square analysis were not statistically significantly which suggest that there was not a meaningful difference between experimental and control groups in terms of the degree to which they were giving socially desir-

Table 7
Socially Desirable Responses

Group	High Social Desirability Many rating of 2 or 3 on at least 2 items	Low Social Desirability Few ratings of 2 or 3 on only 0 or 1 items
Experimental N=35	24 68.6%	11 31.4%
Control N=37	19 51.4%	18 48.6%
Total	43	29

Chi Square Value 2.22

p value >.05 with one degree of freedom

able responses. However, even though the results are not statistically significant, it is possible that differences on the questionnaire may be influenced by the tendency to give socially desirable responses.

Even though there is evidence of subjects giving socially desirable responses, the fact that the groups are not that significant suggests that the impact of inflated responses is probably similar across groups and therefore does not affect the overall interpretations of the impact of the interventions. From a practical perspective, eliminating the subjects who gave 2 or 3 socially desirable responses would significantly affect the total N's which would shrink to 29 from the original 72. (Note: As a check, the basic analyses were run with the smaller sample and overall pattern of results were not different from the results from the full sample. Also, the post-test questionnaire scores could make a justification for true responses, thus limiting the distortion due to students making a socially desirable response.

COEFFICIENT OF REPRODUCIBILITY: PRE-TREATMENT QUESTIONNAIRE

A Guttman's scale analysis using the pre-test results of meaningful learning tests in order to determine whether or not the questionnaire establishes a one-dimensional continuum for the higher level cognitive concepts in the reading-based decision making process (Trochim, 2006). The items on the questionnaire were ordered from low to high in terms of reading-based decision making processes.

INSTRUCTIONAL APPROACHES FOR EXPERIMENTAL AND CONTROL GROUP

All subjects were enrolled in a 6 week Literacy Lab course that met once per week. Students received 4 sessions of instructional time plus the first and last sessions being used for data collection. Each class session included 30 minutes of instruction in textual macros-

strategies with 20 minutes of group practice in effectively using the strategies with college level expository textbooks. During group practice, however, experimental classroom subjects received cognitive skill instruction in a specific level of reading-based decision making. The focus for instruction for the groups was on using textual macrostrategies. Also, all subjects were given a homework assignment using their Self Assessment Logs to complete before the next class and were submitted to the instructor at the start of the next class.

INSTRUCTIONAL MATERIALS FOR BOTH GROUPS

For instruction, the experimental and control groups were taught and allowed to practice literacy strategies using expository textbooks from the areas of Biology, Chemistry, History, Philosophy, Health, Psychology, and Sociology. Activities were based on the textual strategy taught during the lesson and students engaged in the textual strategy in their small groups after it had been modeled for them by the instructor. For example, for the first session the student activity was to write down the author, copyright date, table of contents, appendix, glossary, charts, graphs, and so forth of the textbook they had been given.

INSTRUCTIONAL FORMAT – CONTROL GROUP

During the first 30 minutes of class time, students received instruction in using textual macrostrategies with expository texts. The teacher modeled the strategy and during the last 20 minutes of class, group practice in the strategy occurred. During this time, students got in groups of 3 or 4 students and independently engaged in an activity based on the strategy. The teacher reinforced instructions in using the strategy and clarified directions for the group practice. In some cases, the entire group came back together during the final 10 or so minutes of class in order to share their activity. The homework assignment was then given for subjects to log their use of the strategies they used during the week.

INSTRUCTIONAL FORMAT – EXPERIMENTAL GROUP

During the first 30 minutes of class time, students received instruction in using textual macrostrategies with expository texts. The teacher modeled the strategy and during the last 20 minutes in class, group work in the strategy occurred. During this time, students got into groups of 3 or 4 students and independently engaged in an activity based on the strategy. During group work, the teacher instructed the small groups in the area of cognitive reading-based decision making. The teacher presented the reading-based decision making Practice Log and the cognitive skill being introduced for that session and discussed its application as it pertained to the use of expository texts and the literacy strategy they were currently doing in their small groups. The teacher wrote the cognitive strategy or strategies on a whiteboard and provided written examples of how to cognitively carry out the strategy. Then, the instructor introduced, explained, and modeled to the students the cognitive skill for that session and then asked students to incorporate the cognitive skill into their group work. The students then had the opportunity to incorporate that strategy into group practice of the designated literacy skill. For example, for the first session the student activity was to set a goal for the expository text activity that they were engaged in. They were also required to use the strategy on another text based assignment in another course they were taking and to write about it for homework. In another session, students were to write down the author, copyright date, table of contents, appendix, glossary, charts, graphs, and so forth of the textbook they had been given. The reading-based decision making Practice Logs were used in order for students to assess their own reading-based decision making level. In some cases, the entire group came back together during the final 10 minutes or so of class in order to share their activity. Finally, students were given a homework assignment where they needed to use the strategy they learned that day with another textbook from another class. They needed to provide a written description of how they used this strategy with the other textbook and explain whether or not they believed the strategy helped them.

DATA COLLECTION PROCEDURES: INTERVENTION AND DATA COLLECTION SCHEDULE

The students in this study were enrolled in a non-credit, non-graded Literacy Lab class that met once a week for 50 minutes over a six week period during the summer. There were three control group classes and three experimental group classes, as noted above.

Students were assigned to a control class or an experimental class depending on how the days and times of the experimental or control class fit into their schedule. Approximately 10 – 20 students were in each class. The same instructor, the researcher, was present for all experimental and control classes. There was approximately 30 minutes of instruction followed by 20 minutes of group work. The homework assignment was given using the Self Assessment Log.

MEANINGFUL LEARNING TEST DATA COLLECTION PROCEDURE

During the first and last class meetings, students took the pre-test and post-test, respectively. The tests were administered to the class, using the same test conditions for both tests. The written instructions focused the students on utilizing the photocopied textbook chapter in order to answer the questions. Students had up to 40 minutes to complete the test.

DECISION MAKING QUESTIONNAIRE DATA COLLECTION PROCEDURE

During the first and last class meetings, students answered a questionnaire after they took the pre or post-test. The questionnaire was administered to the class using the same conditions for both questionnaires. The written instructions focus the students on responding “yes” or “no” to a questionnaire regarding whether they used the expository textbook material for the pre-test or post-test. The post-treatment questionnaire was worded slightly differently, as it asked students to support and validate their answers with examples from the text. Students had up to 10 minutes to complete the questionnaire.

DATA ANALYSIS

Data was analyzed to determine whether the intervention was effective in (a) increasing conceptual understanding of the text and (b) increasing the level of reading-based decision making.

TWO-WAY CLASSIFICATION TABLE

A two-way classification table was used to analyze the two outcome measures of this study: (1) Mean Reading-based decision making Score and (2) Mean Content Knowledge Score. The two-way classification table allowed the researcher to see if the desired outcome of the study had been achieved in terms of a gain in scores between pre-treatment subjects and post-treatment subjects.

For data analysis purposes, students were classified

as having either Low Reading Ability or High Reading Ability. This classification was determined by their Critical Reading SAT score. If the subject had a Critical Reading SAT score of 409 or below he or she was classified as having Low Reading Ability. If the subject had a Critical Reading SAT score of 410 or higher he or she was classified as having High Reading Ability. The reason for this is that the state mandated minimum score on the Critical Reading SAT for acceptance into college is 410 or higher.

The design of this study was to assess the degree to which training in the cognitive skills of reading-based decision making improved the level of cognition and meaningful learning of underprepared college students, who were originally denied acceptance into a state college in the northeast because they did not meet state mandated requirements. Therefore, instruments were designed in order to assess the degree to which the instructional intervention improved the subjects' levels of cognition and meaningful learning.

DISCUSSION AND IMPLICATIONS

Instruments were developed to measure conceptual understanding and cognitive processing. The instrument to measure conceptual understanding followed Ausubel's meaningful learning theory (1978). There were six items on the instrument and two equivalent forms of the instrument were developed with subjects taking one form as a pre-test and the other form as a post-test.

The instrument used to measure cognitive processing (questionnaire) was developed to assess the pre and post intervention level of reading-based decision making behavior. The pre-treatment questionnaire contained 7 true or false items that related to Sternberg's Intelligence Model of Decision Making (1985). The post-treatment questionnaire was slightly different in that it contained the same 7 items with the addition of 4 Social Desirability items. Subjects were asked to respond 'true' or 'false' to each item and if they responded true to an item they then had to justify their 'true' response.

Suggestion for future use of the Decision Making Questionnaire: A suggestion for the questionnaire would include keeping the cognitive question "Monitoring" (Question 6) on the Decision Making questionnaire but re-wording the question so it better reflects the level of cognition it was intended to measure. The question as it was used in the study was designed to measure the cognitive decision level "Monitoring" in Sternberg's Intelligent Decision Making

model (1985). The question asked subjects if they had decided to keep track of their progress by looking at what they had already done and still needed to do. The question was not worded in a way that fully exemplifies the cognitive process of monitoring. Subjects might have inaccurately decided that they used a monitoring strategy when they actually had not. There are many possible reasons for subjects making this decision. A better re-wording of this question might include asking students if they kept track of their progress and how.

Suggestion for future use of Meaningful Learning Test: A suggestion for the future use of this test would be to reword Question 4 on the meaningful learning test. The question needs to be re-worded so that it better reflects the level of cognition that occurs at this stage of learning. The question as it was used for this study was designed to fit in with Ausubel's level "Organize" level of meaningful learning. It asked students to outline the main ideas of the text. Unfortunately, subjects seem to find great difficulty with doing this and scores were low for this question. A possible rewording of this question might include asking students to create their own outline of major and minor details of the text or to create an outline for only one paragraph of the text.

What is promising about the development of these tests is that they support both Ausubel's theory of meaningful learning (1978) and Sternberg's theory of intelligent decision making (1985). Because of this, the tests may be used as a shell and modified to fit a variety of academic disciplines with different age levels and different kinds of text. Looking at instrument in different context is a useful way of understanding what students can do after reading a text. For example, if an instructor wants students to understand major ideas of a text, the meaningful learning test can be modified to fit such a goal. This can be done by intentionally writing questions that focus on the bigger picture of the text.

Thus these instruments can be used as instructional tools for cognitive processing and for students to think about their own learning.

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APPENDIX A

CONTENT KNOWLEDGE TEST (CSE) ITEMS FOR CHAPTERS 10 AND 12*

Chapter 10: “Culture, Socialization, and Education”

Directions: Use the reading material you have been given to answer the following questions. Read the question and decide how to use the text to answer the question. There are 6 questions and you have 40 minutes to complete the assignment.

1. Define the following terms found in the text:

nuclear family

latchkey children

2. What are the four agents of socialization as presented in this chapter?

3. The text has a section about bullying that happens in school and out of school. Explain why the author included this section in this chapter of the text? Please use complete sentences.

4. Outline the main ideas of the text you have been given. You do not need to include supporting ideas or details.

5. Use the pro and con table on page 307 and evaluate how the author presents the impact of television and the media on students. What side do you agree with? Please use complete sentences.

6. As a first-year college student, you will be exposed to many different people, ideas, and experiences. Using some of the ideas presented in the text, list and explain how you can make your college experience a positive one both inside the classroom and outside the classroom (for example, in the cafeteria, in the gym, or in the dorm). Your answer must include ideas related to being in the classroom and out of the classroom. Please use complete sentences.

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Chapter 12: "Providing Equal Educational Opportunity"

Directions: Use the reading material you have been given to answer the following questions. Read the question and decide how to use the text to answer the question. There are 6 questions and you have 40 minutes to complete the assignment.

1. Define the following terms found in the text:

desegregation

multicultural education

2. What are the four characteristics of a well desegregated school?

3. The text has a section about multicultural education. Explain why the author included this section in this chapter of the text? Please use complete sentences.

4. Outline the main ideas of the text you have been given. You do not need to include supporting ideas or details.

5. Evaluate the author giving the chapter the title of "Providing Equal Educational Opportunity". Why do you think the author did this and was it a good idea? Please use complete sentences.

6. Pretend that you are a high school teacher or a college instructor. The school where you teach wants to do a better job with meeting the needs of a diverse study body. Use some of the major ideas presented in the text in order to come up with suggestions to help the college do this (for example, teaching students who have different learning styles, who are bilingual, etc.). Be creative and please use complete sentences.

APPENDIX B**PILOT AND REVISED VERSIONS OF PRE AND POST TREATMENT READING-BASED DECISION MAKING QUESTIONNAIRES]****Pilot Pre Treatment Reading-Based Decision Making Questionnaire**

Name _____

Class Day & Time _____

Directions: Place an **X** next to the response that best fits how you would describe yourself.

1. After I was given directions to this assignment, I was able to use the text material to meet the demands of the assignment.
Yes _____ No _____
2. While completing this assignment, I only selected and read parts of the text material that were useful for the assignment.
Yes _____ No _____
3. While completing this assignment, I organized the text material in a way that helped answer the questions.
Yes _____ No _____
4. While completing this assignment, I used a study strategy with the text to help me answer the questions.
Yes _____ No _____
5. While completing this assignment, I figured out how much time I needed to answer all of the questions.
Yes _____ No _____
6. While completing this assignment, I kept track of my progress by looking at what I had already done and what I still needed to do.
Yes _____ No _____
7. After completing the assignment, I will seek out feedback from the teachers or other students about the assignment and how I might have done.
Yes _____ No _____

Revised Pre Treatment Reading- based decision making Questionnaire

Name _____

Class Day & Time _____

Directions: Place an **X** next to the response that best fits how you would describe yourself.

1. After I was given directions to this assignment, I was able to use the text material to meet the demands of the assignment.
True _____ False _____
2. While completing this assignment, I only selected and read parts of the text material that were useful for the assignment.
True _____ False _____
3. While completing this assignment, I organized the text material in a way that helped answer the questions.
True _____ False _____
4. While completing this assignment, I used a study strategy with the text to help me answer the questions.
True _____ False _____
5. While completing this assignment, I figured out how much time I needed to answer all of the questions.
True _____ False _____
6. While completing this assignment, I kept track of my progress by looking at what I had already done and what I still needed to do.
True _____ False _____
7. After completing the assignment, I will seek out feedback from the teachers or other students about the assignment and how I might have done.
True _____ False _____

Revised Post Treatment Questionnaire

Name _____

Class Day & Time _____

Directions: Place an X next to the response that best fits how you would describe yourself after completing the assignment.

1. I was able to use the text to identify the resources to complete the task.

True _____ False _____

If True, please provide examples of how you did this.

If False, please explain why you did not do this.

2. I thought the passage was interesting.

True _____ False _____

If True, please explain why.

If False, please explain why not.

3. I only selected and read parts of text material that were useful for the assignment.

True _____ False _____

If True, please provide examples of how you did this.

If False, please explain why you did not do this.

4. I learned something new from the passage.

True _____ False _____

If True, please provide examples.

If False, please explain why not.

5. I organized the text material in a way that helped answer the questions.

True _____ False _____

If True, please provide examples of how you did this.

If False, please explain why you did not do this.

6. I did not understand some of the concepts the author discussed in the passage.

True _____ False _____

If True, please provide examples of what you did not understand.

If False, please explain why you understood everything.

7. I used a study strategy with the text to help me answer the questions.

True _____ False _____

If True, please provide an example of the study strategy you used.

If False, please explain why you did not use a study strategy.

8. The information in this passage will help me in my career.

True _____ False _____

If True, please provide examples from the text that will help you.

If False, please explain why not.

9. I figured out how much time I needed to answer all of the questions.

True _____ False _____

If True, please provide examples of how you did this.

If False, please explain why you did not do this.

10. I kept track of my progress by looking at what I had already done and what I still needed to do.

True _____ False _____

If True, please provide examples of how you did this.

If False, please explain why you did not do this.

11. I will seek feedback from the teacher or other students about the assignment and how I might have done.

True _____ False _____

If True, please provide examples of how you will do this.

If False, please explain why you will not do this.

