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Theme

4th - Science

Curriculum Analysis

[redacted]

CI 565

Portland State University

Part I

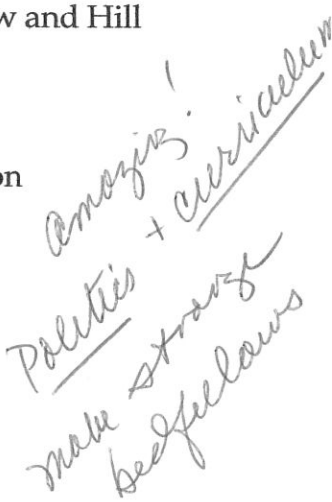
As a fourth grade teacher I am charged with teaching multiple content areas. For each subject I teach, I use various curricula to help students learn the content. At John Wetten Elementary we use published curriculum adoptions for math, science and social studies. Other content areas such as, reading and writing are taught through various materials that are teacher generated. As a result of my previous experiences working in science research, I have always been fascinated with how elementary teachers approach the teaching of science. For the purposes of curricular analysis I will research our fourth grade science curriculum.

Recently, the fourth grade at John Wetten Elementary adopted a new science curriculum, McGraw-Hill Science. McGraw Hill and the National Geographic Society developed this curriculum. It includes a comprehensive set of teacher support materials along with textbooks in several scientific areas. This McGraw Hill publication provides curricular materials for teaching Earth science, physical science and life science. The primary focus of the fourth grade curriculum is aspects of life and Earth science. This science curriculum provides teachers with assessments, activities (home and school), project ideas, test preparation and reading support materials. As with every curriculum there are some driving forces the effected the design, development and the content include in this science program.

There are many political, social, historical and educational forces that helped to create this McGraw-Hill science curriculum. In 1957 the U.S.S.R sent up Sputnik, the first spacecraft to be launched. During the "panic" that ensued following this

revolutionary breakthrough, the United States realized our science programs were lagging behind. As a result there was a big push for science, math and language education. This push for increased science education encouraged book publishers to develop curriculum that would provide adequate science instruction to help our students "catch up" to the rest of the world. In 1983 the *Nation at Risk* report reinvigorated the push for core curriculum including science. Most recently, the No Child Left Behind (NCLB) law has mandated that certain science content standards be taught (Parkay, 2006). All of these historical events have influenced the content and curriculum included in this publication.

As politicians look towards a quantified number to evaluate the effectiveness of education, testing and accountability continue to heavily influence the approaches and content provided in our curriculum. This science curriculum has a "Test Preparation" resource guide to help teachers prepare students for tests. As shown, testing and standards are two very significant components that determine the intended curriculum. Increased standards testing, as mandated by George W. Bush's, NCLB promoted textbook based curriculum to stay current with new standards. As a result, textbook companies profited by being labeled as a federally endorsed official textbook adoption for schools throughout the country. Ironically, the McGraw family, of McGraw and Hill Publishers, has been longtime Bush family friends. Bush's close links with the McGraws, undoubtedly affected curriculum development, design and adoption (Metcalf, 2002). In addition to these powerful political forces that affected the



curriculum, there were also many social forces that played a part in the development of these materials.

Environmental awareness seems to be a dominant social force that has contributed to this science curriculum. Throughout the text there are references to how various human behaviors and animals affect the environment in which we live. At the ends of chapters a story on an endangered species is highlighted to help students understand the effects humans are having on animal habits throughout the world. In addition, there is a chapter devoted to various types of pollution, environmental destruction and preservation. With the increased social awareness to the plight of our global environment, this science curriculum has designed its text to reflect those concerns.

A change in the world of work has also influenced the organizational format of this curriculum. The working world continues to be more technologically centered. This curriculum has catered to the need for a technologically savvy workforce. Throughout the text there are references to websites to enhance student learning. These websites also provide teacher resources. In addition there are interactive CDs and DVDs to enhance learning and expose students to a variety of technologies. This text also includes short passages about new technology that has affected science research. Although technology is not a major aspect of this curriculum, it does create opportunities to use and practice the knowledge they have, and will need later in their adult working life.

This curriculum is also driven by the realization that the world is interdependent. The text attempts to show different perspectives of science related issues. In each chapter there is a passage on various cultural perspectives. Although this curriculum includes a cultural view, its sparse scattering of cultural passages throughout the text seems obligatory, rather than a genuine attempt to show cultural viewpoints. However feeble the attempt may be to help students gain a sense of global interdependence, it is definitely a social force that was considered in the design of this curriculum.

