ASSESSMENT OF REFERENCES TO AGRICULTURE IN A MIDDLE GRADE SCIENCE TEXTBOOK

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Abstract

The central purpose of this study was to assess the degree of bias toward agriculture within a middle grade science textbook, Glencoe Science Integrated Series: Level Blue Teacher Wraparound Edition (National Geographic Society, 2003). Literary formats used to reference agriculture within the text were also assessed.

A content analysis was used to identify all references to agriculture within the textbook. All references were categorized according to the agricultural literacy areas as defined by Frick, Birkenholz, and Machtmes (1995). Subsequently, all text references were then analyzed for bias using the Lowry-Hayakawa news bias categories. Text references were coded as reports, inferences, judgments, and others and were assigned a numerical score based on the assigned code. This allowed an overall bias score of the textbook, in regard to text references to agriculture, to be established.

A total of 265 references to agriculture were found within the textbook. Of these, 151 were text, 82 were pictures/diagrams, ten were unit background information, eight were student activities, eight were assessment components, and six were auxiliary materials. An overall bias score of 1.13 was determined.

It was concluded that within the examined textbook, science students are exposed to agriculture on average once every three pages. Written text, pictures and diagrams are the most common formats used to reference agriculture. The agricultural references tend to focus on plants, processing agricultural products, and agriculture's effect on the environment. Text references were mostly reports in nature. The textbook is generally unbiased in its portrayal of agricultural concepts.

Introduction

The United States has the lowest per capita food cost of any country in the world (National Research Council, 1988). However, American consumers have little knowledge about the production of the food products that are consumed everyday (National Research Council). To compound the issue, Hamlin (1962) noted that these same consumers will eventually help create the policies that control the production of food products. Without agricultural knowledge, uneducated decisions will be made which will affect food production, or the decision making power will be placed in the control of a select group of policy makers promoting the agendas of a small class of producers (Wright, 1992).

Theoretical Framework

The American society is agriculturally ignorant (Terry & Lawver, 1995). This is not a new idea. When discussing early American settlers, Bricker (1914) noted that American farmers exhausted the soil and lacked the skills needed to feed the population. Harris (1993) pointed out "As agriculture became more efficient it became less important for everyone to understand how to raise crops and livestock" (p. 12). Furthermore, Sorenson (1987) concluded that as the typical American becomes more urban he or she is less likely to have any direct contact with farming or farmers. Douglass (1985) substantiated this when it was stated that the American population has been ninety percent non-farm for over thirty years. Swan and Donaldson (1970) noted "Rank and file Americans do not see farming as one of their most successful industries, which is assuredly is, and oddly they do not consider the unique abundance provided by farms to be a blessing" (p.283).

Pope (1990) argued that "the real need for an agriculturally literate society is knowledge of the impact the industry, as a whole, has upon our daily lives" (p. 23). Mawby (1984, as cited in Harris, 1993) noted that many negative decisions affecting food production can be trace to the policy makers' lack of understanding of agriculture. Brown and Coffey (1992) specified that people need a high level of agricultural literacy as it is "imperative that consumers and government policy-makers alike understand the role of science in agriculture so that they may utilize scientific facts rather than emotions in making decisions concerning food" (p. 169). Lichte and Birkenholz (1993) noted an increased trend in the public's interest in agriculture and food issues. However, according to Lichte and Birkenholz, the public's beliefs, attitudes, and actions are often misinformed or mis-guided. Frick, Birkenholz, and Machtmes (1995) explained "The notion of agricultural literacy, since its inception, has been based on the premise that every person should possess a minimum level of knowledge of the industry which produces and markets food needed for human survival" (p. 44).