A Study of the Effect of Daily Graded Reflective Journaling on Gains in Conceptual Understanding for High School Students Studying Newtonian Mechanics

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ABSTRACT

Daily, graded, reflective journaling by high school students studying Newtonian mechanics was the focus of this study. Literature is presented that establishes student misconceptions are an obstacle to the development of conceptual understanding of Newtonian principles and that the Force Concept Inventory (FCI), used in conjunction with the Hake gain analysis, is the accepted metric within the Physics Educational Research community for measuring gain in conceptual understanding of Newtonian mechanics and the effectiveness of instructional methodology. The Force Concept Inventory coupled with the Hake gain calculation revealed that for the Physics students and the honors Physical Science students that engaged in reflective journaling focused on the concepts being studied and how those concepts compared to their existing understandings achieved significant gains in conceptual understanding of Newtonian mechanics. The measured gains in conceptual understanding for these groups were found to compare favorably with other Interactive-Engagement instructional methodologies regarding the facilitation of gain in conceptual understanding.

Newton's laws of motion, a central topic of introductory physics courses, are understood through the concept of force. Many students enter into a study of Newton's laws with an existing understanding of force that has been derived through the use of common sense. According to Piaget (1970) scientific thought is based in large part upon common sense utilizing reflective abstraction to derive meaning from events. These understandings, derived through the use of common sense, do not align with the Newtonian concept of force. These notions are robust, and resist traditional physics instruction. These understandings can interact with the instruction, and thereby may modify the intended learning outcome (Halloun & Hestenes, 1985a). The commonly held and frequently scientifically inaccurate beliefs are the result of students' personal observations and intuitive thought processes that have not been exercised in a rigorous and thorough manner aimed at deriving a comprehensive understanding of the underlying principles responsible for producing the observed phenomena (Driver, 1990). In both science education research literature and physics education research literature, one will encounter many similar

terms, each referring to the existence of notions regarding the concept of force prior to instruction. The abundance of essentially synonymous terms referring to the same phenomenon is indicative of the prevalence of its occurrence.

Research indicates that the pre-instruction understandings derived from a "common-sense" approach to operating within the activities of daily living can contain internal inconsistencies which do not seem to be recognized by the individual (Halloun & Hestenes, 1985a). Traditional introductory physics instruction produces minimal change in the beliefs derived from common-sense (Clement, 1982), even when students have successfully learned problem-solving algorithms (Halloun & Hestenes, 1985b). The conceptual change theory (Posner, et al., 1982) was developed in response to research findings indicating that student pre-conceptions are ubiquitous and of a robust nature. The conceptual change theory acknowledges that unless the learner recognizes the discrepancy between his or her existing understanding and the scientifically accepted understanding, the existing misconception will probably remain the basis of the student's understanding. The conceptual change theory advocates dialogue between students around the concepts known to frequently inspire common-sense based understandings. The idea is that when students ponder the existence of a discrepancy between their understanding and the notion being proposed, an accommodation may occur within the learner's knowledge base through the required resolution of the discrepancy. Both internal speech and external dialogue may be involved in achieving the accommodation.

The justification of ideas is an implicit component within the conceptual change theory. If the justification of ideas is not recognized it is suggested that this characteristic be specifically modeled. The belief that knowledge is constructed both personally and through social interaction places an emphasis on social discourse focused on the topics under consideration. The discourse may take the form of whole class discussion, small group discussion, or small group discussion preceding whole class discussion. The discourse will optimally lead to negotiated meaning being adopted because that meaning is intelligible, plausible, and fruit-

ful, not because the teacher has stated it is such. The discussion needs to be explicitly meta-cognitive (Hewson & Beeth, 1993). Meta-cognition has been defined by Baird (as cited in Etkina, 2000) as “knowledge awareness and control of one’s own learning” (p.604). An adopted meaning is an accommodation, and will not occur until the status of the existing understanding is challenged in the mind of the learner (Posner, et al., 1982).

The conceptual change theory influenced the creation and design of many of the non-traditional methods of instruction (Etkina, & Van Heuvelen, 1991). The term interactive-engagement strategies is synonymous with non-traditional methods. This term emphasizes the fact that research inspired, non-traditional classroom reforms share the commonality of engaging the learner in activities and discussions designed to crystallize the existence of a misconception, if one exists.

The recognition that existing student understandings can mediate the effect of instruction, and that the traditional model of introductory physics instruction is ineffective at replacing student preconceptions with Newtonian alternatives for the majority of students (Halloun & Hestenes, 1985b), led to the development of the FCI (Hestenes, Wells, & Swackhamer, 1992). The Force Concept Inventory, (FCI) is a thirty item multiple choice assessment that offers four Aristotelian (common sense) choices, and one Newtonian response to each question. The FCI has become, and continues to be, the standard formative assessment and instructional technique evaluation instrument within the physics education research community when an evaluation of learning with respect to Newtonian mechanics is conducted. Recently O’Brien and Thompson (2009), in a study investigating the effectiveness of ninth-grade physics instruction, stated, “we used normalized gain as a means of measuring conceptual learning since it is commonly used as a figure of merit for instruction measured by the FCI” (p.237). The FCI is frequently utilized in a pre-instruction, post-instruction pairing that is analyzed to measure student gain with respect to learning Newtonian concepts. Gain $\langle g \rangle$ (the average normalized gain) is calculated by dividing the actual average gain (% posttest - % pretest) by the maximum possible average gain (100 - % pretest) (Hake, 1998a).

The normalized gain $\langle g \rangle$ was introduced as a metric in a publication of a meta-analysis of the 62 data sets (N = 6542). This paper reports on the average effectiveness of a course at promoting conceptual understanding, which is defined as the average normalized gain $\langle g \rangle$ (Hake, 1998a). Average normalized gain was chosen as the statistic for reporting the results because it

allowed for comparisons over diverse student populations, with widely varying initial knowledge states, and the correlation between $\langle g \rangle$ and the average initial knowledge state, $\langle S_i \rangle$, for the 62 courses was + 0.02. Average normalized gain for a course is defined as the ratio of the posttest class average % – pretest class average % to 100% – pretest class average. In reporting the results of the meta-analysis, Hake (1998a) grouped the data by instructional methodology for these courses. The range of scores for course averages was categorized as: high gain ($\geq .7$), medium gain ($.7 > g \geq .3$), and low gain ($< .3$). The fourteen traditionally taught courses yielded an average gain of .23, with all 14 data points falling within the low category. The forty-eight courses incorporating some form of interactive-engagement (IE) strategies yielded an average gain of .48, close to two standard deviations above the traditionally taught courses. An average of the individual class averages ($\langle \langle g \rangle \rangle$) that contributed data to this study was reported. For the 14 traditionally taught classes (T), N = 2084, $\langle \langle g \rangle \rangle = 0.23$ plus or minus 0.04 standard deviation (sd). For the 48 IES courses 41 fell within the medium gain region, with 7 falling in the low gain region. The $\langle \langle g \rangle \rangle$ for these courses was 0.48 plus or minus 0.14sd. Coletta and Phillips (2005) stated, “the importance of Hake’s work cannot be over-emphasized; normalized gain provides a readily accessible, objective measure of learning in introductory mechanics” (p. 1172).

STUDENT REFLECTIVE JOURNAL WRITING

Reflective journal writing, a student learning activity shown to contribute to conceptual understanding in other learning environments, such as pre-service training of teachers (Bell, 2001), business management, clinical psychology and higher education (Bolton, 2005), but currently underutilized in physics instruction, requires the journalist engage in inner speech (reflection) around the learning activities and their implications. Interactive-engagement methodologies are not restricted to verbal interaction but may also include writing that reflects upon interpersonal as well as intrapersonal dialogue. The attributes associated with reflective journal writing are similar to those identified within interactive-engagement instructional methodologies. These attributes include gathering and integrating facts and observations to arrive at an understanding as well as framing a justification for the understanding through the use of language.

In describing the role of instruction, Mestre (2005) relates that the teacher must probe student understanding to check that instruction is leading to students con-

structing knowledge that is aligned with accepted scientific understanding. It has been noted that without some formative assessment the instructor may be left with illusions regarding learning, rather than insight that can inform instruction (Mazur, 1997). In a publication relating findings from cognitive studies to the teaching of physics, Redish (1994) states that “to find out what our students know we have to give them the opportunity to explain what they are thinking in words” (p.798). Reflective journal writing is a student centered activity that serves as a formative assessment, promotes meta-cognitive reflection, and has promoted conceptual understanding in other learning environments. Because reflective journal writing is engaged in outside of the classroom, it is possible that this strategy may mitigate some of the curriculum coverage loss associated with other interactive-engagement strategies.

For this study the treatment involved embedding student graded reflective journal writing within classes studying the Newtonian concept of force. The hypothesis is that by encouraging reflecting on the lesson, and how the concepts as presented in class fit with the student's existing understandings about those concepts, then giving a place for the reflection to be recorded, the probability of thinking about the lesson in a reflective way is increased. That increased probability of reflection increases the odds of connections being made between the lesson and the student's pre-existing understanding. This is especially helpful for the instance where the learner holds a misconception. Many researchers, including Posner, et al. (1982) and Mestre (1994) have commented on the requirement for the learner to recognize the misconception they hold before they will be able to replace that understanding with the scientifically accepted construction.

The data were collected from a large suburban high school of roughly 1800 students. Three Physics teachers and four freshmen Physical Science teachers participated in the study. The researcher participated in the study as the instructor of one Physics class consisting of 24 students. One of the participating teachers taught a Physics class of 27 students and a Physical Science class of 21 students. The other four participants taught a treatment group and a control group of the same subject and level. One of the Physical Science teachers, in addition to instructing the aforementioned treatment and control group pairing, taught a third Physical Science class. The study (N = 274) was comprised of twelve classes. There were four Physics classes (N = 97), two of which were treatment groups and two of which were control groups. Three of the Physics classes were honors level and the one non-honors Physics class was

a control treatment group. The eight Physical Science classes consisted of four honors level classes (two treatment groups and two control groups), and four college non-honors classes (two treatment groups and two control groups). There were no lower level courses that study Newtonian mechanics available for this study.

PROCEDURE

The teachers participating in the study were given a ninety-minute training session. The training included an overview of the study, dissemination of the pre-test instruments, example student graded reflective journals collected the previous semester to help teachers get a feel for the task, (each teacher kept the example journal for reference for the duration of the study), and hand-outs for both the treatment groups and control groups that consisted of guiding questions to help students focus on the desired type of reflection and example reflections (both good and bad examples). The post-test instruments were distributed after the pre-test instruments were submitted to the researcher.

The graded reflective journal entry was graded but not on the quality of the writing. The grade was based on the attempt by the student to use the guiding questions as well as the student's analytical skills to record a reflection. The idea is that the requirement to reflect, daily, is meant to be a catalyst that may help the student recognize the existence of a misconception and facilitate a temporary state of cognitive disequilibrium leading to accommodation and a new cognitive equilibrium, or if a misconception is not present, assimilation. At a minimum the reflecting might raise a question in the learner's mind that may be asked in discussion, or pondered leading to a transformation in knowledge. In combustion reactions lead or platinum atoms give the reactants a location to meet, thus facilitating the reaction. In the cell an enzyme as a catalyst also gives the reactants a place to bind and react. That is the idea behind the reflective journal: by requiring reflective, analytical, thinking about the lesson and the concepts presented in the lesson, then giving a place for the reflection to be recorded, the probability of the previously described outcomes is increased. The repetition of this process over time may help the student develop the capacity to think about force and motion in a Newtonian fashion.

Students that were absent did not reflect on that day. When total points for the reflections were tabulated the software calculated points earned divided by points possible thereby calibrating only for days present. The study occurred over a six to eight week period. No students earned a grade of incomplete due to fre-

quency of absence, eliminating the potential for that post-hoc adjustment. The cumulative effect of daily reflection grades combined with weekly summary reflection grades over the duration of the study contributed to the term grade.

The grading (0–2 quiz points per day) is intended to imply the importance of reflecting because what is assessed is what is perceived as valued (McDermott, 1991). If a journal entry is made, 1, point is achieved. If the reflection is judged to be a sincere effort to reflect on the day's lesson the second point is achieved. No entry results in 0 points. Grammar and spelling are not considerations when evaluating the reflection, although they are corrected when required. The language skills of the learner are not an important factor; reflecting on the lesson as opposed to not reflecting on the lesson is. Each weekend the student is required to make a summary reflection based upon the entire week's lessons. This reflection is worth 0 to 5 points. For a five day week this results in 15 quiz points available to each student.

Each student received a hand-out regarding the type of journaling assigned, treatment or control, upon completion of the pre-test, which was given during the first weeks of the semester. Each group received instruction on the requirement of making a daily reflection in their journal which was graded on a weekly to bi-weekly basis. The treatment groups' focus for the reflection is the day's lesson and how the content of the lesson relates to the student's existing understanding regarding that topic. A hand-out that includes an explanation of why journaling was required, a set of questions designed to focus the student when journaling, and a set of authentic student reflections from a previous year (from the geometric optics section of the curriculum), meant to serve as a model of reflective journaling for the students, was distributed upon completion of the pre-test.

The grading and explanation of journaling for the control groups were done in the same manner as the treatment groups. A difference between the control groups and the treatment groups includes the focus of the reflection. For this group the focus of the reflection is on how events outside of the class influence their disposition toward school in general, and towards particular classes if the student believes that only certain parts of their school life are being affected, and how outside of school issues and events might impact in-class learning. Another difference between groups was the guiding handout, which is specific to the focus of the reflection. The example reflections for the control group handout did not come from pre-existing student journals, as that focus of journaling had not been required in semesters preceding the study. The example reflections for the

control group were generated by the researcher so as to provide consistency between the treatment and control group introductory instruction. The inclusion of graded journaling for the control group is meant to control for a rival hypothesis, which is that a difference in time-on-task may be responsible for any difference between groups detected through statistical analysis. The variable of interest is the comparison of gains in conceptual understanding for the treatment group versus the control group.

The change in conceptual understanding regarding the linked concepts of force and motion was measured with the FCI, given as both a pre-instruction and post-instruction assessment. After instruction on Newton's Laws, force, and motion was completed the FCI was included in the mid-course examination, which contributes toward the first term grade. The Hake gain analysis was computed. The instrument's design and some of its history has been described previously. As previously described the FCI has frequently been used to measure the effectiveness of an instructional methodology at improving student conceptual understanding regarding the Newtonian concept of force. Many studies using traditional instruction as the control and IES as the treatment have found significant differences in gain in conceptual understanding, as measured by the FCI, with the gain difference between IES and traditional instruction sometimes being as large as the two sigma gain (Bloom, 1984) found to be associated with personal tutoring as opposed to traditional classroom instruction. The claims regarding comparative effectiveness of a particular Physics Education Research (PER) inspired reform to traditional physics instruction methodology are based upon the commonly utilized methodology of FCI pre-test/post-test for treatment and control groups. The metric of comparison is $\langle g \rangle$.

A student exit survey was conducted after the post-instruction administration of the FCI and CLASS. The student post-assessment survey solicited comments, two per student, regarding what the students liked or found helpful about the graded daily journal writing. The students were asked for two comments regarding what each disliked or found distracting about the journaling activity. These responses were categorized, rated, and tallied to determine the breadth and frequency of responses. This data attempts to capture information, through student self-reporting, to allow assessment of the correlation between student perceptions of the activity and parameters measured by the instruments used. These comments also provide data that can be used in the continuation of the study, and for future research.

Table 1

A Treatment by Course Type by Gender (2x2x2) ANOVA on FCI Percent Gain Scores

	Experimental						Control					
	Physics			Physical Science			Physics			Physical Science		
	N	Mean	SD	N	Mean	SD	N	Mean	SD	N	Mean	SD
Females	10	75.4	14.68	47	25.3	13.79	18	31.34	19.43	45	14.76	17.92
Males	39	64.2	22.64	39	31.84	17.72	30	40.04	22.68	46	17.46	18.30

	df	Mean Square	F-ratio	P	Omega Squared
Treatment	1	9084.13	18.50	< .001**	.065
Level	1	35580.33	78.56	< .001**	.228
Gender	1	3720.08	7.58	.006**	.028
T * L	1	770.99	1.57	.211	.006
T * G	1	12.76	.026	.872	< .001
L * G	1	102.32	.208	.648	.001
T * L * G	1	1558.38	3.17	.076	.012
Error	266	491.12			

R squared = .356, Adjusted R squared = .339

Note: T = Treatment, L = Level, G = Gender

** significant differences between groups

*** interactions between factors

Data analysis occurred in three phases. The first phase was to establish data condition, quality, and group similarities, as well as check various assumptions regarding data analysis. Student demographics were used to describe how similar these groups are. This was assessed using ANOVAs to test on background and pretest variables. Phase two explored the data using various univariate techniques (ANOVA, multiple regression, and frequency of response analysis) to understand the design and how it worked analytically and statistically. The appropriate statistical model and procedures were then selected for the final phase. The goal was to select the analysis that will yield the highest power, strictest family-wise error rate control, and the smallest error component for each test. The final phase included ANOVAs on the FCI scores.