Part II
Orientation/Values

This curriculum is driven by an essentialist philosophy of education. The essentialist viewpoint, as touted by Bagley, is that … practically all the higher and more nearly permanent interests grow out of efforts to learn, are not at the outset interesting or appealing in themselves" (Parkay, 2006). McGraw-Hill Science (2002) presents topics that are "classic" to the study of science. For instance, the unit on plant and animal cells spends a great deal of time delving into the organelles found in a cell. At first glance it seems unimportant and not necessarily interesting. However, when students realize that those tiny little organs in the cell are the reason that living things stay alive, suddenly interest is sparked. Eventually, students begin to appreciate the significance of this seemingly abstract scientific phenomenon.

The underlying values that this curriculum appears to espouse are fairly liberal views on science. This façade appears through short vignettes on culture and the environment. When the content is further analyzed it shows that this text is also

conservative with regards to certain science topics. In this curriculum the text shows very little information on evolution. There is an entire unit that discusses animals. The idea of evolution only appears on one page and it is discussed very generically. I am suggesting that possibly as a result of the publisher's political affiliations with politicians that are religiously oriented, evolution is minimized. Evolution is not really given as a significant theory on how animals came to be. The book discusses animal adaptations, but does not make an explicit link with the theory of evolution. Another possible explanation for the near omission of evolution is simply because evolution is not a National Standard for science in the fourth grade.

good insight

Purpose/Content

The ultimate purpose of this curriculum seems to be aimed at educating children on the basic, important ideas and facts of the natural world. This curriculum provides students with the scientific education and materials needed to pass the Oregon, Benchmark II science test. The content that is included in this curriculum is directly linked to the Oregon Science Standards. There is very little background, or information on content that is not on the state of Oregon science assessment.

A large piece of this curriculum that is ignored is the hands-on, experientially based science education. There are not any lab supplies or activity materials that are designed around a student performing an individual experiment. There are slight traces of possible activities that could be modified for classroom experiments. As stated by McGraw-Hill Science this curriculum "...was developed to enable teachers to implement national standards within the context of their own state and local science

good insight

criteria by focusing on three major aspects" (Moyer, Daniel, Hackett, Baptiste, Stryker, and Vasquez, 2002). These "three major aspects" that are purported to be intertwined in the curriculum are, to provide "tools and processes of inquiry in every lesson, grade-level sequenced content, and a variety of assessments" (Moyer, Daniel, Hackett, Baptiste, Stryker, and Vasquez, 2002).

The content included in the life science text of this curriculum starts with the most basic aspects of plants and animals. This text starts with what a cell is. There are in depth discussions about plant and animal cells along with visual representations. Once students have developed a firm understanding of cells, they learn about classifying organisms, extinct organisms, where various organisms live and how an ecosystem changes. In Chapter 2 the text focuses on plant parts, plant growth, and reproduction. Chapters 3 and 4 contain information about animals. The main topics on animals include; animal characteristics; invertebrates, vertebrates, organ systems; reproduction and development; and animal survival. In the Gladstone School District, the fourth grade also studies weather.

The Earth Science text includes a unit on water and weather. This unit discusses where water comes from, how it effects our environment, air, wind and the atmosphere. The unit is concluded with a lesson on the relationship between weather and climate.

Assumptions

It appears as though this curriculum has made the assumption that all students learn in the same way. Reading and writing are the two primary modes for learning about new scientific concepts. This curriculum assumes that the teacher and student

will only care about learning the basic science needed to meet the benchmark II standards. Through the NCLB, students are charged with knowing a vast array of science related content. As a result, the curriculum, the teachers, and the students don't have adequate time to "experience" hands-on scientific experimentation and inquiry for every area of science that needs to be learned. The book recognizes this unintended consequence of the push for increased standards and standards based testing and it provides the basic essential information needed for students to meet the national science standards. There are very few opportunities throughout the text for students to interact with the science that is being taught. It appears as though this curriculum assumes that elementary teachers would not have the background knowledge in science to competently carry out an actual experiment. There are very few opportunities throughout the text for students to interact with the science that is being taught. The curriculum has ideas for demonstrations, but very few ideas for student centered experimentation. To create "authentic" experiences for students, teachers must supplement this curriculum with hands on activities and performance assessments. Good point

Organization

The student textbooks that are a part of this curriculum have a uniform format. Each chapter is introduced with a "Vocabulary Preview". In this section, key vocabulary for the chapter is highlighted to help improve student comprehension. A possible inquiry activity is also described prior to beginning each lesson. Throughout the text, important vocabulary is highlighted in yellow. Each lesson contains colorful pictures and descriptions of the concepts being taught. At the end of each chapter is a

section entitled "Why It Matters". This section attempts to help students understand why the scientific concept presented is important in daily life. Critical thinking questions at the end of each lesson encourage students to think deeper about what they have learned. In addition to the standard science content in each lesson there are cross-curricular links to math, literature, writing and technology. In addition to the information included in the student textbooks, the teacher's edition includes reading strategies, critical thinking questions to pose, images of corresponding worksheets, and science background on the topic being presented. There are other supporting materials in addition to the textbook.