According to the National Research Council (1988), students should receive some systematic instruction about agriculture. However, a very small percentage of students are actually enrolled in "traditional agriculture courses." Therefore, to reinforce Hamlin's (1962) argument, agricultural policy and nutritional choices will be made by individuals who have never had instruction about agriculture. What can be done to change this lack

of agricultural knowledge? Law and Pepple (1990) argued that agricultural concepts should be integrated into core area subjects including science, mathematics, social studies, and language arts. Russell, McCracken, & Miller (1990), also suggested that agricultural concepts could be infused into core subjects such as mathematics, reading, science, and social science.

Altbach (1991) noted that textbooks are not only used as a resource by teachers, but have become the curriculum on which educators heavily rely. Therefore, the use of textbooks is an excellent way to provide context to integrate agricultural concepts into other educational subject areas. Textbook publishers employ a variety of literary formats to provide education about and examples of content area concepts (Deighton, 1971). These same formats can be used to incorporate agricultural concepts into existing textbooks.

It has been documented that agriculture is not immune to bias (Terry, Dunsford & Lacewell, 1996; Whitaker & Dyer, 1998; Whitaker & Dyer, 2000). These researchers also noted that the news media is often negatively biased in its portrayal of agriculture. Furthermore, it has been noted that bias toward various ideas, religions, and populations exists in textbooks (Vitz,1986). But, does bias exist toward agriculture in textbooks? Through extensive literature review, no research was found that examined the previous question. This lack of data does not diminish the value of the question. On the contrary, it begs for data to be gathered to determine if the information about agriculture disseminated through textbooks is portrayed in an objective manner.

In summary, studies have reveled that, American society has a sub-standard knowledge about agricultural concepts. Furthermore, negative bias exists toward agriculture in the public sector. Therefore, to ensure the general public's knowledge of agriculture is adequate and objective, incorporating agricultural concepts in core area textbooks can be an effective format to improve these deficiencies.

Purpose and Objectives

The purpose of this study was to assess the agricultural references made in a selected middle school science textbook and determine if there is any bias towards agriculture in those references. Objectives of this study were to: (1) identify each instance where agriculture is referenced in a selected textbook used for science instruction in the middle grades; (2) assess the literary formats used in each reference to agriculture in the textbook; (3) categorize the references to agriculture according to category of agricultural literacy; (4) determine what bias, if any, exists in the references to agriculture in the textbook.

Procedures

The research design utilized in this study was content analysis. Content analysis can be applied to examine any piece of writing or occurrence of recorded communication.

Additionally, content analysis can be used to detect the existence of propaganda and to identify the intentions, focus or communication trends of an individual (Berelson, 1952). The science textbook used for this study was *Glencoe Science Integrated Series: Level Blue Teacher Wraparound Edition* (National Geographic Society, 2003) published by Glencoe/McGraw-Hill. The following procedure was used to select this textbook. First, utilizing the Internet, companies that wrote and produced a general science textbook for middle grade students were identified. Glencoe/McGraw-Hill, Holt, Rinehart and Winston, Pearson Education, and Thompson/Wadsworth met the previous criteria. Finally, Pearson Education and Holt, Rinehart and Winston were eliminated as these companies incorporated a textbook series model as a middle school science text option. Through personal contact with Thompson/Wadsworth publishing company (Beeman, personal communication April 27, 2004) the researcher determined that the market share between the pair of textbooks was inferior to that of the Glencoe/McGraw-Hill textbook. A reserve copy of the text was requested from Glencoe/McGraw-Hill. Michael Oster, science education representative at Glencoe/McGraw-Hill, was contacted to determine the market share of the *Glencoe Science Integrated Series: Level Blue* textbook. According to Oster (personal communication, April 27, 2004) it is used by 24% of all middle school science students in the United States.