RESULTS

The results are presented by contrasting the treatment group results with the control group results. Differences between results with respect to gender and course level are also presented. For all cases group comparisons are done using the .05 confidence level for the rejection of the null hypothesis. The data analysis began by establishing how equivalent or not the groups in this study were initially on the major variables of interest. The equivalencies of the baselines influence both the analyses of effects done and the interpretation of results. The established baselines allow for comparison of the

results of this study to the results of other studies that have been done, or that will be done in the future.

As can be noted from Table 1, the gain in conceptual understanding of Newtonian mechanics was not equal across Treatment, Level, or Gender. The F-ratio of 78.56 for the analysis that compares gains in conceptual understanding by level indicates that there is a significant difference between the gains for honors level students versus non-honors level students. The honors level students experienced greater gains in conceptual understanding over the time interval of the study than non-honors level students. Figure 1 (next page) illustrates this difference graphically. At first glance the fact that the slopes on each graph are parallel and of roughly equal length might give the impression that the gains, though starting at different values were equal in magnitude. This illusion is created by the unequal intervals for the y-axis values on each graph.

In terms of treatment, the experimental treatment resulted in significantly higher gains for both the Physics and Physical Science students. This findings supports the interpretation that when students spend time reflecting on the lesson they have just participated in, and record their reflections about the lesson and how the information in the lesson compares to their existing understandings in a journal on a daily basis, and follow up each in conceptual understanding of the week's daily reflection with a weekly summary reflection then the gain in conceptual understanding may be

enhanced. It can also be seen in Table 1 that roughly 23 percent of the difference between groups can be attributed to the unequal effect of the level difference upon gains in conceptual understanding.

It can also be seen in Table 1 that there is an inequality in gain regarding conceptual understanding with respect to Gender. In general the males had greater gains than the females. The exception to this pattern is the experimental treatment females who exhibited the greatest gain of any group. The 75.4% gain for this group means that on average three out of every four questions that were answered incorrectly prior to entering into instruction on force and motion in Physics were answered correctly at the end of instruction on these topics. This is an atypically high figure and would be categorized as high gain, which in Physics Education Research literature is accepted as evidence of an instructional methodology that facilitates learning with a magnitude of effect similar to that measured for individual tutoring. Inspection of the Physics control treatment female group gain score which had atypically low scores prior to instruction on both conceptual understanding and scientific attitude toward conceptual understanding reveals that while being the lowest mean gain score within the Physics groups this score was not below the Physical Science mean scores although it is roughly equal to the highest Physical Science mean score, that of the experimental treatment males.

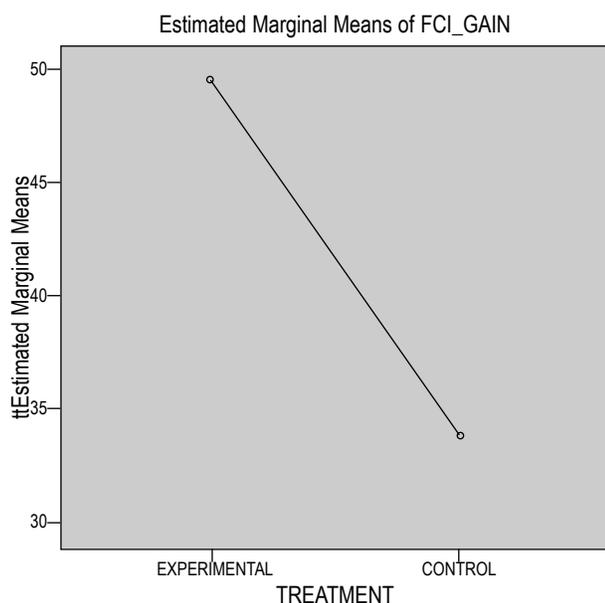
Post-instruction data was also collected regarding student perceptions of the journaling. At the end of the study of Newtonian mechanics, after the post-instruc-

tion FCI assessment was completed, students were asked to submit two comments on what they found helpful or enjoyed with respect to the journaling activity as well as two comments regarding what they did not like or didn't find helpful about the journaling. Student responses were tabulated then categories were identified based on the relative frequencies of responses

The bulk of the students comments about their perceptions' regarding the type of journaling done align with the findings comparing the gain in conceptual understanding with respect to Newtonian mechanics to the type of journaling done. It was found that the treatment journaling yielded greater gain for conceptual understanding than the control journaling. The imbalance between the experimental and control group comments regarding aspects of the activity that would be associated with the process of learning such as the enhancement of targeted learning and higher order thinking skills by experimental treatment subjects indicates that the students engaged in the treatment journaling found greater value in that activity than the control journaling students found in that type of journaling.

Analysis of the results of the positive and negative comments may validate that students found the journaling to be a significant part of the treatment that contributed to their learning in the experimental group but not so in the control group where students did not write about the Newtonian content. Therefore, it was not simply achievement effects observed but writing about the content being studied. Also it was not additional

HONORS LEVEL



NON-HONORS LEVEL

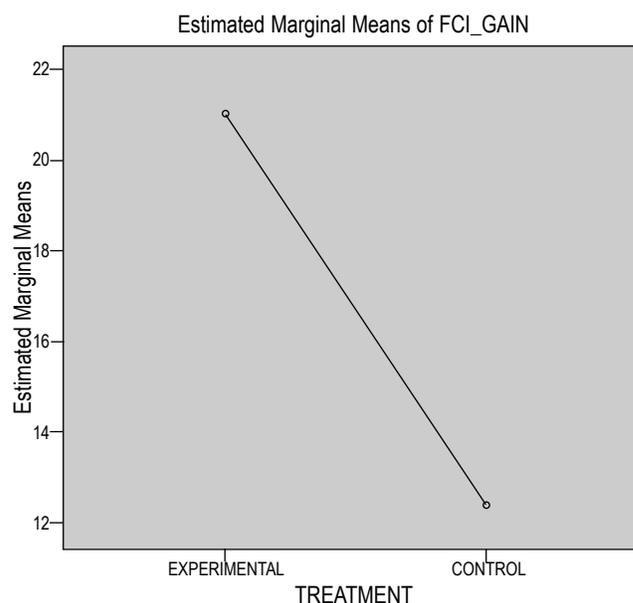


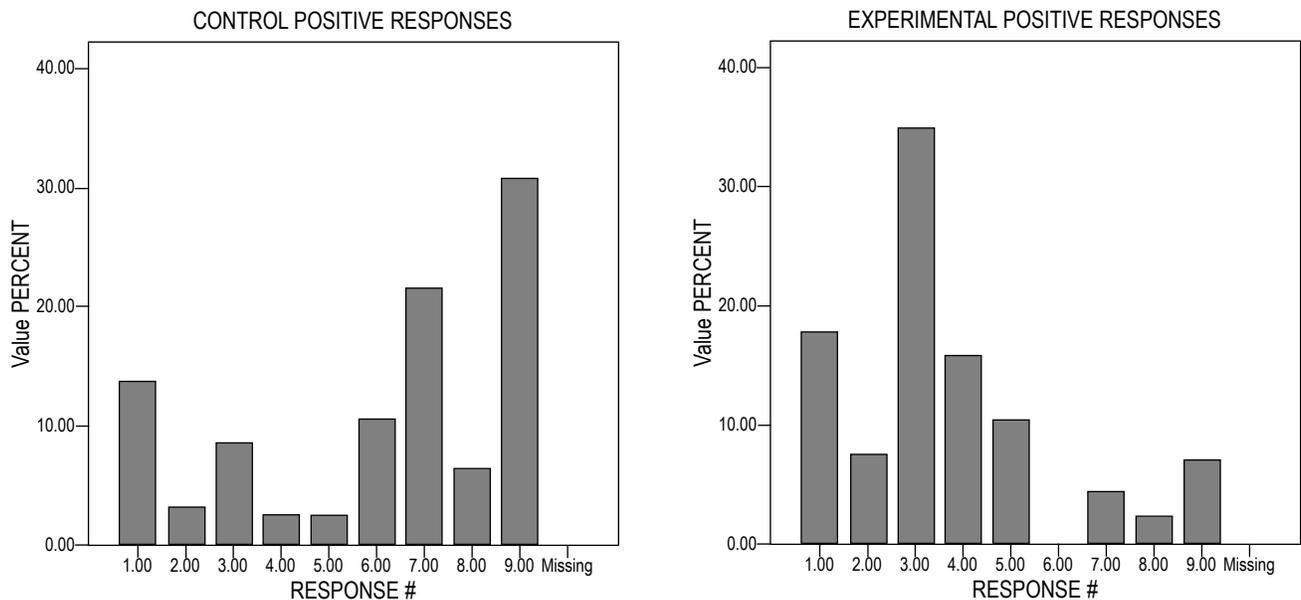
Figure 1. Gain in Conceptual Understanding by Course Level

instructional time that produced the effects observed but additional instructional time engaged in learning Newtonian mechanics. The data about the effects and characteristics of journaling provided by students strongly supports that it was the journaling about Newtonian mechanics that was contributing to the achievement gains more strongly than the noise elements (i.e. instructors, differing baselines, and so on) within the study.

Both the learning outcomes as measured by the FCI through gain analysis and the perception of value by the participants indicated through the frequency of responses within the journaling macro categories post study comments support the conclusion that daily graded reflective journaling, focused on how the day's lesson fits with the existing understanding of the learner, followed by a weekend summary of the weeks learning facilitated greater gain in conceptual understanding than as well as a stronger perception that engaging in the activity was beneficial in terms of facilitating better learning outcomes. The control journaling which was also graded and done on a daily basis, followed by a weekend summary, yielded less conceptual gain for Newtonian mechanics, yielded fewer positive comments relative to learning activities and usefulness, and

also produced more negative comments.

A quick perusal of the topographical contour of the respective graphs indicates that the frequency and types of responses on the student end-of-study survey was dissimilar between groups. As can be seen from Figure 2 some of the differences between the positive comment frequencies for the experimental treatment and the positive comments frequencies for the control treatment these are dramatically different. The treatment versus control response frequency totals for the Enhancement of Understanding Content were 34.5% for the experimental treatment and 8.5% for the control treatment indicating that the students that were required to reflect on the lesson were four times more likely to perceive a benefit in terms of developing conceptual understanding than the students that were required to reflect on how outside of the classroom issues might impact their learning. The belief that the type of journaling done Enhances Higher Order Learning response totals were 15.5% to 2.7% with the experimental group again many times greater in the frequency of offering this comment than the control group. The distribution of responses for the macro category, Enhances Memory of, or Retention of, Content Knowledge totals were 10.4% for the experimental treatment and 2.5% for the control



Response Number Key:

- | | |
|---|---|
| <ul style="list-style-type: none"> 1. Enhances Reviewing Targeted Content (including review of problems & labs for tests) 2. Enhances Academic/Study/Science Writing Skills (includes developing discipline & memory skills) 3. Enhances Understanding Targeted Content 4. Enhances Higher Order Learning (includes thinking, application, & question generation) | <ul style="list-style-type: none"> 5. Enhances Memory/Retention Targeted Content 6. Enhances Emotional Expression 7. Other (including untargeted review/easy grade) 8. None 9. Response Left Blank |
|---|---|

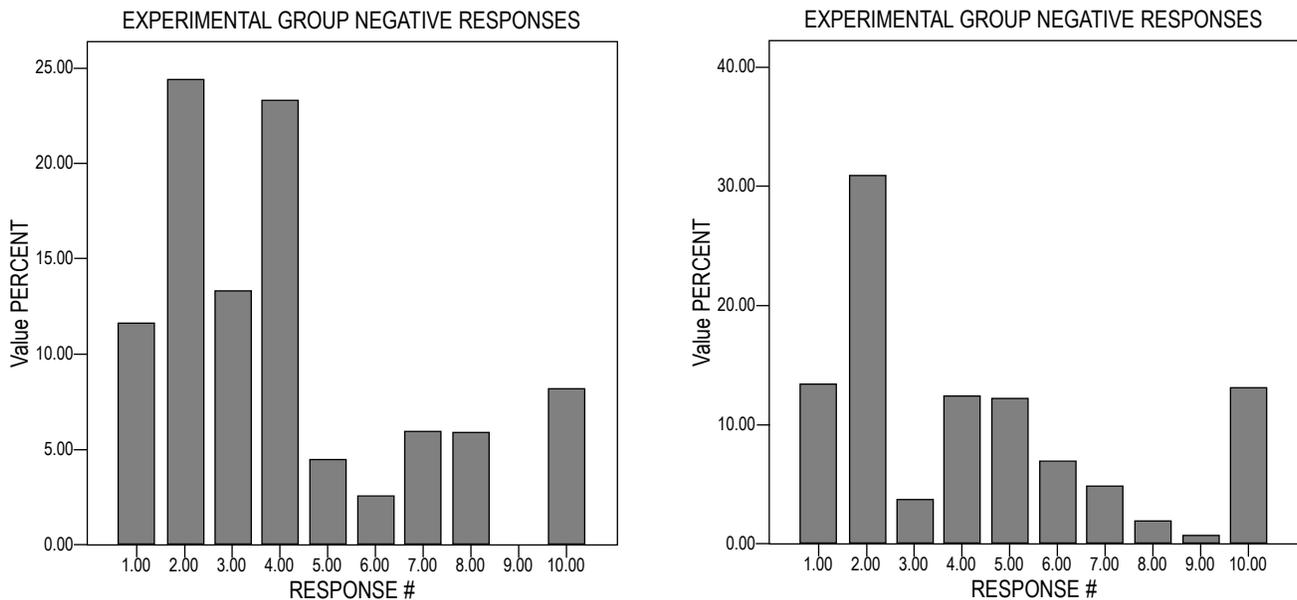
Figure 2. Positive Response Frequencies by Treatment Type

treatment. The response frequency totals for the Enhances (Periodic) Reviewing of Targeted Content totals did not differ by as wide a margin as other categorical responses but was a favored response for 17.6% of the experimental group and 13.8% of the control group respondents.

Three other Positives of Journaling Macro Category frequency of response totals can also be seen as informative based upon response frequency inequalities. The first of these categories is the Enhances Emotional Expression macro category. The control journal group frequency total of 10.6% within this macro category does not seem large until compared to the fact that 0% of the experimental treatment group offered this response. This statistic could be interpreted to indicate that roughly 1 of every 10 control group students used the focus of the control journaling, which was to reflect on how issues outside of the classroom affected their in school experience as an opportunity to put their emotional state in writing.

