

Evolution and University-level Anthropology Textbooks: The “Missing Link”?

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Abstract Although studies analyzing the content of evolution curriculum usually focus on courses within the context of a biological sciences department or program, research must also address students and courses outside of the biological sciences. For example, using data solely from biological courses will not fully represent the scope of coverage of evolution in university education, as other fields, like anthropology, also utilize evolutionary principles. We analyzed the content of 31 university-level anthropology textbooks for the following: (1) presence of a definition of evolution in various sections of the textbooks, (2) accuracy and consistency of the definitions provided in the textbook sections, and (3) differences between textbooks for cultural and physical anthropology. Results of this study suggest that anthropology textbooks do not necessarily (1) provide a single definition of evolution or (2) provide an accurate, “baseline” definition of evolution when present. Additionally, substantive differences were observed between definitions provided in different sections within a single textbook, as well as between textbooks written for cultural anthropology and physical anthropology/archaeology courses. Given the inclusion of anthropology courses in general education curriculum at the university-level, we conclude that this situation may further exacerbate the misunderstanding of

the basic tenets of evolution that university students have been repeatedly shown to demonstrate. We stress the role of the instructor in choosing textbooks that provide accurate information for students, as well as the responsibility they hold in providing a concise, accurate definition of evolution in social sciences courses.

Keywords Evolution · Textbook analysis · Anthropology

Introduction

Many researchers have addressed university students’ attitudes toward knowledge of and/or exposure to evolution. Nearly all of these studies, however, either focused on the content and impact of courses within the biological sciences (see Demastes et al. 1995; Matthews 2001; McKeachie et al. 2002; Nehm and Reilly 2007; Robbins and Roy 2007) or used samples that were comprised solely of students enrolled in courses within the biological sciences (see Bishop and Anderson 1990; Fuerst 1984; Grose and Simpson 1982; Ingram and Nelson 2006; Johnson and Peeples 1987; Moore et al. 2006; Sinclair and Baldwin 1995; Sinclair et al. 1997; Wilson 2001). Notably, one of the only exceptions to this general pattern was the study of Brem et al. (2003), in which university students’ perceptions of how the acceptance of evolution impacts moral and social aspects of American life were analyzed. These researchers solicited students in potentially every department by setting up a booth on the campus of a public university in a Western state. More recently, Cunningham and Wescott (2009) found that students enrolled in introductory physical anthropology (PA) courses at a Midwestern public university did not necessarily have a broad understanding of evolutionary theory or processes.

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While the focus on the biological sciences seems logical and justified, these courses are not the only ones in which students may be exposed to evolution. This concept is likely to be at least mentioned in anthropology, astronomy, geography, and geology courses as these disciplines address change over time, though faculty in each discipline may define evolution differently given their specific areas of interest. Depending on students' choice of both major and general education courses, there is the potential that they may only be exposed to the concept of evolution within courses in these other disciplines. Students who take courses from a range of disciplines may, as a result, also be exposed to differing definitions of evolution. For these reasons and considering the results of Cunningham and Wescott's (2009) survey, research must also address students and courses in disciplines outside the biological sciences. This manuscript focuses on one of these disciplines: anthropology.

According to the American Anthropological Association, anthropology is "the study of humankind, from its beginnings millions of years ago to the present day" (Givens 2008). Anthropologists operate within the framework that humans are subject to the same evolutionary processes as all other biological organisms, and that biological modifications and limitations impact the behavior of all human groups, both in the past and present. Given this perspective, the American Anthropological Association (2000) holds that evolution is central to the discipline.

While some universities may offer a generalized course in anthropology, anthropology courses usually focus on a particular subfield, or a combination of subfields, within the discipline. Evolution is particularly central to PA, which addresses the human evolutionary record and fossil discoveries, and cultural anthropology (CA), which covers the social organization of human cultural groups in the modern day. While CA courses may not directly address biological evolution, it is still likely to be one of the underlying assumptions of CA courses given anthropologists' contention that human behavior is impacted and influenced by limitations imposed on the human species, its ancestors, and other members of the order Primates by the environment or biological processes (see Henrich and McElreath 2003). In addition, CA courses are likely to include the concept of "cultural evolution" or to ascribe the term "evolution" to different cultural processes and changes. Furthermore, CA courses are likely to address topics to which evolution is directly related, including the discussion of race as a socially constructed or biological phenomenon (see Lieberman et al. 1990; Mukhopadhyay and Moses 1997; American Anthropological Association 1998). For these reasons, research needs to address the content of both CA and PA courses and course material, though it is reasonable to assume that the presentation of evolution in these courses may differ given their different foci.