McGraw-Hill Science curriculum includes six supporting books. These supporting books are; School to Home Activities; Cross Curricular Projects; Reading in Science Resources; Test Preparation and Practice; Assessment Book; and an Activity Resources book. All of these books have possible activities or assessment related resources. These books are sequentially organized and correlate to the lesson being taught.

Part III
Implementation

Every teacher implements this curriculum in a slightly different way while presenting the same information. If a teacher were to strictly adhere to the suggested schedule and activities set forth by the publisher students would lose interest. Many of the activity books repeat information. Typically I integrate some of the publisher-generated activities and other projects and experiments that I have developed. During the unit on water and water currents I do a demonstration to show the concept of

convection currents. I fill a glass cake pan with water ¾ full. On one end I place hot rocks and the other end ice cubes. A drop of red die is placed by the hot rocks and blue die is dropped by the ice. As the water circulates, the red (warm) water flows in the top layers of the water and the blue (cold) water sinks to the bottom. This model shows the way warm and cool currents behave in the oceans. Rather that than just reading about ocean currents and doing a worksheet, students can see this concept happening. During the unit on plants we also do a science inquiry project with green beans. Through inquiry, students investigate how various environmental conditions affects plant production. In addition I grow green beans to the ceiling of our classroom for observational purposes. As the bean plants work their way up the strings, the class discusses the stages of the plant life cycle. As we read through the text, students generally complete a reading activity to check for comprehension. At the end of each chapter students are assessed with a publisher designed test on their understanding. I generally use tests as a learning tool. Students always take the test individually, following a chapter review of the content. After I correct the tests, students usually have a chance to find the right answer in the textbook. The class eventually discusses the test so that students understand what information they initially did not grasp. I also assess student understanding through interdisciplinary projects. To help students understand animal adaptations students design an imaginary animal. After teaching adaptations we watch the Animal Planet video "Animals of the Future". Students then develop their own imaginary animal with several adaptations. Students must also justify reasons for their animal's adaptations. Their animal adaptations must be

consistent with the habitat in which they live. This project includes writing a report; drawing a picture of their animal; creating a food chain with their animal in it; and performing a speech explaining their project. I utilize the McGraw Hill curriculum to initially teach the idea of adaptations but I supplement with other projects.

It sounds as though you need a great deal of authentic work to the curriculum

Evaluation By Others

Throughout my research I have found no evidence of an internal or external review of this McGraw Hill Macmillan curriculum. When our district adopted this science curriculum in 2003 there was no documented external review completed. Typically, a teacher in the grade level volunteers to be on the textbook adoption committee and each grade decides on the text that will help their students to meet the content standards. To objectively distinguish advantages and disadvantages of a curriculum it is important to develop evaluative criteria.

Judgment and Reflection

I have developed a rubric to evaluate curriculum on six different dimensions. These dimensions of the curriculum were chosen because I believe they are some of the most important components to help students learn and meet state standards. I will evaluate this science curriculum on, if each lesson has highlighted vocabulary; shows visual representations; has ideas and materials for experimentation; has clearly stated goals that address state standards; incorporates various learning styles; and incorporates problem solving and critical thinking into the curriculum. As shown below in Table 1.1, the rubric is based on a scale of 0 – 3. A score of zero being "not present" and a score of three meaning the curriculum fully addresses the dimension.

Table 1.1 Curriculum Analysis Scoring Guide

Criteria	0	1	2	3
Highlighted Key Vocabulary	0 words / lesson	1-2 words / lesson	3 - 4 words / lesson	5 or more words / lesson
Visual Representation (Pictures)	0 visuals/page	1 visual/page	2 visuals/page	3 or more visuals /page
Ideas and Materials for Experimentation	No ideas or materials provided	1 experiment is presented in the lesson with no materials provided.	2 experiment ideas are presented without materials	At least 1 experiment idea is presented and materials are included.
Clearly stated goals that cover state standards	There are no stated goals.	There is 1 goal for presented for the lesson.	There is at least 1 goal presented for each lesson, but is not in alignment with Oregon State Content Standards.	There is at least 1 goal presented in each lesson that is in alignment with state standards.
Incorporates Various Learning Styles	Addresses only 1 learning style	Addresses 2 learning styles	Addresses 3 learning styles	Addresses 4 or more different learning styles.
Promotes problem solving and critical thinking	0 opportunities for problem solving or critical thinking in each chapter.	1 opportunity for problem solving, but no chance for critically thinking.	2 opportunities for problem solving and critical thinking in the chapter.	3 or more opportunities for problem solving and critical thinking in the chapter.

The scores are based on the average number of times that the dimension is addressed in the curriculum. After evaluating the curriculum using the scoring guide shown in table 1.1, the curriculum earned an overall score of 14 across all dimensions. The highest score possible is 18. Based on the assessed dimensions, this curriculum earned 77% of the possible points. This is not to say that this curriculum is merely average. Other curriculum would need to be evaluated to determine whether the rubric needed adjusting, or that the curriculum is average relative to other curricula.