A review of the topographical contour of the negative response graphs reveals some dissimilarity in the frequency of response patterns between the treatment groups, but a difference that is less pronounced than the Positive of Journaling comments. As can be seen from Figure 3 the frequency of response totals that support this observation include frequencies of 24.5% for the

control journalists and 31.0% for the treatment journalists in the Tedious, Boring, or Monotonous macro category. The control journalists responded with a 12.1% frequency in the Not Relevant to Learning or Useless macro category, while the experimental treatment journalists responded at a 4.5% frequency in this category. Another macro category in which there was a significant difference in the percentage of responses between the journaling groups was the Pace of Instruction (too fast or too slow) macro category. The contradictory sub categories within this macro category were found to be related to the subject/level differences within the study. The honors level physics students accounted for roughly 57% of the comments within this category, although they comprised only 26% of the study participants, with most of the comments from these students being related to the curriculum coverage pace of about a chapter per week which the commenting students felt was too fast to expect the students to also record reflections on their lessons on a daily basis. Most of the comments inferring that the pace of curriculum coverage was too slow actually took the form of complaining about having to do a journal entry every day. These comments most frequently mentioned that sometimes you were doing the same topic for multiple days in a row but still had to reflect on it every day. The frequency distribution in the Pace of Instruction macro category was 13.4% for the experi-



Response Number Key:

- 1. Memory Problems/Blanking
- 2. Tedious, Boring, Monotonous
- 3. Pace of Instruction (too fast/too slow)
- 4. Cognitive/Homework Load of Task
- 5. Not Relative to Learning/Useless

- 6. Privacy/Grading Issues
- 7. Lack of Skills to Do Task
- 8. Other (including reduced instructional time)
- 9. None
- 10. Left Blank

Figure 3. Negative Response Frequencies by Treatment Type

mental group and 3.7% for the control group. Within the Privacy Issues or Grading Issues the experimental treatment complaints came largely from freshman boys who would forget to do the journaling and felt they should not get a grade penalty, the total frequency for the experimental treatment was 2.6%. In the same category the most common control treatment negative comment related to being asked to write about what some students considered their personal life and having a grade attached to this requirement. The control treatment response frequency within this category was 6.9%. Roughly equal percentages for each group found it difficult to remember to do the journaling each day, or remembering what had been done on a given day when they got around to recording the journal entry. In the Memory Problems/Blanking macro category 11.6% listed remembering to do it as a negative while the frequency of this response was 13.5% for the control group.

One of the categorical frequency of response differences implied that the experimental journaling requirements demanded more effort than the control journaling requirements for the study participants. This category was the Cognitive Load or Homework Load macro category. There was a large difference in the frequency of respondents that complained, if negative comments can be viewed as complaints, about the journaling adding to the homework load or how hard it was to understand what they should write. The frequency of responses in the Cognitive/Homework Load of Task macro category was 23.4% for the experimental treatment and 12.4 % for the control treatment. These figures seem to reflect that trying to evaluate how what was presented in the day's lesson fit with the individuals existing understanding is a more challenging cognitive task than identifying if events that take place outside of the class are having an effect on the ability to concentrate and learn when in class. The comparison between treatment types of the frequency of responses within the Negatives of Journaling Macro Categories, while not as unbalanced, comparatively, as the frequency of responses within the Positive of Journaling Macro Categories were, also indicate that the treatment journalist found the activity less boring, more relevant to learning, and harder to do, which would be viewed as a good thing because learning is an effortful endeavor.

SUMMARY

For this study, analysis of the baselines for the experimental treatment group versus the control treatment group revealed interactions for the Treatment by Gender and Gender by level existed at the .001 confi-

dence level for the conceptual understanding of Newtonian mechanics prior to instruction. It was also found that a Treatment by Level by Gender interaction existed also at the .001 confidence level with respect to the scientific attitude toward conceptual understanding between the treatment groups. It was determined that the differences that existed regarding these interactions were not homogenous between treatments.

Pre-instruction ANOVAs by Treatment by Level by Gender revealed that prior to instruction the control treatment Physics females were atypically low on both of the measured variables. It was also found that gender differences existed regarding conceptual understanding of Newtonian mechanics and level differences existed for the scientific attitude toward conceptual understanding as the study began.

ANOVAs on Treatment by Level by Gender were then conducted on the post-instruction status and the Hake gain regarding conceptual understanding and the scientific attitude toward conceptual understanding. It was found that the experimental treatment was more effective at facilitating gain in conceptual understanding ($F = 36.49$; $P = <.001$), with the honors level experiencing greater gain than the non-honors level. In general it was found that males experienced a greater gain than females for conceptual understanding ($F = 10.77$; $P = .001$) but the most dramatic improvement in conceptual understanding occurred for the female honors level Physics experimental treatment group which saw a very large (75%) gain. This outcome must be evaluated with respect to the very small sample size for this group ($N=10$). The females in the Physics control treatment saw gains on this variable which were not as high as the other Physics groups but were not significantly lower than the honors level Physical Science males which was the status for their conceptual understanding at the beginning of the study.

Frequency of response analyses for the Macro Categories regarding positive comments and negative comments from students on an end-of-study survey indicated that students in the experimental treatment viewed that activity as useful for activities associated with learning while the control journaling students viewed that activity as useful for emotional expression, which is not an attribute usually associated with benefit when learning Newtonian mechanics. The students in the experimental journaling not only derived greater benefit in learning Newtonian mechanics through participation in that type of journaling, they perceived the activity as beneficial. This student perception may have contributed to the apparent shift to experimental treatment journaling by some members of the control journaling group.

DISCUSSION AND CONCLUSIONS

A body of evidence suggesting that interactive-engagement methodologies were more effective than traditional instruction at facilitating conceptual understanding accrued (Hake, 1998a; Mazur, 1997). It has also been reported that while IE instructional methodology seems to be required to produce gains in conceptual understanding greater than 30%, the boundary between the traditional instruction range and the moderately effective range (Hake, 1998a), IE methodology in and of itself is not sufficient to produce moderate or large gains in conceptual understanding (Hake 1998b). Variables found to interact with the instructional methodology thereby modifying the gain in conceptual understanding include mathematical skills, English language proficiency, and educational background (Hake, 1998b).

For this study none of the cited confounding variables was directly measured. The educational history for the study participants is related to the course level choice of the student. It seems reasonable to infer that students that have chosen the honors level for a course most probably have had a more successful educational background and accordingly would be more likely to show a greater gain differential than students that chose the non-honors level. The findings of this study suggest that educational background did play a role in influencing the magnitude of measured gain. It was found that the students in the honors level courses had significantly higher gain in conceptual understanding, approximately 42 %, than students in the non-honors level courses, approximately 17 % ($F = 34.5$, $p < .001$). The average gain by course level includes both treatments.

When the gain by treatment by level for this study is calculated it is found that the honors level experimental treatment gain of 50% is significantly higher than the 35% gain of the honors control treatment students ($F = 78.56$, $p < .001$). These results suggest that the experimental treatment may be more effective at facilitating gains in conceptual understanding than the control treatment. It is also noteworthy that the both treatment groups for the honors level courses in this study showed gains in conceptual understanding within the moderately effective range of the instructional methodology effectiveness scale. It is also noteworthy that both honors level treatment groups had dramatically greater gains in conceptual understanding than either of the non-honors treatment groups.

The non-honors gain by treatment values are 21% gain for the experimental treatment and 13% gain for the control treatment ($F = 23.1$, $p < .001$). Each of these

gain values is within the traditional instruction gain range and indicates that neither the experimental nor the control treatment was effective at moving the non-honors students in this study toward Newtonian thinking to any significant degree. After instruction the mean raw scores for each of these treatments remained below the random guess value of 20% which is another indication that neither treatment method was effective for these students.

For both the honors level and non-honors level the experimental treatment yielded greater gains in conceptual understanding than the control treatment. The hypothesis for this study is that if students engaged in the kind of reflection required to recognize the discrepancy that exists between common-sense based understandings and the accepted scientific understandings soon after the lesson, then more students would move toward a Newtonian conceptualization. May and Etkina (2002) reported that there seems to be a correlation between gains in conceptual understanding and the ability of the students to reflect upon their learning. May and Etkina (2002) found through analysis of required, graded, weekly reflections that high gain students reflected on the learning activities and the meaning found through reflecting on those activities while low gain students tended to repeat teacher statements or list formulas in their weekly reflections. The relationship between gain and meta-cognitive skills reported by Etkina and Eisner (2003) offers a possible explanation for the type of gain exhibited by both the honors experimental level treatment and the non-honors experimental treatment. Here it was found that high gain students possess the meta-cognitive skills required of reflection and are therefore predisposed to benefit from reflective journaling while the low-gain students seemed to lack the meta-cognitive skills to reflect and therefore did not derive much benefit from the activity. While Etkina and Eisner (2003) used only six high-gain and six low-gain students but if their conclusion is applied to the findings of this much larger sample then it may indicate that daily, graded, reflective journaling is a more appropriate mathemagenic activity for those students that would be expected to have more fully developed meta-cognitive skills such as honors level students. The findings of this study with respect to the non-honors level students and the evidence from the May and Etkina (2002) and Etkina and Eisner (2003) study seem to imply that reflective journaling may be a learning activity that is appropriate for honors level students taking high school introductory Physics and Physical Science courses but not for non-honors level students.

Differences in gains with respect to conceptual

understanding were also found to be based on the course type. The mean gain for Physics students was 43% while the mean gain for Physical science students was 22% ($F = 124.7, p < .001$). The Physics students were high school juniors and seniors that had taken the Physical Science course as freshman. Given the age and cognitive maturation differences, and the fact that the Physics students had already received formal instruction in Newtonian mechanics at the high school level as freshman, it is not surprising that the gain in conceptual understanding for the Physics students was greater than the gain for the Physical Science students regardless of journaling type. This may be taken to imply that the more you know to begin with, the more you are likely to learn over an interval of instruction. The fact that Physics is an elective subject traditionally chosen by the most successful students while Physical Science is a graduation requirement that all freshman must take may also contribute to the gain differential between the courses.

Hake (1998b) has reported that English language proficiency also interacts with the instructional methodology, and as all IE methods involve reflection upon concepts and discussion of understandings it is not surprising that English language skills contribute to the effect of instruction on gains in conceptual understanding. As journaling is a language based treatment, the effect of English language skills upon the outcome of a language based treatment may be a variable that should be studied. English language competence was not a measured variable in this study but the age and maturation difference between freshman Physical Science students and the Physics students previously described could have been a contributor to the course type mean gain differential measured through the probable difference in English language skills.

Data collected regarding the student positive and negative response frequencies submitted at the end of the study indicate that the type of response submitted was related to the type journaling the student engaged in. The comparison between the experimental treatment groups' and the control treatment groups' gain scores and comments suggests that the experimental treatment journaling was more effective at facilitating gain in conceptual understanding than the control journaling and that this difference was perceived by the students. Other evidence supporting the claim that the study participants viewed the experimental treatment journaling as more effective at facilitating conceptual understanding and thereby promoting higher grade scores is the indirect evidence of possible crossover from control treatment journaling to experimental treat-

ment journaling by roughly 25% of the control journaling participants sometime during the study. This indirect evidence is the post-hoc analysis of the end-of-study positive and negative comments submitted by the students. If this crossover did occur, and if and when it did occur is not identifiable, the fact that the crossover seems to have occurred only from control journaling to experimental journaling offers strong support for the conclusion that the students viewed the experimental journaling as a more desirable learning activity. As studies relating the effect of reflecting journaling upon conceptual gain to the students' perception of the journaling activity have not been reported the findings of this study cannot be related to other research findings.

In concert, all of the data collected regarding the effect of the experimental treatment journaling strongly suggest that the experimental treatment journaling was more effective than the control treatment journaling at facilitating gain in conceptual understanding for the students in this study. The two explicit sets and one implicit set of evidence each support this conclusion. Quantitative analysis of experimental treatment gain versus control treatment gain by course type, course level, and gender have yielded greater gain for the experimental treatment, although not always a statistically significant difference. Analysis of the frequency of responses within the macro categories for positive and negative responses on the students' end-of-study survey also indicate that students in the experimental treatment group perceived a greater academic benefit in association with this type of journaling than was perceived by the control treatment journaling group. The implied evidence was the apparent partial or complete crossover from control treatment journaling to experimental treatment journaling by almost 25% of the control journaling students. This is implicit because, as has been previously described, this is based on the type of comments submitted on the end-of-study comment sheet. The fact that the spurious crossover occurred, if it did occur, only in the direction of control treatment to experimental treatment is indirect evidence that some students through conversation with peers or through instruction regarding the study by the teacher seem to have decided that there would be personal benefit to doing the experimental journaling as opposed to, or combined with, the assigned control journaling.

This study took place over a six week period. It may be that the acclimation period for the students took place over a part of the study thus reducing the positive effect of the experimental treatment with respect to the benefit that may have been derived if the treatment continued throughout the course. It is feasible that during

the acclimation period the unfamiliarity of the activity and the learning curve associated with engagement in a new activity initially diminished the positive effect of the journaling and the thereby the benefit of reflection on the topics being studied.

Given the homogeneity of the students that participated in the study and the small sample size available for the study, which becomes even smaller when the Physics groups are separated from the Physical Science groups, and the unequal distribution of gender within the Physics study groups, it may be that the most important contribution of this study is in the direction of future research. The findings of this study will only be significant if they can be replicated with large heterogeneous samples and at schools of various sizes and geographical settings.

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Educational Resources

The Copernican Revolution in Science Class: Why Not?

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ABSTRACT

Copernicus' "On the Revolutions of the Heavenly Spheres" is a math- and empirical-based argument that demonstrates that a sun-centered model for the universe is as legitimate a predictor of astronomical phenomena as a model, which places the earth in the center of the universe. Because Copernicus' work represents a fundamental change in how the universe was conceived, it started a scientific revolution. The way Copernicus wrote his work is an excellent example of persistence at logical proof, citation, review, criticism of resources, and critical thought. As such, Copernicus' work is an excellent example of collaborative, inquiry-based scientific work, and can be a good model for science students. Many of today's science educators claim to support inquiry-based methods, but they seem not to be using the Copernican Revolution in their classes. This is an enormous opportunity lost for students. It is possible effectively to teach the Copernican Revolution in a short amount of class time. Science educators should, therefore, study the possibility of introducing their students to Copernicus.

This paper is about Nicholas Copernicus' "On the Revolutions of the Heavenly Spheres," (1543), (hereinafter, "On the Revolutions"), the historical context in which it came to be written, what it contributed to the world discussion about the universe, and how Copernicus' methods of proof are a model for professional scientific work. The paper discusses some of the philosophical implications of Copernicus' work and attempts to characterize where Copernicus stands as a philosophical figure. The paper then examines state, national, and international science learning and testing standards and asks why studying the Copernican Revolution is mentioned in the teaching standards, while at the same time apparently not being addressed in the world's classrooms. After a statement strongly advocating the position that the Copernican Revolution is a perfect opportunity for students not only to learn about the solar system, but also to learn how science has been done in the past, plus how students can engage science in the present, the paper gives some guidelines for how to bring Copernicus to the classroom, even in these days of limited time due to the

omnipresence of high stakes testing. "On the Revolutions" is an experience that every student of science should witness.

HISTORICAL AND PHILOSOPHICAL SIGNIFICANCES OF THE DEVELOPMENT OF THE COPERNICAN SOLAR SYSTEM

HOW COPERNICUS CONCEIVED THE HELIOCENTRIC SOLAR SYSTEM

Ever since the days of the ancient Chaldeans, Egyptians, Chinese, and Babylonians, people have looked to the skies for patterns that might predict the start of planting seasons, eclipses, and other sky-related phenomena. Even from ancient times, many cultures have been successful at predicting these things with great measures of precision (Pannekeok, 1961). Although most of the stars have appeared never to move, everyone has noticed that the moon, the sun, the planets, and many comets move about against the background of the stars, apparently fixed in their positions in the sky, and that many of these heavenly bodies, most obviously the sun and the moon, move in fairly regular and predictable patterns. Explaining how and why some heavenly bodies appear to remain fixed, while others move has long been a human pursuit. Among the questions that have long arisen, and which Copernicus (1543) addressed thoroughly is that of how the planets seemed to retrograde, or move in one general direction most of the time, but occasionally went for a period of days or weeks in the opposite direction before resuming their normal paths once again. Another of Copernicus' questions was how planets brightened and darkened regularly over the months and years of their travels through the skies. Yet another question that Ptolemy and Copernicus (1543) addressed extensively was how Mars, Jupiter, and Saturn seemed to move in long periods, far from the sun, while Mercury and Venus tended to move in short periods, staying close to the sun.