In addition to focusing almost exclusively on courses and students in the biological sciences, the relevant literature also neglects the contents of college-level textbooks. While textbooks are only one aspect of education, they are included in the majority of university courses and therefore impact students' understanding of the course material (see Carrothers and Benson 2003; Clump et al. 2004; Hood 2006). Although it may seem to be an obvious point, data do indicate that at least some students do, in fact, make use of their textbooks, albeit at different times. For example, Podolsky and Finkelstein (2006) found that 37% of the students in the four mathematics courses they sampled usually read, while 38% read sometimes, and the remaining 25% rarely read. They also found that 18% of the students read before a lecture (with higher percentages in the courses that had pop quizzes), while 21% read both before and after the lecture, and 61% read after the lecture. Similarly, Clump et al. (2004) found that depending on the level of the course, 21–43% of the psychology students in their sample read before a lecture, while 61–91% read before a test.

Although this literature supports the notion that university students utilize their textbooks, additional studies suggest they do so in a piecemeal fashion. For example, Weiten et al. (1996, 1999) and Marek et al. (1999) found that students were most likely to read, and to perceive as valuable, the chapter summaries, running glossaries, or text boxes (definitions or descriptions that are presented in the textbook's margins), chapter glossaries, and the bolded terms in the text. Given these results and the general indication among faculty members that textbooks "matter," researchers interested in university-level evolution education should address the presentation of evolution in textbooks, or at least in particular sections of these textbooks.

In our literature search, we were able to locate only one study that directly addressed the coverage of evolution in textbooks. Linhart (1997) focused on textbooks designed for one of the following six courses in the biological sciences: general biology (for majors and non-majors), evolution, genetics, paleontology, ecology, and systematics. He restricted his sample to 50 textbooks that had multiple editions and a sizable market share, and he located at least some of these textbooks using colleagues' recommendations. He analyzed the content of the glossary entry for evolution in each textbook, as well as the material in any pages listed in an index entry for evolution, and compared these data against a definition of evolution he constructed after reviewing the literature:

Evolution is said to have occurred within a species, lineage, or population when measurable changes in various morphological, physiological, behavioral, or

biochemical characteristics can be detected. These characteristics must be at least partly under genetic control. The genetic change(s) can occur as a consequence of processes such as migration, mutation, genetic drift or bottleneck, natural selection, and nonrandom mating. Genetic changes within different populations of a species can lead to differences among lineages, and sometimes to the origin of new species...Evolution is not a synonym of natural selection. Nor is evolution a process that leads inevitably to increased or improved adaptation, or to greater reproductive success. Evolution does not imply a progressively closer fit between a population and its environment. Finally, evolution does not involve predictable or irrevocable changes from simple to more complex forms or toward some sort of perfection (Linhart 1997: 387).

While he found variation between the textbooks written for the six different courses in his sample, his findings indicated that the majority of all of the textbooks equated evolution with natural selection or adaptation and did not describe evolution in much detail. Linhart (1997) expressed much concern regarding the content of the definition of evolution in these textbooks, arguing that many students will have an inaccurate or incomplete view of evolution unless they are provided with additional material.

The argument may be made that Linhart's (1997) concern is overstated since faculty may (and might be expected to) provide their students with a more accurate and complete understanding of evolution through their lectures and supplemental material. Linhart's (1997) research, however, highlights how problematic the presentation of evolution in university-level textbooks is and, thereby, the integral role of the faculty member in ensuring that students gain a complete and accurate understanding of evolution. Additional content analyses are needed as Linhart (1997) only addressed textbooks for courses in the *biological sciences*.

The aim of this study is to explore the presentation of evolution in various sections of university-level anthropology textbooks, which will provide information regarding the portrayal of evolution in a discipline outside the biological sciences. Furthermore, this project builds upon previous research that highlighted students' use of different sections of a textbook by comparing the content and consistency of these definitions. An additional goal of this study is to compare the presentation of evolution in the textbooks written for CA and PA courses. One would expect these presentations to vary given the substantive differences between the two sub-disciplines, as well as Linhart's (1997) finding that the definition of evolution differs between disciplines in the biological sciences. To

summarize, we seek to answer the following three research questions:

1. To what extent do the textbooks provide a definition of evolution in the sections that students are most likely to read?
2. To what extent do the definitions presented in the sections of the textbooks provide an accurate and consistent description of evolution? Furthermore, does the accurate information include a "baseline" definition of evolution, and/or does it go beyond this definition?
3. To what extent do the textbooks written for a CA course differ from those written for a PA course, in terms of the topics addressed by the first two questions?