Data regarding text bias were collected using the Hayakawa-Lowry method (Lowry, 1971). S. I. Hayakawa developed a system to categorize incidences of based upon a trichotomy of sentences discussed in *Language in Thought and Action* (Hayakawa, 1978). Hayakawa defined the three basic categories of sentences as reports, inferences and judgments (1978). "Reports adhere to the following rules: first, they are verifiable; second; they exclude as far as possible, inferences, judgments, and the used of 'loaded' words" (Hayakawa, 1978, p.23). According to Hayakawa (1978), an inference "is a statement about the unknown based on the known" in which a writer or speaker "draws inference from some set of observable data" (p. 24) Hayakawa (1978) defined judgments as "expressions of the writer's approval or disapproval of the occurrences, person, or objects he is describing" (p. 25).

While conducting a content analysis of television news during the Richard Nixon presidency, Dennis Lowry (1971) expanded on Hayakawa's work. His work developed into the Hayakawa-Lowry News Bias Categories (Lowry, 1971). Later, Lowry (1985) developed more specific definitions of reports, inferences, and judgments. He wrote, "Reports sentences are factual and verifiable … Inference sentences are subjective and are not immediately verifiable," and, "Judgment sentences contain expressions of the writer's or speaker's favorable or unfavorable opinions about whatever is being described" (Lowry, 1985, p. 573).

The Hayakawa-Lowry news bias categories are:

1. Report sentence/attributed;
2. Report sentence/unattributed;
3. Inference sentence/labeled;
4. Inference sentence/unlabeled;
5. Judgment sentence/attributed/favorable;
6. Judgment sentence/attributed/unfavorable;

7. Judgment sentence/unattributed/favorable;
8. Judgment sentence/unattributed/unfavorable; and
9. All other sentences.

(Lowry, 1985, p. 574)

Establishing validity and reliability for this study were done using traditional content analysis methods. Reliability for this study was established using the aid of check-coders. Check-coders are individuals, in addition to the researcher, who read, identified, and classified instances of agricultural references (Babbie, 2002). Two check-coders assisted the researcher to identify and classify all agricultural references.

The check-coders for this study were not randomly selected. They were selected based on various criteria. Check-coder one was a female journalism student. She was chosen to ensure that a female perspective was represented in the study. Furthermore, check-coder one was selected because she did not have an agricultural background, contributing to objectivity in data collection. Additionally, her background ensured a journalistic approach when examining the textbook.

Check-coder two was a female nursing student. She, like check-coder one, was selected to provide female representation in the study. Since objectivity toward agriculture was emphasized, check-coder two was selected because she was reared in a metropolitan area with minimal agricultural experiences. Finally, due to her course of study, check-coder two was able to provide a science perspective when analyzing the textbook.

The primary researcher was a graduate student in agricultural education. He had three years of agricultural education teaching experience. He provided a male perspective with extensive agricultural experiences.

To establish construct validity of the Hayakawa-Lowry news bias categories, Lowry (1985) used a two-part study conducted at Liberty University and Ohio University. "The assumptions underlying the Hayakawa-Lowry category system were twice put to the test, and a group of subjects ranging from college freshmen to Ph.D. professors…for the most part evaluated the news stories and sentences as predicted" (Lowry, 1985, p. 580). "Thus, the results strongly suggest that the differences measured by researchers in content analysis studies are differences that do indeed make a meaningful difference to news consumers" (Lowry, 1985, p. 580).

While conducting a content analysis of *Glencoe Science Integrated Series: Level Blue* (National Geographic Society, 2003) textbook, a frequency count was taken of all references made to agricultural topics. The agricultural literacy topic areas were defined by Frick, Birkenholz, and Machtmes (1995). The categories include: (a) Societal and Global Significance of Agriculture, (b) Public Policy in Agriculture, (c) Agriculture's Relationship with the Environment and Natural Resources, (d) Plant Science, (e) Animal Science, (f) Processing of Agricultural Products, and (g) Marketing and Distribution of Agricultural Products (Frick, Birkenholz, & Machtmes). In addition to being coded

according to agricultural literacy topic area, references were categorized according to their literary format. The literary formats used in the textbook included pictures/diagrams, text, student activities, assessment components, auxiliary materials (transparencies), and unit background information for teachers. To achieve Objective 4, each text reference was coded using the Hayakawa-Lowry news bias categories.