From the days of the classical Greeks through much of the Middle Ages, the conventional wisdom among

philosophers and observers of nature was that the cosmos were earth-centered, the earth sitting still in the middle of everything, while all other heavenly bodies orbited the earth, or else orbited points in space that were themselves orbiting around the earth in patterns called epicycles (Derry, 1999). Derry has stated that although the Greek Aristarchus proposed a sun-centered universe with all else circling around the sun, this idea was not considered a serious explanation to the motion of heavenly bodies. Copernicus (1543) himself explained that such a proposal went contrary to the very simple observation that the earth was immense and heavy, and seemed to move only during earthquakes, while the stars and planets appeared to be small and easier to move about. Citing Ptolemy, Copernicus (1543) rhetorically asked how immense, solid earth could possibly move, while the tiny stars were firmly fixed? Derry (1999) has explained that the earth-centered idea put forth by many, including Ptolemy, was therefore held to be the best explanation. Kuhn (1962) noted that because Ptolemy could mathematically predict astronomical phenomena with some limited accuracy by using a system of circular motions of the planets, this earth-centered idea was considered by most to be the best explanation for things astronomical. Copernicus (1543) explained that because Ptolemy's idea obeyed the metaphysical Platonic idea of perfect circular motion and the Aristotelian idea that earth was at center, with water, air, and fire stacked above it, Ptolemy's explanation was philosophically pleasing to nearly all scholars.

According to Copernicus (1543), there were several ancient Greek scholars who proposed a sun-centered universe; Copernicus wrote that Plato traveled all the way to Italy to discuss philosophy with Philolaus, another believer in such a model, and a man whom Plato greatly respected. According to Derry (1999), an astronomer named Regiomontanus proposed the idea of a sun-centered universe a generation before Copernicus, but he focused his proof on precise measurements, rather than on trying to use his new model to predict astronomical phenomena. Copernicus was the first astronomer who attempted to predict astronomical phenomena, such as the orbital inclinations and retrogrades for all the planets, through a math-based sun-centered model, a fact which Copernicus (1543) himself proudly asserted many times throughout "On the Revolutions." Derry (1999) wrote that Copernicus' model offered a mathematical proof, and because he published his work for others to review and challenge, Copernicus often has received credit for starting the international conversation about which model best

explained motion among heavenly bodies. That Copernicus (1543) cited his sources, ancient and contemporary, again and again throughout the text of his proofs and discussions no doubt added to the credibility of his writing. Because Copernicus' proof admitted to the strengths of Ptolemy's model, while at the same time using Euclidean geometry to prove the validity of his own model, he established a sun-centered universe as a believable alternative to Ptolemy's geocentric solution.

HOW COPERNICUS' WORK QUALIFIES AS THE START OF A REVOLUTION

The troubles that Galileo endured for espousing Copernicus' heliocentric model are common knowledge. Not as commonly known is that Copernicus' model initially found great support in the Roman Catholic Church and that Copernicus actually dedicated "On the Revolutions" to Pope Paul III. Although the Church eventually banned the work, it was not until decades after it was published and discussed among many scholars throughout Europe. How, then, could Copernicus have received credit for starting a revolution without having made a loud or violent exposition of it? Webster (1986) has defined 'revolution' broadly as "a complete or radical change of any kind (p. 1218)." Simply put, Copernicus' model, which assumed that the sun was at the center of everything, was so completely contrary to the Ptolemaic model, which kept the earth at the center of everything, that it could be characterized as a fundamental change in understanding of how the heavens operated.

The process of scientific revolution, or the rearrangement of ways to explain and predict phenomena, is the primary topic of Kuhn's (1962) book. While Popper (1979) asserted that Kuhn's analysis of how ideas change did not apply equally to all scientific disciplines, Popper gave Kuhn credit for providing a useful way to understand how ideas have changed in astronomy. Kuhn labeled this useful means of understanding the transition from one model to the next model a paradigm shift. The case of changing from Ptolemy's geocentric model of the universe to Copernicus' heliocentric model is a classic example of such a paradigm shift.

According to Kuhn (1962), a paradigm is an overarching idea that defines a particular science's 'big picture,' and directs much of the research conducted by scientists in that field. Kuhn has written that Ptolemy's model was astronomy's paradigm for over a thousand years because this paradigm succeeded at mathematically predicting astronomical phenomena when no

other model could do so. Kuhn asserted that as long as a model can predict and explain phenomena, direct research, and explain anomalies (observations that appear at first not to match the paradigm's predictions) in the absence of any other model, the science could be considered to be proceeding 'normally.' Kuhn wrote that most of the research done in normal science is to fine-tune the model so that it can make predictions and explanations with better and better accuracy.

According to Kuhn (1962), a crisis occurs when an anomaly is observed which the model cannot explain. In that situation, Kuhn said, scientists often try to ignore the anomaly, or else they try to expand the paradigm to include it. The crisis, Kuhn wrote, occurred when the paradigm began to lose its ability to explain things. Copernicus (1543) described exactly such a situation in the fifth book of "On the Revolutions," as he noted that the calculations one needed to make under the Ptolemaic model were overly complex and frequently led to erroneous results. What made Copernicus' contribution revolutionary in the sense that Kuhn (1962) described a revolution is that the math-based heliocentric model could also predict astronomical phenomena. Kuhn noted that the height of a scientific crisis occurs when one or more competitors to an existing dominant model proves to be able to answer questions that only the old model used to answer, and improve the method and accuracy of answering them in the process. Although Rosen (1978) warned that Copernicus' model was guilty of producing erroneous results, this is what happened when Copernicus proved that a heliocentric model could predict astronomical phenomena with equal or better accuracy than the then-dominant geocentric model. Kuhn (1962) thus described a crisis in increasing complexity of calculation under the old model which Copernicus' model partially remedied by creating a far simpler overall concept.

Kuhn (1962) explained that science does not move in gradual baby steps, but that science often makes enormous leaps which are revolutionary. Although some scholars have disagreed with Kuhn's characterization of the evolution of scientific ideas, one can hardly argue that shifting from an earth-centered to a sun-centered model of the universe is in any way a gradual change. So fundamental are the conceptual and philosophical differences of those opposing world-views that the Copernican transition quite clearly meets the definition of 'revolution' stated by both Kuhn (1962) and Webster (1986). This is not to say that Copernicus accomplished the entire revolution himself. As Derry (1999) has written, Copernicus started the debate in earnest; however, it took decades of discussion and

attempts to falsify Copernicus' model to consummate the revolution.

Although most middle and high school students are not able to grapple with many of these philosophical ideas, the change from one scientific model to another that thoroughly reverses the first model is an excellent example of how revolutionary changes can occur in scientific thinking. How to consider such a revolution in the context of a high school or middle school science curriculum is addressed below.

PHILOSOPHICAL CONCERNS

The story of the ascendancy of Copernicus' (1543) argument usually centers around the simplicity of his model, as compared to the labyrinthine complexities of Ptolemy's epicycles. Indeed, at the end of the 5th and 6th books of "On The Revolutions," Copernicus (1543) demonstrated complete geometric proofs of most of the planets' predicted movements, but then listed other movements still left to compute, leaving the reader to compute them with Copernicus' assurance of the simplicity of what he developed in each chapter. Also, in the dedication of "On The Revolutions," Copernicus (1543) rhetorically made fun of the strangeness of his own sun-centered argument as he introduced it to the Pope, calling its absurdity and novelty good reasons not to have published it (pp. 3-4). However, by the end of the first book's ninth chapter, Copernicus had laid aside all notions, real or rhetorical, of absurdity, as he explained the retrogrades simply and succinctly. At that point, Copernicus announced, in clear contradiction of his earlier disclaimer, that it was sensible to place the sun at the universe's center.

However compelling Copernicus' simplicity and accuracy of prediction may have been, these qualities of his model are not the whole story. In fact, Rosen (1978), in his commentaries to "On The Revolutions," noted that Copernicus' calculations were fraught with errors, some because of poor data from other astronomers, but others of Copernicus' own doing. In Chapters 7 and 8 of the first book of "On the Revolutions," Copernicus (1543) went to great lengths to define the distinction that Ptolemy had made between uniform motion and violent motion. Violent motion, Copernicus explained, was most commonly associated with up and down movement, where uniform motion was associated with circular motion. After explaining that the earth could spin without leaving the clouds behind, (an argument that had frequently been offered against the notion that the earth spun), Copernicus (1543) explained that the heavens ought to be immobile and stable, as they were the dwelling place of the divine, while Earth, populated by

man, ought to be that which experienced the violence. Copernicus (1543) asserted that to keep the earth in the center of the universe was to subject the heavens to the violence by moving the heavens, rather than the earth. Of course, this argument contradicted itself, as Copernicus had asserted that circular motion was not violent. Nevertheless, the underpinning of the argument was a metaphysical stance, based in proffered perfection of circular motion and the nobility of the heavens.

Given this metaphysical aspect to Copernicus' work, Feynman (1974) might wonder whether that portion of Copernicus' arguments might be classified along with cult sciences. Similarly, Derry (1999) would likely warn that most scientific thinkers have tried to stay away from metaphysical arguments for their unfalsifiability. Kuhn (1962) would likely have defended Copernicus on the grounds that it was common for true scientists to rely on nearly pure philosophical thought and thought experiments such as geometric proofs during times when their sciences have faced crises of paradigm. Additionally, because of Copernicus' detailed proofs and cited facts, his model could in fact be falsified. Therefore, in spite of having some metaphysical underpinnings, Copernicus' argument was certainly in the realm of science and not false science.

This logical and metaphysical underpinning of Copernicus' argument is philosophically significant in that it likely placed Copernicus in the camps of both the rationalists and the empiricists. Derry (1999) noted that Copernicus used a tremendous volume of empirical data, which he cited again and again throughout "On the Revolutions." However, Derry reiterated that the totality of the logical foundation for the proof that Copernicus offered is the Euclidian geometry of circles, arcs, tangents, chords, and parallel lines. As a good rationalist would, Copernicus (1543) stated his premises first, and then moved step-by-step through each of the many proofs throughout the books of "On the Revolutions." As noted above, Derry (1999) contrasted Copernicus' reliance on mathematics with Regiomontanus' reliance on precise measuring instruments. This placed Regiomontanus along with Galileo closer to the camp of the empiricists, while Copernicus, by placing most of his faith in the logic of mathematics, was closer to the rationalists, although neither scientist could be placed entirely in one camp or the other. Philosophically speaking, Copernicus therefore restricted himself to the same sorts of observations, thought experiments, logic, and peer review that most of today's scientists deem essential to scientific research and discourse.

DEVELOPMENT OF THE COPERNICAN SOLAR SYSTEM: RARELY EXPRESSED IN TODAY'S CLASSROOMS AND ASSESSMENTS

MASSACHUSETTS CURRICULA, TEACHER AND ASSESSMENT STANDARDS, AND TEXTBOOKS

According to the Massachusetts Department of Education's Science and Technology Curricular Frameworks (2006), (The Frameworks), most of the coverage of the solar system is found in Earth and Space Sciences, and Physical Sciences. According to The Frameworks in the Earth and Space Sciences, third through fifth graders should know that the solar system has the sun at the center and sixth through eighth graders should be able to construct a scale model of the solar system and use such a model to help to explain the seasons. The Frameworks also states that in the Physical Sciences, high school students should be able to understand circular motion and universal gravitation. Nowhere in either of The Frameworks' Earth or Physical Science sections is history of science or Copernicus mentioned. The only place in The Frameworks where one encounters Copernicus is in Appendix III, where the History-of-Science sections mentions the Copernican Revolution. The Massachusetts Department of Education's Comprehensive Assessment System (2010), (MCAS) is consistent with The Frameworks, in that out of 102 released science questions, five cover facts about the solar system, three cover the moon's phases, and two cover the universe, galaxies, and other topics, while zero questions focus on the development of scientific models in general, or Copernicus specifically.

With regard to assessing teacher competency, the Massachusetts Department of Education's Tests for Educator Licensure (2009) (MTEL) field topics is likewise consistent. For example, while the MTEL's Earth Science Field objectives cover hypotheses and idea development, plus models of the universe and how the solar system works, it never mentions the Copernican Revolution. Similarly, the MTEL's Physics Test Objectives spends most of its language on the generalities of scientific inquiry, although it does mention Kepler and Copernicus directly. However, in MTEL's set of practice questions for Physics content knowledge, zero of the 100 questions cover astronomy at all, let alone the Copernican Revolution. Furthermore in MTEL's set of practice questions for Earth Science content knowledge, while 15 of 100 questions address astronomy, only one question deals with Newton's laws as applied to space, and there are no questions at all dealing with Copernicus.

In high school textbooks, the situation for Copernicus is equally grim. Many texts do not mention Copernicus at all, even in passing. Examples of this are Hurd, et al. (1991), Zitzewicz et al. (1999), and Halliday, et al. (1997). A number of commonly-used texts mention Copernicus in passing, devoting one to two sentences to his model, but saying nothing about how that model was developed. Examples of this are Taffel (1986), which compares a brief description of Ptolemy's model to a brief description of Copernicus' and asks which one is right; Serway, (1996) which mentions Copernicus in one sentence; Serway (1994), which compares Copernicus and Ptolemy in two sentences, and gives them credit for working on the problem; Beiser (1991), which mentions the Copernican system in a passing description on the way to introducing Kepler; and Fishbane et al. (1996), which includes two marginal diagrams and ten lines of text comparing the two systems, but mentioning nothing about the development of either model. Haber-Schaim et al. (1981) expands slightly in their treatment of Copernicus, by briefly stating that there was a controversy between proponents of the Ptolemaic and Copernican systems, and that Copernicus was reluctant to publish his findings; however, no insights are provided about how Copernicus proved his case, nor is any explanation given as to the reasons for the controversy between proponents of the two systems. Hewitt (1998) also mentions Copernicus' theory briefly, but gives no explanation of the theory's development or merits, and only mentions that there were many philosophical arguments that initially ran against it. Hewitt (1998) briefly noted that Galileo supported Copernicus' model, but says little about the heart of the controversy.

The Hewitt book is quite troubling in that many schools nationwide have adopted it as the preferred non-math-based text in the Physics First programs for 9th graders. (As Physics First has not yet become a widespread movement in Massachusetts, that program and Hewitt are addressed in more detail below). Another troubling aspect of high school textbooks is that some of the more advanced ones, presumably used to train students pursuing more advanced science, say little, if anything, about the Copernican Revolution. Of the books cited above, Halliday et al, Serway (1996), Zitzewicz, and Fishbane's make either no mention at all or only a sentence or two's passing reference to the Copernican model. The only textbook that does justice to the historical development of Copernicus' model and the controversy that arose around it is the Project Physics (1981) text, which spends four full chapters covering over 100 pages of text on the development of

various models of the universe, from Ptolemy's to Newton's. This book explains in detail the controversies, the proofs, and the consequences of these interactions in a readable format that is designed for high school students. The only problem with this text is that very few schools are using it.

Overall, then, the Massachusetts education system pays very little attention, either through its curriculum structure or through its state student assessments, its textbooks, or its standards for licensing its teachers, to the development of the Copernican system or the cataclysmic revolution that publishing that system eventually caused.

NATIONAL AND INTERNATIONAL ASSESSMENT STANDARDS AND TEXTBOOKS

Nationally, there are many resources that define goals and standards for science education. The discussion that follows is not exhaustive, but it does consider a few of the more widely followed sets of national standards. Probably the most wide-reaching of these efforts to coordinate curricular objectives is the American Association for the Advancement of Science's (1993, 2009) (AAAS), *Benchmarks for Scientific Literacy* (Benchmarks). Benchmarks' (2009) overall concerns, mostly stated in Benchmark 1, are generally for students to be able to grasp overarching principles in science and to master skills necessary for scientific inquiry. Benchmark 4 (2009) is where the AAAS addresses standards for content knowledge in the Physical setting. Benchmarks 4-A and 4-B address the universe and the earth specifically, and the historical development of the modern view of the universe and Copernicus are specifically mentioned. The National Research Council's (1996) (NRC) *National Science Education Standards* (NSES) likewise promotes an inquiry-based approach to the study of science that fosters collaborative learning and peer review. NSES' (1996) sixth chapter addresses science content standards, and the solar system is specifically mentioned in the Earth and Space Section. However, under the History of Science section, the NSES (1996) standards are very general, focus on the social history of science, and mention no specific scientific creations or discoveries. The NRC's *Taking Science to School* (2007) (TSS) is another overarching set of science teaching guidelines. Like the NSES standards, TSS devotes its entire sixth chapter to the topic of understanding how scientific knowledge is constructed, without discussing specific cases from the history of science. In TSS' section on Mature Cosmology, Copernicus is specifically noted, but only as a model, and not as an example of scientific revolution.