A dimension that is crucial in any science curriculum is to emphasize new vocabulary. The vocabulary that is typical of science is a "foreign language" to most elementary students. As a result, it is important that key vocabulary is taught during each lesson. The highlighting of vocabulary helps English language learners as well as

native speakers learn new science content. The Science curriculum on average emphasizes 6 vocabulary words for each lesson, earning it a 3 in the dimension of "Highlighted Key Vocabulary" (see Table 1.2).

This McGraw Hill curriculum was very strong in the dimension of "Visual Representations". The pages are filled with colorful, well-labeled diagrams and pictures of the discussed concepts. This curriculum did an excellent job providing visual representations, which gave this dimension a score of "3" (see Table 1.2).

This curriculum falls short of providing effective "tools and processes of inquiry" in every lesson. It may provide an idea, however, many of the projects are impractical to carryout in a typical classroom setting. In chapter 3 on Describing Animals, the authors suggest putting a gold fish in a jar with a snail and observing their movements. For a class size of 10 this might work. This inquiry could work if you already have a classroom aquarium. Getting a goldfish simply for observational purposes is not practical. This curriculum earned a "1" (see Table 1.2) in providing ideas and materials for experimentation for its lack of materials and activities for practical experimentation. The curriculum tries to provide realistic experiences for students, but with no materials it becomes difficult to carryout many of these investigations.

This curriculum works very hard to include content that will help students reach the national and Oregon science standards. Each chapter includes an average of 4 goals for each lesson. The goals and objectives are fully aligned with state standards. Due to the copious number of goals for each lesson, this curriculum earns a solid "3" (see Table 1.2) in the dimension of "Clearly stated goals that cover state standards".

All curricula should consistently incorporate various learning styles into the curricular experiences. This curriculum does very little to include different learning styles in a practical way. In most lessons, visual/spatial learning styles are addressed through pictures and diagrams. Kinesthetic learners are accommodated through occasional hands-on experiments. Linguistic learners would have their learning needs met consistently through reading text and answering questions. Since there are on average 3 different learning style incorporated into each lesson, this curriculum earned a score of "2" (see Table 1.2).

It is vital that educators push our students to use higher order thinking skills. One way that this can be done is by providing opportunities to problem solve and think critically. This curriculum scored a "2" (see Table 1.2) in this dimension. On average, each lesson includes about 2 opportunities to solve problems or think critically about an issue. Problem solving is generally promoted through science inquiry. Students are forced to solve various problems related to their inquiry, needing to relate background knowledge to their current issue. Critical thinking is encouraged through open-ended questions at the conclusion of the lesson. Although this curriculum does provide some opportunities for higher order thinking its major emphasis is on fact level information dissemination.

Table 1.2 Curriculum Analysis Scoring Guide

Criteria	0	1	2	3
Highlighted Key Vocabulary	0 words / lesson	1-2 words / lesson	3 - 4 words / lesson	5 or more words / lesson
Visual Representation (Pictures)	0 visuals/page	1 visual/page	2 visuals/page	3 or more visuals /page
Ideas and Materials for Experimentation	No ideas or materials provided	1 experiment is presented in the lesson with no materials provided.	2 experiment ideas are presented in the lesson without materials	At least 1 experiment idea is presented in the lesson and materials are included.
Clearly stated goals that cover state standards	There are no stated goals.	There is 1 goal for presented for the lesson.	There is at least 1 goal presented for each lesson, but is not in alignment with Oregon State Content Standards.	There is at least 1 goal presented in each lesson that is in alignment with state standards.
Incorporates Various Learning Styles	Addresses only 1 learning style	Addresses 2 learning styles	Addresses 3 learning styles	Addresses 4 or more different learning styles.
Promotes problem solving and critical thinking	0 opportunities for problem solving or critical thinking in each chapter.	1 opportunity for problem solving, but no chance for critically thinking.	2 opportunities for problem solving and critical thinking in the chapter.	3 or more opportunities for problem solving and critical thinking in the chapter.

Note: The boxes outlined in red, highlights the scores the curriculum earned in each dimension.

I don't believe there is a "perfect" curriculum. All students need different types of curricular experiences. There are some curriculums that are more comprehensive than others. This McGraw Hill Science curriculum exhibits many positive aspects that can greatly contribute to increased student learning. This curriculum does a great job explicitly linking the science content to national content standards for science. There are also some missing pieces, such as practical hands-on activities and materials; and activities that meet the needs of students of varying learning styles. As educators it is our duty to present information in a way that is meaningful to all students. We must continue to analyze our instructional practice, and curricula to make the necessary modifications to meet the diverse needs of our students.

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