Two "check-coders," in addition to the researcher, coded the textbook to ensure coder reliability. Prior to coding the textbook, the check-coders were trained by the researcher. The check-coders were educated about the agricultural literacy categories and what topics were included in each. Second, the literary formats that existed within the textbook were described and examples from other textbooks were used to give the check-coders experience identifying them. Finally, the check-coders were trained to code text references using a modified version of the coding manual developed by Lowry. The researcher and each assistant coded all references. The two initial coding sets were compared and all discrepancies were noted. The check-coders and researcher reviewed the discrepancies until a consensus was reached on the code assigned to each reference.

To determine a mean score (level of objectivity) for each reference, the researcher valued all report sentences as "1," all inferences as "2," and all judgment sentences as "3." Therefore, according to Hayakawa's procedures, the higher the mean, the less objective the textbook (more biased). The sentences were grouped according to their assigned agricultural literacy category and an objectivity mean was calculated for each. The resulting frequencies and corresponding percentages were used to determine the level of bias in order to meet objective 4.

Findings

Objective 1: Identify each instance where agriculture is referenced in a selected textbook used for science instruction in the middle grades.

The analysis for Objective 1 resulted in a frequency count in which 265 agricultural references were identified within the 770 pages of the textbook.

Objective 2: Assess the literary formats used in each reference to agriculture in the textbook.

Of the 265 agricultural references, over 85% were labeled either as text references (57.0%) or as a picture diagram (31.0%). These data are illustrated in Table 1.

Table 1
Instances of Agricultural References by Literary Format

Literary Format	Frequency	Percent
Text	151	57.0
Picture/Diagram	82	31.0
Unit background information	10	4.0
Student activity	8	3.0
Assessment component	8	3.0
Auxiliary material	6	2.0
Total of all references to agriculture	265	100.0

Objective 3: Categorize the references to agriculture according to category of agricultural literacy.

The categories for Objective 3 were defined by Frick, Birkenholz, and Machtmes (1995a). Of the 265 references over 75% were classified as plant science (28.7%), processing of agricultural products (27.2%), and agriculture's relationship with the environment and natural resources (21.5%). These data are illustrated in Table 2.

Table 2
Frequency of Agricultural References According to Agricultural Literacy Categories

Agricultural Literacy Category	Frequency	Percent
Plant science	76	28.7
Processing of agricultural products	72	27.2
Agriculture's relationship with the environment and natural resources	57	21.5
Societal and global significance of agriculture	38	14.3
Animal science	21	7.9
Marketing and distribution of agricultural products	1	0.4
Public policy in agriculture	0	0.0
Total of all agricultural references	265	100.0

Table 3 provides further details regarding Objective 3. Found in Table 3 are each agricultural literacy category and the number of agricultural references within each literary format.

Table 3
Literary Format of Agricultural References according to Agricultural Literacy Category

Literacy Category	Text	Picture/ Diagram	Unit Background	Student Activity	Assessment Component	Auxiliary Material	Total
Global	31	2	2	1	1	1	38
Public	0	0	0	0	0	0	0
Environment	42	10	3	2	0	0	57
Plant	40	24	4	4	2	2	76
Animal	12	5	0	0	2	2	21
Processing	25	41	1	1	3	1	72
Marketing	1	0	0	0	0	0	1
Total	151	82	10	8	8	6	265

Objective 4: Determine what bias, if any, exists in the references to agriculture in the textbook.

Table 4 presents data regarding the objectivity level of the text within each agricultural literacy category. Within the textbook 151 sentences pertaining to agriculture were identified. One hundred thirty were reports, 19 were inferences, and two were others, thus, an objectivity level of 1.13 was reached. This data appears in Table 4.