Another nationwide effort at organizing how science teaching is conceived and executed is the Physics First movement, introduced above. This effort is inspired by Project American Renaissance in Science Education (1998) (Project ARISE), which advocates strongly for Physics to be the first high school science taught, in part because many Chemistry textbooks use Physics principles as prerequisites for Chemistry, and many Biology textbooks use Chemistry principles as prerequisites for Biology. Project ARISE (1998) blames the Committee of Ten's 1893 science curriculum recommendations for what Project ARISE calls a science curriculum whose courses are taught in exactly the wrong order. As a result of Project ARISE's advocacy, many schools are restructuring their high school science sequences to feature Physics in the 9th grade. Whether Physics should come first is beyond the scope of this discussion; however, the fact remains that many school systems are trying it, and this has created an enormous demand for Hewitt's concept-based text, which, like much of the NRC literature, contains very little analysis of the development of scientific revolutions or the Copernican system.

National assessments reflect the omission of the history of science. The College Board's Scholastic Assessment Test (2010) (SAT), for example, notes that in its Subject for Physics, only 4 to 9% of all questions involve miscellaneous items such as astronomy or history of science. None of SAT's (2010) practice questions asks for knowledge of astronomy. ACT International's American College Test's (2010) (ACT) Science practice test has a similar set of questions. Of 40 ACT questions, 7 are based on astronomy, but these questions require only knowledge of the current model. Although the ACT is more skills and science inquiry based than the SAT, neither test examines the history of science in any way.

International assessments are quite similar to what one finds variously on the MCAS, the ACT, and the SAT exams. The Institution for Education Services' (2010) (IES) Trends in International Mathematics and Science Study (TIMSS), a widely administered and highly regarded international test for 4th and 8th graders, releases for public review approximately half of all its test questions after each test has been administered. In 1999 and 2003, for example, 74 eighth grade science questions were released and only 3 of them addressed astronomy; none of them questioned the history of astronomy. In those same years, 80 fourth grade questions were released; of them, 3 addressed astronomy topics, and none of them addressed history of science. The Organization for Economic Co-Operation and

Development's (2010) (OECD) Programme for International Student Assessment (PISA) is, as the TIMSS, an international scientific literacy test, but this one is administered to 15-year-old students. Similar to the TIMSS, the PISA is widely-administered and highly regarded internationally. Similar to MCAS, SAT, ACT, and TIMSS, PISA releases practice questions to the general public. Of 34 questions currently offered for public review, the vast majority are environmental in nature, with only three questions addressing topics in astronomy. Of these three questions, one addresses the student's knowledge of the current model of the solar system to address questions involving the seasons; one addresses the safety of viewing the transit of Venus across the sun, and the other addresses light pollution as a problem interfering with star gazing. None of these questions addresses the notion of the development of scientific ideas.

Overall, then, whether one examines Massachusetts, American, or international standards for science education, one can find language that generally supports the development of scientific skills and an inquiry-based approach. However, when these standards are actually examined, there is very little attention paid to historical cases that actually demonstrate scientific development or discourse. The Copernican Revolution is mentioned in name only, but does not appear to be practically relevant to the education of most of the world's children.

COMMENTARY: WHY IS THE GREAT SIGNIFICANCE OF A FUNDAMENTAL SCIENTIFIC REVOLUTION SO RARELY EXPRESSED IN TODAY'S SCIENCE CURRICULA OR ASSESSMENTS?

Given the rich, interdisciplinary opportunities that studying the Copernican Revolution has to offer, and given the high regard that the many educators claim to place on inquiry-based science, it is surprising to find that there are few, if any places where historical instances of inquiry-based scientific principles are reviewed. Although examining textbooks and teacher and student assessment test questions is not a formal proof that the Copernican Revolution is not being taught in classrooms, such an examination of the available materials certainly legitimizes the question of whether the Copernican Revolution and other foundational developments in the history of science are being adequately addressed. If the development of such rich ideas is not being discussed with students, then educators need to ask either why such developments are being ignored, or else whether addressing the many

struggles over scientific ideas would fail to help students to learn or appreciate science.

Science is a process that involves observing and measuring phenomena, speculating, analyzing, testing hypotheses, and the like. However, science is also a human drama and it is drama that has a host of interesting and challenging stories that are part of its history. To leave the world's students with no knowledge of science's stories, and to leave the students instead with only a mass of nursery rhymes and myths, novels and political-figure stories, is to leave the human part out of the students' science learning. An approach to science that leaves out the struggles that have occurred and still occur in the individual and collective human mind seems to leave the thinking out of science education, and to reduce science learning to formulas and 'facts.'

HOW THE COPERNICAN REVOLUTION MIGHT BE INCLUDED IN TODAY'S CLASSROOM TEACHING AND ASSESSMENTS

LEARNING OBJECTIVES

Probably the simplest objective to be met through considering Copernicus' (1543) "On the Revolutions" is to convey the content knowledge that the earth travels around the sun, that the earth spins on its axis, and that this axis is tilted. As such, Copernicus gives the student the basic model and information needed correctly to answer state and national test questions. Were an in-class treatment of Copernicus' work to provide only that information, it might be best to skip the story and simply show the students an illustrated model of the solar system and explain how it can help them to understand the seasons. Yet, "On the Revolutions" offers much more.

Copernicus himself provided some worthy goals for a classroom treatment of his work. In the introduction to the first book, Copernicus (1543) stated that he had studied the cosmos mainly for their great beauty. He paid homage not only to the psalmist, but also to the discipline of mathematics, to which he stated that all scientists could contribute meaningfully. Such a statement of respect for nature's intrinsic beauty and for the universality of mathematics made to middle or high school students can only inspire. In addition, Copernicus provided over 100 pages of geometrical proofs, demonstrating in writing that simple freshman or sophomore geometry, without even the need of trigonometry or algebra, could be used to construct an entire universe in a way that caused one of science's greatest revolutions. Persistence is the quality that

Copernicus' writing so clearly demonstrates. Additionally, Copernicus cited his sources consistently, from the ancient Egyptians, to the Greek Pythagorists and philosophers, to his own contemporaries. In doing so, Copernicus' work shows students the value of crediting sources while, at the same time, criticizing their data and argumentation. As such, "On the Revolutions" is an excellent model of critical thinking and writing. With so many educators (Examples are The Frameworks' Guiding Principles, MTEL's Physics Test Objectives #0002 for teachers, and MTEL's Earth Science Test Objectives #0001 for teachers, the NRC's Benchmark 1 B, the NRC's 1996 NSES #4, and PISA's Science Competencies) concerned with methods of scientific inquiry and the development of critical thinking skills, an authentic, five-hundred-year-old example of scientific inquiry and critical thinking can speak quite effectively. In addition, Copernicus published his work so that other scientists could review it. Although Copernicus (1543) himself stated that he published against his wishes, by making his research known to the world, he provided an example of scientific collaboration and peer review. Thus, Copernicus' work can go far beyond teaching students the differences between the geocentric and heliocentric models and the locations of the planets—it can be used to teach many skills and attributes of good scholarship and responsible participation in a culture.

As noted above, "On the Revolutions" is an example of a paradigm that competed directly with a paradigm already dominating the field. Although it would be too much to ask high school students to understand the process that Kuhn (1962) described as the anatomy of a revolution, students can certainly use the general notion of a change in explanation in any lab-based class. For example, in many lab experiments, as students attempt to explain phenomena, they must re-examine their data. During this process, they often learn that explanations change, either through new information or through a new student's taking a look at the same data from a different standpoint, as Copernicus did. Hence, the Copernicus story can be used as an analogy for what students do every day in their studies. The story of Copernicus' work and subsequent criticism of it can also show students that an intellectual diversity of opinion is often positive and necessary. Experiencing intellectual diversity can convey the lesson that other sorts of diversity encountered throughout life can lead to better understandings of all sorts of phenomena.

METHODS OF PRESENTATION

Presenting the story of the Copernican revolution can be done many ways. What follows are some general guidelines. First before studying the solar system, the Physics or Earth Science classroom should be clear of all posters that show the heliocentric model. For the classroom walls silently to say, day after day, that “This is *the* way the solar system works,” can cement that model in students’ minds and make discovering such a model’s origins seem to the students to be a waste of their time. By keeping posters of that model off the walls until after considering the Copernicus story, the classroom itself can invite inspection and discovery of the ideas.

The Copernicus story can be addressed in middle school; however, middle school students’ lack of exposure to geometry or geometric proof will make any treatment of “On the Revolutions” a scratching of the surface at best. It is far better to wait until the students have done some formal geometric proofs so that they can better appreciate the great persistence that Copernicus had to furnish the sheer volume of such proofs necessary to establish his case.

Materials needed effectively to convey the story might include posters or projected images of what a retrograde looks like, the Ptolemaic model, the Copernican model, Galileo’s Starry Messenger diagrams of the locations of Jupiter’s moons, and hard-back copies of “On the Revolutions.” Of course, sources of such images can be had through a myriad of media; therefore, it is up to educators to select those which are most accessible to any given school and its existing resources. Equally important to seeing projected images of the progression of ideas, students could benefit from feeling the physical weight of “On the Revolutions,” to hold the book in their hands, and to leaf through the pages and pages of charts and geometric proofs. Even though the students may groan that they cannot follow the formal geometry that dominates its pages, they could see that such proofs exist, and that the works of other scientists and philosophers are cited again and again throughout the work. Through their perusal of the work’s pages the questions of whether the geometry is reliable, the observations that led to such a geometric approach, the meaning of the information in the charts, and host of other queries can arise, creating rich discussion of Copernicus’ work and methods. Any school would need to assess whether it could afford the money or the space to purchase and store copies of “On The Revolutions.”

There is no one correct method for presenting the development of Copernicus’ work. However, in pre-

senting the story, a teacher might consider using a documentary video, or if the teacher is a good story-teller, a lecture format, even though that style is so disfavored today. This is one place where a passionate exposition can efficiently introduce Copernicus’ work and its many connections to the history and philosophy of science, methods of scientific inquiry, and the like. After such a presentation, there could follow an examination of selected sections of the book, including the dedication, some of the proofs, and many of the diagrams, plus some guided discussion of how Copernicus presented his case. These things could happen in one class period, followed by a brief review the next day. Short writing assignments or discussions could follow.

Under today’s high stakes testing, high school educators might not wish to commit the time to engage this work through extensive research and collaborative projects, when so little of what is on those tests has to do with Copernicus’ contributions to scientific method and philosophy. Although this situation may change, in today’s climate, to spend a week on the research and discussions needed to do justice to Copernicus’ work is, unfortunately, not realistic. Not all hope is lost, however, if the teacher briefly treats the story as news that the students do not know, presenting it interactively, with some passion for its content and implications for scientific work. A flavor for the relevance and impact of Copernicus’ work could be gained in one to two class periods, if the teacher or teachers plan well. Even though there is a very small likelihood of encountering a Copernicus question on the MCAS or some other national or international test, the hour spent on his work is well worth the time. That considering Copernicus’ work and story can give the student some content knowledge plus a classic example of scientific thinking, criticism of data and collaboration discussed above makes it all the more fruitful an investment of time.

CONCLUSIONS

“On the Revolutions” is a work of thorough scientific inquiry that involved voluminous research and painstaking mathematical proof. It provided credible evidence that there was at least one other way, other than the Ptolemaic system, to explain and predict astronomical phenomena. As such, “On the Revolutions” created a paradigm crisis for astronomers who had long labored under the Ptolemaic model. The Copernican system idea eventually became the new way to explain how things moved in space. Because this new system was a complete change in human understanding of space, the development and propagation of the

Copernican model can rightly be called a scientific revolution. It is, in fact, one of the most studied revolutions, scientific or political, of all time. Studying the development of Copernicus' model is a rich opportunity for students to examine a historical example of scientific inquiry and scientific methodology at its best. Because Copernicus argued from fact, because he cited his sources and criticized them, while, at the same time giving them credit where credit was deserved, and because he published the work for peer review, Copernicus' story is a model of inquiry-based science.

However, the evidence suggests that even though educators fully support inquiry-based methods of teaching science, they may not be fully committed to teaching historical examples of it. Statewide, nationwide, and worldwide, educators extol the virtues of inquiry-based learning, but they make little or no use of one of history's best examples of it. As a result, the world's students miss the opportunity to witness an important example that is consistent with what they practice in the lab. It is possible to teach the Copernican revolution without its taking substantial class time away from other skills and content matters in today's science classes. Educators ought to explore the idea of doing so.

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The Missing Link: Intergroup Dialogue as a Component of Secondary English Curricula

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ABSTRACT

While many school systems have recognized a need for multicultural curricula and differentiated instruction that is sensitive to various cultural needs, there have been few efforts to help students understand the perspectives of their classmates and learn to prosper in a diverse social climate. Educators recognize that curriculum needs to engage students in culturally meaningful domains of conversation that connect with various disciplines. They also recognize that students must become skilled in listening, speaking, and utilizing language. However, the vast majority of teachers dominate classroom conversation and struggle to initiate meaningful dialogue between their students. The purpose of this paper is to suggest that intergroup dialogue should be incorporated in high school English curricula as it offers teachers a structure through which to engage students in meaningful dialogue in order to ameliorate social conflicts while simultaneously addressing many of the Common Core standards as well as 21st Century Skills. This research addresses the following questions: What social conflicts are currently experienced by adolescents in the United States and how can these be ameliorated through intergroup dialogue? How can existing classroom discussion be enhanced through the use of intergroup dialogue? In what ways does intergroup dialogue address the English Language Arts Common Core standards as well as 21st century skills?

PROBLEM

Home is where the heart is. However, for millions of adolescents from conflicting regions, home may also be where the hate is. Many adolescents from countries such as Northern Ireland, South Africa, Cyprus, or Israel, express loyalty to their region through their dislike of the other. In 2003 the United Nations labeled more than 72 countries as unstable and identified 50 million people living outside their communities or countries, displaced by conflict (United Nations, 2005). In the past decade, an estimated two million youth, between the ages of 15 and 24, have died in armed conflict, and five million have been disabled (United Nations, 2005). Due to their proximity to the all-encompassing conflicts, adolescents from these regions often maintain identities that are strongly connected to the regional conflict. Recent immigration patterns suggest that many adolescents embedded in conflict

regions immigrate to the United States to seek political freedom and religious tolerance (Taylor & Whittaker, 2009).

Public and private schools in the United States are becoming increasingly diverse as enrollment in grades 9–12 increased 26 percent between 1993 and 2006 with numbers of students from different races, ethnic backgrounds, cultures, and beliefs escalating (Hussar & Bailey, 2009). It appears that adolescents have not adapted to the changing social and cultural climate of their schools. Instead, the increasing diversity in United States' schools has spurred a ubiquitous tension among adolescents. The United States Federal Bureau of Investigation (FBI) reports that 29 percent of the approximately 10,000 hate crimes reported in the United States in 2008 were committed by offenders who were under the age of 18 whose motivation was related to race, religion, sexual orientation, ethnicity, or disability. According to the Indicators of School Crime and Safety report published by Bureau of Justice Statistics (BJS) and the Department of Education's National Center for Education Statistics (NCES) (2003), 12 percent of students between the ages of 12–18 have been the victims of hate related words and 36 percent report seeing hate-related graffiti while at school. The Center for Disease Control (CDC) (2010) states that although "strategies to change the social and cultural climate to reduce youth violence are often difficult and infrequently used... [they] may facilitate lasting change include addressing social norms" (p. 4).

As many adolescents are beginning to solidify their individual and social identities, meaningful intergroup contact is needed at the secondary level and would "help students become more invested in learning, understanding, imagining and knowing" (Howard, 2002, p. 1126), while leading them to become advocates of social justice. Through intergroup dialogue, students come to "take the perspective of others, feel comfortable communicating across differences, develop positive beliefs about conflict, and express an interest in building bridges across differences" (Nagda & Zuniga, 2003, as cited in Zuniga, 2003, p.16). As American classrooms become "more diverse and socially stratified" (Zuniga, 2003, p.8), intergroup dialogue between adolescent students could greatly enhance student par-

ticipation in the classroom community and provide teenagers with an opportunity for meaningful interaction that can help establish a classroom community that encourages participation and community membership (Wiltse, 2006). It is doubtful that understanding or community could be enriched without a dialogical discourse, as humans live from a dialogical stance (Howard, 2002). Dialogue allows participants to gain deeper ways of thinking, to build relationships with others, and to work effectively on collaborative projects (Nagda & Gurin, 2007).