Materials and Methods

Textbook Selection For our analysis, we included either the only or the most current edition of the textbooks written for an introductory PA or CA course that were available for purchase on the websites of four college textbook publishers (McGraw Hill, Oxford University Press, Thompson Wadsworth, and Pearson/Prentice Hall/Allyn and Bacon) between September 2007 and December 2007. We focused on introductory courses because they are frequently the only exposure that students from a wide range of majors have to anthropology. We included PA textbooks that also addressed archaeology (another subfield of anthropology) because the study of the human cultural past may be incorporated into a combined course with PA. The final sample contained 31 textbooks. Eighteen of these books (58.1%) were marketed for CA, and 13 textbooks (41.9%) were marketed for PA.

Data Collection and Coding We created the data set for this project by recording verbatim the definitions of evolution provided in the glossaries, chapter summaries, and text boxes as well as any definitions that appeared in the text after the bolded word "evolution" (from this point on, these will be referred to as the "in-text" definitions). These definitions, as well as the title, author(s), publisher, and publication date of each textbook are presented in Tables 1 and 2. The presence or absence of a definition of evolution in each of these sections will provide the information needed to address our first research question (as well as part of our third research question), which centered on the extent to which the textbooks provide definitions. While previous research indicated that students also tend to read chapter glossaries (Marek et al. 1999; Weiten et al. 1996, 1999), only four of the textbooks in our sample (three of which were written by the same author) are included this section. As a result, the definitions provided

Table 1 Information about cultural anthropology textbooks included in the sample

ID	Author(s)	Title	Publisher	Year	Glossary	Summary	Text box	In-text
1	Bates and Franklin	Cultural Anthropology	Pearson/Allyn and Bacon	2003	The process by which small but cumulative changes in the species can, over time, lead to its transformation; may be divided into two categories: physical evolution (adaptive changes in biological make up) and cultural evolution (adaptive changes in thought and behavior)	Explains the development of all species as the outcome of adaptation to environmental circumstances through the process of natural selection		A shared and ongoing change
2	Ferraro	Cultural Anthropology: An Applied Perspective	Thomson/Wadsworth	2006				
3	Haines	Cultural Anthropology: Adaptations, Structures, and Meanings	Pearson/Prentice Hall	2005	A view that, over time, human and other species change based on the differential advantages of new characteristics or behavior			
4	Harris and Johnson	Cultural Anthropology	Pearson/Allyn and Bacon	2007				
5	Haviland, Prins, Walrath, and McBride	Cultural Anthropology: The Human Challenge	Thomson/Wadsworth	2008	Changes in the genetic makeup of a population over generations		Changes in the genetic makeup of a population over generations	Changes in the genetic makeup of a population over generations
6	Kottak	Cultural Anthropology	McGraw Hill	2008	Belief that species arose from others through a long and gradual process of transformation, or descent with modification	Belief that species arose from others through a long and gradual process of transformation, or descent with modification		Belief that species arose from others through a long and gradual process of transformation, or descent with modification
7	Kottak	Window on Humanity: A Concise Introduction to Anthropology	McGraw Hill	2007	Descent with modification; change in form over generations.			species arose from others through a long and gradual process of transformation, or descent with modification.
8	Kottak	Anthropology: The Exploration of Human Diversity	McGraw Hill	2008	Belief that species arose from others through a long and gradual process of transformation, or descent with modification	Belief that species arose from others through a long and gradual process of transformation, or descent with modification		Belief that species arose from others through a long and gradual process of transformation, or descent with modification
9	Kottak	Mirror for Humanity	McGraw Hill	2008				
10	Lavenda and Schultz	Core Concepts in Cultural Anthropology	McGraw Hill	2007				

11	Lenkeit	Introducing Cultural Anthropology	McGraw Hill	2007	Models a delineate sequence of culture change over time and the processes at work in this change
12	Miller	Cultural Anthropology	Pearson	2007	Says that early forms evolve into later forms through the process of natural selection, whereby the most biologically fit organisms survive to reproduce while those that are less fit die out
13	Miller	Anthropology	Pearson	2008	Inherited and accumulated change in the characteristics of species, population, and culture
14	Nanda and Warms	Cultural Anthropology	Thompson/Wadsworth	2007	The change in the properties of populations of organisms that occur over time
15	Omohundro	Thinking Like an Anthropologist: A Practical Introduction to Cultural Anthropology	McGraw Hill	2008	Inherited and accumulated change in the characteristics of species, population, and culture
16	Peoples and Bailey	Humanity: An Introduction to Cultural Anthropology	Thompson/Wadsworth	2006	The change in the properties of populations of organisms that occur over time
17	Salzman and Rice	Thinking Anthropo-logically	Pearson/Prentice Hall	2008	Darwin defined it as "descent with modification"; a more modern definition might claim it is the process by which one group/species of plant or animal changes over time to become a different/new population
18	Shultz and Lavenda	Cultural Anthropology: Perspective on the Human Condition	Oxford University Press	2005	Change over time. Biological evolution which concerns the resources for human development provided by our genes and other elements that make up our physical bodies. Cultural evolution which concerns the beliefs and behaviors we incorporate into human development through the experiences of teaching and learning