Table 4
Objectivity Levels of Text References

Agricultural Literacy Category	Frequency of Sentences in Each Hayakawa Bias Category				Total	Objectivity Level (Mean)*
	Report	Inference	Judgment	Other		
Global	17	14	0	0	31	1.77
Public	0	0	0	0	0	0.00
Relationship	42	0	0	0	42	1.00
Plant	37	1	0	2	40	1.03
Animal	10	2	0	0	12	1.17
Processing	23	2	0	0	25	1.08
Marketing	1	0	0	0	1	1.00
Total	130	19	0	2	151	1.13

**Note*: 1=report; 2=inference; 3=judgment.

Conclusions and Recommendations

Since prediction was not the central focus of this investigation, the results should not be extended beyond the study case. Examination, analysis, and interpretation of the findings provided the opportunity for the authors to draw several conclusions. Due to the number

of references found, students using the textbook are exposed to agricultural concepts approximately once every three pages. Written text, pictures, and diagrams are the most common formats used to reference agriculture. These formats made up 88% of all references within the textbook. Furthermore, written text is the most common way to incorporate references to agriculture's relationship with the environment. Generally, the agricultural references tend to focus on plants, processing agricultural products, and agriculture's effect on the environment, as they made up 70% of the references within the textbook.

This particular textbook is not an effective medium to reference public policy in agriculture concepts. In addition, including agricultural examples may simply not be appropriate in every topic area within the textbook, such as public policy.

The agricultural text references were mostly report style in nature. Reports made up 86% of all text references. As compared to studies that focused on agricultural bias in the news media, the textbook is generally unbiased in its portrayal of agricultural concepts.

As a result of the data analysis and conclusions several recommendations for agricultural education were made. First, agricultural educators should contribute to the development of science text books to ensure that accurate and appropriate references to agriculture are included. Agricultural references should be presented in a greater variety of formats including auxiliary materials, student activities, and assessment components. Incorporation of agricultural concepts with critical thinking skills and more open-ended assessment questions should be included in the textbook. Furthermore agricultural concepts, such as animal and plant production practices, should be used more frequently as examples to illustrate scientific theories and laws. Perspectives of agriculturists should be included in chapters focusing on biodiversity and conservation of natural resources.

In addition to recommendations for agricultural education, recommendations for further research were based on the findings and conclusions. A replication of this study using other middle grade science textbooks should be conducted so that all texts can be compared. In order to compare how other academic areas portray agriculture a replication of this study should be conducted using textbooks from other core education areas such as social science, mathematics, and English/literature. To determine if students understand agriculture after utilizing core area textbooks research should be conducted to investigate the relationships between agricultural references in textbooks and students' knowledge and perceptions of agriculture.

During the course of this study it was found, by the researcher and check-coders, to be difficult to assign various agricultural references to the appropriate category. As a result of this study it is apparent that one or more categories should be added to list of categories of agricultural literacy most recently proposed by Frick, Birkenholz, and Machtmes (1995), specifically food science and technology. Therefore a reevaluation of the categories of agricultural literacy proposed by Frick, Birkenholz and Machtmes is in order.

Discussion

Textbooks are utilized by teachers and students everyday. In some cases textbooks have become the very curriculum that teachers rely upon (Altbach, 1991). With this heavy usage students are exposed to various the thoughts, ideas, and beliefs of the textbook publisher. It has been documented (Terry, Dunsford & Lacewell, 1996; Whitaker & Dyer, 1998; Whitaker & Dyer, 2000) that news reports are negatively biased toward agriculture. However, until now, it was not known if textbooks were biased toward or against agriculture. Furthermore, outside of agriculture education textbooks, it was not known if students were even exposed to agricultural concepts in core area subject textbooks. Although this study cannot be generalized to all middle grade science textbooks, the findings suggest that the examined textbook does expose students to a variety of agricultural concepts and that agriculture is portrayed in a generally unbiased tone.

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