The interactional construction of meaning in particular social and cultural contexts is the basis of literacy (Colombi & Schleppegrell, 2002) and the Common Core Standards as well as 21st Century Skills, call for dialogue to be included in high school English curricula so as to promote the communicative and critical thinking skills needed for adulthood. However, the findings of several studies show that discussion in classrooms is predominately monologic and dominated by the teacher, often because the teacher is unaware of how best to stimulate meaningful dialogue or how to find its relevance in relation to the course content (Nystrand, 1997; Gramoran and Carbonaro, 2001; Applebee, 2000). As a result students are unable to find their place in the classroom community, think critically on global issues in relation to the course content, or practice expressing their thoughts as representations of their personal identities within a diverse forum.

PURPOSE

The purpose of this paper is to suggest that intergroup dialogue should be incorporated in high school English curricula as it offers teachers a structure through which to engage students in meaningful dialogue in order to ameliorate social conflicts while simultaneously addressing many of the Common Core standards as well as 21st century skills. This research addresses the following questions: What social conflicts are currently experienced by adolescents in the United States and how can these be ameliorated through intergroup dialogue? How can existing classroom discussion be enhanced through the use of intergroup dialogue? In what ways does intergroup dialogue address the English Language Arts Common Core standards as well as 21st century skills?

SUMMARY OF BACKGROUND

In his theory on prejudice reduction Allport (1979) states that there is a condition of separateness among

human groups and that much of this “automatic cohesion is due to nothing more than convenience” (Allport, 1979, p. 18) as the human mind uses categorization to rationalize as it forms clusters for guiding daily adjustments (Allport, 1979). The categorization of self typically occurs during adolescence, “triggered by the biological changes associated with puberty, the maturation of cognitive abilities, and changing societal expectations” (Tatum, 1997, p. 19), and greatly influences the choices one makes throughout his or her life. An individual’s perception of self is multidimensional and is mediated by race, gender, age, social status, sexuality, religion, and political stance (Tatum, 1997; Jussim, Asmore, & Wilder, 2001). Social identity is the “part of an individual’s self-concept which derives from his knowledge of his membership in a social group (or groups) together with the value and emotional significance attached to that membership” (Tajfel, 1981, p. 225 as cited in Jussim, 2001, p. 6). Individuals who experience intense emotional feelings related to their self-identity (Allport, 1979) and are deeply influenced by conflicts in which their group’s welfare is threatened, may “undergo identity changes that render them more vulnerable to committing atrocities against other groups in the future” (Jussim et al, 2001, p. 8). High school students representing American minority groups display higher ethnocentrism than most adults (Allport, 1979).

Delpit (1995) writes that people must be encouraged to allow the realities of others to enter their consciousness by seeking out those whose “perspectives may differ most, by learning to give their words complete attention, by understanding one’s power...by being unafraid to raise questions about discrimination ...and to *hear* what they say” (Delpit, 1995, p. 47).

Intergroup contact that fosters opportunities for “self-revealing interactions” has been shown to facilitate identity reformation and the reduction of bias (Gaertner, Dovidio, and Bachman, 1996). In his reformulation of the Intergroup Contact Theory, Pettigrew (1998) found that change occurs through “learning about outgroups, the opportunity for reappraisal and recategorization of outgroups, generation of empathy and positive emotion, and the potential for friendships” (Dessel & Rogge, 2008, p.214). Cognitive learning and social identity theories add to an understanding of how intergroup dialogue in particular reduces conflict and promotes relationship building as it has been shown to facilitate critical self-reflection and perspective taking, two of the crucial components of attitude change (Gurin, Dey, Hurtado, and Gurin, 2002; Gurin, Nagda, and Lopez, 2004; Nagda, 2006; Nagda and Zuniga, 2003). Dialogue is an “existential necessity” (Freire,

1970/2006, p. 77) for personal and social transformation. However, “true dialogue cannot exist unless dialoguers engage in critical thinking...which discerns an indivisible solidarity between the world and the people and admits of no dichotomy between them” (Freire, 1970/2006, p. 92).

Applebee (1996) suggests that school curriculum needs to engage students in culturally meaningful domains of conversation that connect with various disciplines. Applebee (1996) states that students need the type of education that is grounded in the knowledge that involves students in larger conversations which extend beyond the initial content of the course. Dialogically organized instruction promotes learning in that “both the character and tone of classroom discourse set important expectations for learning...and establishes a suitable climate for learning and communicating” (Nystrand, 1997, p. 28). A cooperative and effective curriculum is based on entry into conversation and is also built around language episodes of high quality which incorporate an appropriate breath of interrelated materials to sustain conversation (Grice, 1975). When teachers use dialogue in their instruction, students are provided with opportunities to have a voice in the content of their instruction. A curriculum focused on dialogue “is coherent, as the teacher weaves together his/her contributions with those of students, and the different components of instruction such as reading, writing, and talk are brought into a relation with one another” (Gamoran & Carbonaro, 2002).

Although many teachers state that they incorporate dialogue in their lessons, Nystrand (1997) claims that most instruction in secondary schools is monologic and dominated by teachers who ask questions that have correct answers, and follow the traditional initiation-response-evaluation form of instructional talk. Based on his classroom observations Nystrand (1997) states that even teachers who claim to be using a dialogic approach tend to avoid controversial topics and over-simplify complex issues. In response, students...show little enthusiasm for learning, and their work is often superficial, mindless, and quickly forgotten” (p. 3). Emphasis on the entry into such conversations should be central as “a curriculum of conversations...offers a way to think about the problems and possibilities of multiculturalism in our increasingly pluralistic world” (Applebee, 1996, p. 127).

The English classroom, in part due to its frequent use of literature, is the ideal venue to enter into dialogue concerning alternative perspectives. The Common Core Standards and 21st Century Skills outline goals for students’ language development and speaking and listening.

Intergroup dialogue, a means for addressing cultur-

al conflict through “facilitated group experience that may occur once or may be sustained over time and is designed to give individuals and groups a safe and structured opportunity to explore attitudes about polarizing societal issues” (Dessel & Rogge, 2008, p. 201), holds great potential to be useful in high school English courses as it enables adolescents “to speak and listen in the present while understanding the contributions of the past and the unfolding of the future” (Dessel & Rogge, 2008, p. 211). Intergroup dialogue also addresses three components that typical communicative interaction does not: critical analysis of difference and dominance; discursive engagement across cultures; sustained community building and conflict engagement (Nagda & Gurin, 2007). Participants have been shown to display an increase in personal and social awareness in terms of their identity and were also seen to exemplify an increase in knowledge about other groups, social inequalities, and conflict management strategies (Schoem & Hurtado, 2001).

In order to address the increased diversity of the population, intergroup dialogue has been used in community-based contexts, leadership trainings, public forums, and in academic settings at colleges and universities to “foster listening skills, improve communication patterns, value differences, and develop shared meanings” (Dessel et al., 2006, p. 304). Despite high schools experiencing a drastic increase in enrollment and diversity and the demands of newly adopted standards, intergroup dialogue is not typically used in secondary school environments (Hussar & Bailey, 2009). While many school systems have recognized a need for multicultural curricula and differentiated instruction that is sensitive to various cultural needs, there have been few efforts to help students come to understand the perspectives of their classmates, learn to function and prosper in a diverse social climate, and establish a learning community. Whereas diversity education teaches students about tolerance and unity within the existing social structure, social justice education teaches students about social structure equality and citizenship in pluralistic societies (Freire, 1970/2006).

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Asian International Students in the United States and the Importance of Building Social Capital

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ABSTRACT

Research suggests that adjusting to a new academic and social environment may cause both cognitive and emotional uneasiness. This paper examines the complex issues involved in this process with a focus on Asian international students. A review of literature investigates the variables that may account for these adjustment issues including English language proficiency, background knowledge, cultural differences, acculturative stress, and racial and ethnic identity. This paper also draws upon the perceptions and insights gained from Maria Conley, the director of International Students and Scholars Office (ISSO) at University of Massachusetts Lowell (UML). The research suggests the important role of social capital plays in helping Asian international students' academic and social adjustment. This paper also provides implications at both instructional and institutional levels for future research and practice.

There are a large number of foreign students who come to colleges and universities in the United States in order to pursue their study every year (Hung, 2006). These students approximately constitute half of the world's total number of international students (Poyrazli, Kavanaugh, Baker, & Al-Timimi, 2004). For most international students, English is not their first language (L1). When they come to the United States to further their study, they are expected to experience the transition from English-as-a-Second-Language (ESL) classes to mainstream classes in the university learning environment (Bifuh-Ambe, 2009). Learning a second language (L2) is a long and complex process and there are many variable involved in this process (Brown, 2007). When multiple interdisciplinary perspectives including psycholinguistics, sociolinguistics, and classroom research are taken into consideration (Beebe, 1988, as cited in Bifuh-Abme, 2009), this process of L2 acquisition tends to become even more complex.

In the U.S. learning environment, ESL international students have to learn not only English language, but also the subject matter knowledge in English. This dual task has posed great challenges and difficulties for them in academic learning even at a college level. According to the research, as discussed by Huang and Brown (2009), these challenges and difficulties may come from different sources including students' inadequate English proficiency, their unfamiliarity with the U.S. culture,

lack of study skills or strategies, academic learning anxiety, low social self-efficacy, financial issues, social isolation, and so on.

According to the released data reported by the Institute of International Education (IIE, 2007), over one-half (58%) of all international enrollments in the U.S. higher educational institutes consists of students from Asian countries. Most Asian students, especially East Asian students, come from monolingual countries, where their native languages contain different linguistic features from English. When they come to the United States, they have to use English as the primary language for academic learning in the U.S. learning context. In addition, research suggests that the geographical distance and cultural difference including Confucian tradition and collectivism, impact how these students adjust to a new environment (Hung, 2006). Thus, it can be assumed that a number of variables such as students' prior knowledge, experience, and English proficiency combine to affect how they adjust the academic and social life within the U.S. learning context.

According to Sümer, Poyrazli and Grahame (2008), adjusting to a new academic and social environment can be a stressful process. In order to examine the complex issues involved in this process with a focus on Asian international students, this review attempts to draw upon theoretical and empirical research to explore the following questions:

- What kind of cognitive and emotional uneasiness may these Asian international students encounter within the U.S. learning environment? And, what might be the challenging factors to cause the cognitive and emotional uneasiness for these students?
- What are the support systems available and accessible for these students in order to achieve their academic learning goals? In what ways can the U.S. institutions of higher education provide a supportive learning environment for Asian international students to better adjust into the new learning environment?

METHODOLOGY

This paper examines both theoretical and empirical research studies from 19 education databases through

the University of Massachusetts Lowell library systems. The keywords *Asian international students* have been used together with *academic challenges*, *adjustment issues*, *ESL/ELL college students* or *social capital* in order to collect research studies. The abstract of these articles have been reviewed. The articles used in this literature review have been narrowed down to scholarly journal research studies. Both empirical studies and other relevant theoretical research have been reviewed for this paper. In addition, based on the author's interview, this paper also draws upon the perceptions and insights from the interviewee, Maria Conley, the director of International Students and Scholars Office (ISSO) at University of Massachusetts Lowell (UML). Ms. Conley has over 20 years of experience working with international undergraduate and graduate students. Her perceptions on adjustment issues of Asian international students based on her rich experiences provide with helpful resources in understanding this topic.

ENGLISH PROFICIENCY

According to Cummins (1980, 1979), there are two different kinds of English proficiencies, cognitive/academic language proficiency (CALP) and basic interpersonal communicative skills (BICS) (as cited in Brown, 2007). This distinction suggests that English language proficiency includes the ability to use this language effectively in both academic and social contexts (Bifuh-Ambe, 2009). Asian international students, who move to the United States and begin their study in mainstream university classes, need both CALP and BICS to participate in and adjust to their academic and social life. Both Hung (2006) and Bifuh-Ambe (2009) identify English proficiency as one of the major factors to account for academic challenges Asian students tend to encounter.

In most Asian countries, particularly East Asian countries, such as China, Japan, and Korea, English is offered as one of the required subjects at schools (Hung, 2006). As discussed by Hung (2006), the classroom instruction in these countries primarily relies on traditional teaching methods, emphasizing "translation and mechanical drills in vocabulary, grammar, and sentence structure" (p. 171). Receiving this teacher-oriented English education, students from these countries may have developed strong reading abilities through years of training and practice, but they may relatively lack authentic English language environment for them to practice English especially speaking and writing skills (Hung, 2006).

In addition to students' previous learning experiences, the research also indicates other background fac-

tors, which may affect students' English proficiency (Gradman & Hanania, 1991). Using survey instruments and interviews with ESL students including Asian international students, Gradman and Hanania's study (1991) identifies a number of background factors that affect these students' English proficiency, touching upon their previous formal learning experiences, their exposure to and use of English both in and outside class, their attitude and motivation towards learning English, and their own personal observations and suggestions about current language learning needs. Gradman and Hanania's (1991) study suggests that a number of cognitive, social, affective, and pedagogical factors tend to affect students' language learning and proficiency.

In order to study in the U.S. colleges and universities, most Asian international students have to pass the Test of English as a Foreign Language (TOEFL), which is an admission requirement for non-native English speakers. Informed by the aforementioned perspectives, it can be assumed that for Asian international students, meeting the admission requirement with a valid TOEFL score does not guarantee that they have fully developed both CALP and BICS. For these students, academic learning tends to be their major task in the U.S. mainstream learning environment. Without the CALP, students may have difficulties in academic courses which require much reading and writing (Cummins, 2000). As pointed out by Brown (2007), academic English differs from conversational language in two major ways. First, academic texts tend to use expository and formal language (Brown, 2007). Second, the discourse used in academic reading is absent from features such as facial features, intonation, and gestures in conversational discourse (Brown, 2007). These characteristics of academic English discussed by Brown (2007) partly account for why Asian international students may encounter challenges and difficulties during their academic learning.

Some Asian international students with limited English proficiency in the U.S. mainstream learning environment need to learn not only English language but also content area knowledge and how to proceed and complete the academic tasks (Echevarria, Vogt, & Short, 2004). In addition to CALP, students also need BICS to effectively participate in both academic and social life. As suggested by Gradman and Hanania (1991), cognitive, social, affective, and pedagogical factors tend to affect students' language learning and proficiency. Therefore, the lack of English language skills may affect how they participate in and adjust to academic and social life in the U.S. mainstream learning environment.

According to the interview with Conley at

University of Massachusetts Lowell (UML), the Asian international student population is the largest representation on campus. Language challenges, as Conley pointed out, appeared to be the most common issues. She stated some students may get very good TOFEL scores, but still had hard time understanding English and keeping up with the pace since “being in the classes, speaking and listening part are very different, the assignments here are very frequent” (Ms. Conley, personal communication, October, 19, 2010). This perception is consistent with Hung’s (2006) and Bifuh-Ambe’s (2009) discussion which identifies English proficiency as one of the major factors to account for academic challenges Asian students tend to encounter.

BACKGROUND KNOWLEDGE

In addition to English proficiency, research also indicates that students’ background knowledge affects their academic learning and social performance (Bifuh-Ambe, 2009; Huang & Brown, 2009). Background knowledge tends to be used interchangeably as prior knowledge or previous knowledge in academic research. Perhaps the most seminal work regarding this topic is research on schema theory. In McVee, Dunsmore, and Gavelek’s (2005) review on schema theory from different theoretical perspectives, the terms *schema* or *schemata* are used as “existing knowledge, topic knowledge, prior knowledge, and previous knowledge” in recent research (p. 534). By examining the origins and development of schema, McVee et al. (2005) suggest reconsidering schema from sociocultural perspectives framed by the work of Vygotsky particularly and viewing schema as something within “the individual’s social and cultural communities” rather than just the individual’s “in-the-head phenomenon” (p. 532).

These perspectives are important for both researchers and educators to understand the role of an individual’s background knowledge in academic learning (McVee et al., 2005). When readers comprehend the text, their schema can provide them a basis to understand, learn, and remember the facts and ideas in texts (Echevarria et al., 2004). Textbooks used in mainstream classes, as pointed out by Brown (2007), assume that all readers “share similar cultural experiences and have the necessary background knowledge to comprehend the text” (p. 34). Limited background knowledge tends to cause difficulties for them to comprehend the concept in the texts. In addition, as suggested by Echevarria et al. (2004), background knowledge which does not fit or match the culture of the text may also hinder these students’ comprehension. These perspectives are also in

line with Holmes, Rutledge, and Gauthier’s (2009) discussion, which views the lack of relevant cultural knowledge as one of the challenges for students to acquire L2 proficiency. Therefore, it can be assumed that Asian international students from culturally and linguistically diverse backgrounds may come to the class with different amount of prior knowledge, which may affect how they participate in both academic learning and social life.

CULTURAL DIFFERENCES

Confucian tradition has exerted great influences upon Asian cultures, particularly on East Asian cultures (Huang & Brown, 2009; Rao, 1996). One of its phenomenal influences is embodied in its philosophy in education. Based on Confucius’ maxims, as interpreted by Rao (1996), teachers should provide background knowledge, explain passages and contexts, give answers to controversial questions, lecture on the subjects, pass their experience and knowledge to the students, and show students the correct way to study and investigate. As discussed by Rao (1996), the most obvious features of English teaching and learning include: concentration on intensive reading as a basis for language study; use of memorization and rote learning as a basic acquisition technique; meticulous emphasis on linguistic details and a corresponding lack of attention to communicative skills; use of translation as both a teaching and learning strategy; teacher’s authority and students’ passive role.

Huang and Brown (2009) also discuss the impact of cultural differences on Asian students’ academic learning as well as social performance, especially on Chinese students. As suggested by Huang and Brown (2009), for these students, the cultural environment and education system in the U.S. universities tend to be different from their home countries. As discussed by Huang and Brown (2009), these difference may cause challenges for Asian international students in American learning context, including the lack of common interests in communication with native English speakers, participation in academic and social activities, little interest in religion, homesickness or stress caused by cultural differences, and unfamiliarity with the instructional styles, etc. Therefore, it can be assumed that cultural differences may affect how Asian international students adjust to academic and social life in the U.S. learning environment.

As observed by Conley during her contact with the Asian international students, the frequent assignments and language barriers are common themes they have reported especially in the first semester. She stated that the first cultures of many students use large tests only at the end of a term; while tests and assignments are used

more frequently in their current learning environment at UML. She said that “they try to get used to a culture, language, finances, all of this,” and still have to “concentrate on deadlines and all those assignments” (Ms. Conley, personal communication, October, 19, 2010). These perceptions are consistent with Huang and Brown’s (2009) and Rao’s (1996) discussion on the impact of cultural difference to students’ academic learning and social performance.

ACCULTURATIVE STRESS

Research on acculturative stress of this student population has examined some possible causal factors to the psychological well-being (Iwamoto & Liu, 2010; Poyrali et al., 2004; Sümer et al., 2008; Wilton & Constantine, 2003). In Wilton and Constantine’s (2003) study, the researchers administered a survey packet to a sample of Asian and Latin American students who were attending a college in the United States in order to explore and understand the relationships among length of stay, cultural adjustment difficulties, and psychological distress of these international students. According to their findings, the more time Asian students are in the United States, the lower their psychological distress levels are (Wilton & Constantine, 2003). In addition, Wilton and Constantine (2003) also found that “higher acculturative distress and intercultural competence concerns predicted higher levels of psychological distress” (p. 183).

In addition to the length of stay, researchers have found that English language proficiency, cultural difference, and social support may affect Asian international students’ psychological well-being (Poyrali et al., 2004; Sümer et al., 2008). Using survey instruments, Poyrali et al. (2004) found that students with higher levels of English proficiency and social support tend to experience lower levels of acculturative stress. This finding is similar with Sümer et al (2008), which indicated that students with lower levels of social support are more likely to have higher levels of depression and anxiety. Additionally, Poyrali et al. (2004) also consider the differences between Eastern and Western culture as one of the factors to account for acculturative stress reported by Asian international students. The aforementioned research suggests that the length of stay, English language proficiency, cultural difference, and social support may affect the acculturative stress of Asian international students, which further impact how they adjust to both academic and social life in the U.S. learning environment.

RACIAL AND ETHNIC IDENTITY

Racial and ethnic identity is also viewed as factors to affect Asian students’ psychological well-being. Iwamoto and Liu (2010) examined the effects of racial identity, ethnic identity, Asian values, and race-related stress on the positive well-being of a sample of Asian American and Asian international college and graduate students. The findings indicate both consistency and discrepancy compared with the previous literature and the researchers’ original hypotheses. According to Iwamoto and Liu (2010), ethnic identity affirmation and belonging and internalization attitudes are respectively associated with psychological well-being.

Informed by the aforementioned reviewed studies (Huang & Brown, 2009; Hung, 2006; Iwamoto & Liu, 2010; Poyrali et al., 2004; Sümer et al., 2008; Wilton & Constantine, 2003), it could be noticed that in addition to academic and psychological uneasiness, these Asian international students who come to a new learning context tend to experience the process of reshaping their identity. Hsieh (2006) conducted a qualitative study to investigate how five East Asian female international students developed their identities in the U.S. as a second-language environment. Considering identity and participation in communities of practice as inseparable constructs, Hsieh (2006) conceptualized this study in the concept of communities of practice, which addresses the interplay between individuals’ participation as well as the quality of that participation and their identity development. According to Hsieh (2006), all the participants’ stories suggest the American context and the social relations of power in American society play a role in affecting their identity development.

SOCIAL CAPITAL

Coleman (1987) characterizes social capital as the “information, support, and supervision that closely knit networks of relationships provide” (as cited in Conchas, 2006, p.90). Stanton-Salazar (2001) provides a more detailed version of this definition, which defines social capital as “a set of properties existing within socially patterned associations among people that, when activated, enable them to accomplish their goals or to empower themselves in some meaningful way” (p.265). Conchas (2006) suggests that parents are not the only sources of social capital. His research indicates that nonfamilial social capital including friends, teachers, school officials, and communities contribute to children’s achievement (Conchas, 2006).

The theoretical and empirical research reviewed in the previous sections suggests that Asian international

students may encounter challenges and difficulties in both academic learning and social performance when they adjust to the U.S. learning context. Informed by the abovementioned perspectives on social capital, it can be assumed that building support systems is critical for these students who travel far away from home and move into a new learning environment different from their own countries in many ways. Some of the reviewed empirical studies have examined the impact of social support (Poyrali et al., 2004; Sümer et al., 2008). In particular, Sümer et al.'s (2008) study shows that students with lower levels of social support tend to have higher levels of depression and anxiety. This finding is consistent with Poyrali et al.'s (2004) study, which indicates that students with higher levels of social support experience lower levels of acculturative stress.

The abovementioned reviewed studies (Hsieh, 2006; Hung, 2006; Iwamoto & Liu, 2010; Poyrali et al., 2004; Sümer et al., 2008; Wilton & Constantine, 2003) have provided implications for school personnel including instructors and clinicians, on how to support Asian international students. These implications indicate the importance of establishing the support system for this group of students. In addition to the implications from the reviewed research, the interview data also suggests the role of social capital in meeting these students' diverse needs.

According to Conley, the ISSO provides two major types of services by which students can receive support. The first type is information sessions which are organized in large group or one-on-one during drop-in hours depending on the number of students. The second type is personal appointments which are offered to students every work day. For the information sessions in large group, Conley found this type of new model effective since it provides students with opportunities not only to get the information they need, but also to learn from each other. (Ms. Conley, personal communication, October, 19, 2010).

As pointed out by Conley, students in one-on-one sessions or personal appointments tend to report more personal issues related to academic and social uneasiness and stress. She perceives that students in some cultures may find it hard to talk about certain issues to others (Ms. Conley, personal communication, October, 19, 2010). Therefore, as suggested by Conley, building trust is an important part in the service provided by the ISSO. She thinks that even if the ISSO cannot solve every problem timely for students, it can at least provide students a comfortable place to report the challenges and difficulties that said that they would like to share. (Ms. Conley, personal communication, October, 19,

2010). Conley's perception on building trust embodies Stanton-Salazar's (2001) discussion, which views establishing relations of trust and rapport as a "necessary vehicle for regular help seeking" (p. 198).

IMPLICATIONS

The selected literature review has identified several major factors to account for challenges and difficulties Asian international students tend to experience in both academic and social life, including English language proficiency, background knowledge, and cultural differences. In addition, both academic and emotional uneasiness these students may encounter also have impact to their psychological well-being. The reviewed literature suggests that Asian international students could benefit from social capital provided to them. Furthermore, Cummins (2000) points out that in order to develop students' academic knowledge in L2, the instruction should focus on meaning, language, and use. This framework suggests that cognitive challenge, intrinsic motivation, and promotion of critical literacy need to be integrated into the interactions between teachers and students. These perspectives and the interview data suggest that two kinds of support can be provided to Asian international students, including instructional and institutional.

INSTRUCTIONAL LEVEL

At the instructional level, it is important for the instructors in the U.S. colleges and universities to be aware of the challenges and difficulties that Asian international students may experience so that a better learning environment can be created for these students (Huang & Brown, 2009). First, since English language proficiency is essential for Asian international students to succeed in both academic learning and social performance, it is helpful to provide them with English literacy support (Hung, 2006). It is critical for these students to be able to express themselves academically and professionally in order to fit into both academic and social context (Hung, 2006). Therefore, the instructors may enhance extensive comprehensive input and promote meaningful language use both in and outside classroom for these students (Gradman & Hanania, 1991). This is in line with Cummins' (2000) argument, which discusses that the instruction needs to go beyond the literal comprehension in order to integrate comprehensive input for academic learning.

Additionally, Lei, Berger, Allen, Plummer, and Rosenberg (2010) provide more detailed strategies for improving reading skills among ELL college students,

including having positive attitudes toward reading, increasing vocabulary, using dictionaries, vocabulary notebooks, and signal devices, repeated reading, and frequent and extensive reading. Furthermore, Hsieh (2006) suggests that it is necessary for educators to provide learners opportunities to speak their own voice rather than just concern with their grammatically correct use of L2. Hsieh (2006) views helping students develop their agency of identity is as important as improving their linguistic skills. These perspectives are also in line with Cummins' (2000) views, which consider providing students with opportunities to express themselves through language critical for literacy development and identity affirmation. These suggestions may also provide instructional implications for instructors to teach Asian international students.

Second, the literature suggests that lack of background knowledge and may affect Asian international students' academic learning and social performance (Bifuh-Ambe, 2009; Huang & Brown, 2009). Thus the instructors in the U.S. higher institutions may need to adjust their teaching methods in order to make the instruction more comprehensible and accessible to these students (Huang & Brown, 2009). For instance, providing students with a study guide and a summary of major points may help them get access to the information covered during the instruction (Huang & Brown, 2009). In addition, supplementary reading materials may provide students information and content background knowledge to make connections with the texts and related discourses (Huang & Brown, 2009; Hung, 2006; Lei et al., 2010).

Third, the literature suggests that cultural differences may affect Asian international students' academic learning and social performance (Huang & Brown, 2009; Rao, 1996). Informed by Huang and Brown's (2009) discussion, it can be seen that North American teachers' different instructional styles may cause challenges for Asian international students in their academic learning due to the impact of different culture. The researchers identify a number of instructional factors including too much student participation, too much group work, failure to follow the textbook, different lecture organization, little lecture summary, and the lack of blackboard writing. Thus it is important for U.S. instructors to be aware of the challenges faced by Asian international students and try to create a supportive learning environment for these students (Huang & Brown, 2009).

INSTITUTIONAL LEVEL

In the institutional level, the literature suggests it is

important to develop a supportive atmosphere for Asian international students. The literature suggests that cultural differences affect Asian international students' academic learning and social performance. As discussed by Hung (2006), the institutions play an important role in assisting their faculty and staff in helping culturally diverse students to become successful learners through academic and interpersonal validation.

In addition, most of the reviewed literature touches upon implications for counseling practice within the U.S. higher education institutions. According to these research studies (Iwamoto & Liu, 2010; Poyrali et al., 2004; Sümer et al., 2008; Wilton & Constantine, 2003), in order to mediate and combat their acculturative stress, it is helpful to offer social support groups or programs which address their academic and cultural adjustment issues and mental and psychological concerns. Informed by these perspectives, the following section outlines several kinds of programs that the institutions can be offered to Asian international students.

For instance, through programs which match Asian international students with other more experienced international students, social support can be provided to them upon their arrival to the United States in order to help these students have a smoother adjustment (Sümer et al., 2008). In addition, programs which address issues of cultural diversity can help faculty, staff, and students in the broader campus community to better understand the cultures and lives of Asian international students (Wilton & Constantine, 2003). Furthermore, peer programs may provide Asian international students opportunities to interact with American students. The research indicates that building social relations with Americans for Asian international students and increasing social support systems help to mediate and combat their acculturative stress (Poyrali et al., 2004). The interaction and social support systems can also help American students to develop open-minded attitudes toward diversity (Hsieh, 2006).

Conley's perceptions towards the support which the ISSO seeks to offer also imply the importance of building social capital to the Asian international students. According to Conley, two major sub-themes are present in the future ISSO plans. The first one relates to technology. As pointed out by Conley, one of the goals in the coming year for the ISSO is to promote more interaction in its website (Ms. Conley, personal communication, October, 19, 2010). The second sub-theme touches upon increasing social connection between international students and various agents. According to Conley, more "social piece[s]" will be added to the office (Ms. Conley, personal communication, October, 19, 2010).

She hopes that more social types of programs will be established to increase the connection among international students themselves and between these students with other American students (Ms. Conley, personal communication, October, 19, 2010). Another goal, as suggested by Conley, is to “integrate all students into all the programs and also American cultures here” (Ms. Conley, personal communication, October, 19, 2010). Some of the examples Conley provided regarding those programs include TAs/RAs training workshops, English as a Second Language (ESL) courses, family-oriented programs including students’ spouses or children, and some other informal meeting time. These perceptions are consistent with the implications about building social support systems in the reviewed studies (Huang & Brown, 2009; Hung, 2006; Iwamoto & Liu, 2010; Poyrali et al., 2004; Sümer et al., 2008; Wilton & Constantine, 2003).

CONCLUSIONS

There are limitations of this paper based on the scope of this literature review. First, gender differences are not clearly embodied in the reviewed research. For instance, in both Hsieh’s (2006) and Hung’s (2006) studies, the participants were all comprised of female students. This homogeneity of the female subjects can be considered as one of the limitations in both studies. Thus, whether gender matter the learning behaviors of this student population still needs further research.

In addition, ethnicities among Asian international students and demographic information have not been fully represented. For instance, in Iwamoto and Liu’s (2010) research report, the authors do not clearly state the demographics of the institution for data collection in the section on methodology. Not until at the end of the article can readers find that the institution consists of a 50% Asian American student body. Furthermore, just as Iwamoto and Liu (2010) point out, international student status was not obtained in their study. Thus, whether these international students are permanent residents or not was not clear in the study. Likewise, in Hsieh’s (2006) study report, it is not explicit whether the five participants are selected in the same institute or not. Therefore, it is still difficult to generalize these findings to all Asian international students.

This paper examines the research which touches upon the challenges and difficulties Asian international students tend to experience during their academic and social adjustment to the U.S. learning environment. It investigates the variables which may account for these adjustment issues including English language proficien-

cy, background knowledge, cultural differences, acculturative stress, and racial and ethnic identity. Through this examination, this paper also explores the important role of social capital playing in helping Asian international students’ academic and social adjustment. The limitations of the reviewed research suggest some possible directions of future research. Future research related to this student population needs to be examined to explore whether gender and ethnic differences matter Asian international students’ academic and social adjustment and whether these differences affect the social support that may be offered to these students.

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