Table 2 Information about physical anthropology textbooks included in the sample

ID	Author(s)	Title	Publisher	Year	Glossary	Summary	Text box	In-text
19	Campbell, Loy, and Cruz-Uribe	Humankind Emerging	Pearson	2006	Cumulative changes in the average characteristics of a population generally thought to occur over many generations	Cumulative changes in the average characteristics of a population generally thought to occur over many generations	Cumulative changes in the average characteristics of a population generally thought to occur over many generations	
20	Cela-Conde and Ayala	Human Evolution: Trails from the Past	Oxford University Press	2007				
21	Crabtree and Campana	Archaeology and Prehistory	McGraw Hill	2001				
22	DeCorse	The Record of the Past: An Introduction to Physical Anthropology and Archaeology	Prentice Hall	2000	Process of change within the genetic makeup of a species over time			Process of change in a species over time
23	Feder	The Past in Perspective: An Introduction to Human Prehistory	McGraw Hill	2007	The systematic change through time of biological organisms or human cultural systems			The focus of Darwin's work and the organizing theme of this book; biological evolution simply implies a process of systematic change through time
24	Kottak	Physical Anthropology and Archaeology	McGraw Hill	2006	Belief that species arose from others through a long gradual process of transformation or descent with modification	Belief that species arose from others through a long gradual process of transformation or descent with modification		
25	Lewis, Jurmain, and Kilgore	Understanding Physical Anthropology and Archaeology	Thompson Wadsworth	2007	A change in the genetic structure of a population from one generation to the next; the term is also frequently used to refer to the appearance of a new species		A change in frequency of alleles from one generation to the next	The gradual unfolding of new varieties of life from previous forms over long periods of time
26	Park	Biological Anthropology	McGraw Hill	2008	Change through time, usually with reference to biological species, but may also refer to changes within cultural systems		Change through time; here, with reference to biological species	Species of living things change over time, and under the right circumstances, this change can produce new species of living organisms from existing ones
27	Price and Feinman	Images of the Past	McGraw Hill	2008	The process of change over time resulting from shifting conditions of the physical and cultural environment, involving mechanisms of mutation and natural		The process of change over time resulting from shifting conditions of the physical and cultural environment, involving mechanisms of mutation and natural	

28	Relethford	The Human Species: An Introduction to Biological Anthropology	McGraw Hill	2005	selection; human biology and culture evolved during the late Miocene, Pliocene, Pleistocene, and Holocene	Change in living organisms over time
29	Rice and Moloney	Biological Anthropology and Prehistory: Exploring Our Human Ancestry	Pearson	2005	The transformation of species of organic life over long periods of time	Biological change through time
30	Stanford, Allen, and Antón	Exploring Biological Anthropology	Prentice Hall: Pearson	2008	Transformation of species of organic life over long periods of time A change in the frequency of a gene or a trait in a population over multiple generations	Slow and inefficient, but over many generations, it can mold animals and plants into a bewildering variety of forms
31	Stein and Rowe	Physical Anthropology	McGraw Hill	2006	Change in the frequencies of alleles within a gene pool of a population over time	A significant change in the gene pool of a population over time

in the chapter glossaries were not included in our data set or analysis.

Once data collection was finished, authors met to collectively code the definitions so we could address our second research question, which centered on the content of the definitions. Each definition provided by a single textbook was coded separately, and a definition received a given code if it contained certain key words or phrases. Some of the phrases used for these codes were derived from Linhart (1997), while others appeared in at least one of the textbook definitions and matched the central meaning of each code (described below). There were four codes, and a single definition could receive multiple codes. We resolved any coding differences through discussion and, when needed, consultation of the textbooks.

The first of the four codes was applied to any definition that included both the term “common ancestry” and the phrase “descent with modification.” (For an example of a definition that included “descent with modification,” see the glossary definition of book 6 in Table 1.) This code was derived from the definitions of evolution provided in Darwin’s *On The Origin of Species by Means of Natural Selection, or the Preservation of Favoured Races in the Struggle for Life* (1859), journal articles and scholarly books regarding evolution (Alberts and Labov 2004; Bishop and Anderson 1990; Bobrowsky 2000; Moore et al. 2006; Ruthledge and Warden 2000; Scott 2005; Witham 2002), and the websites of various scientific organizations (National Committee on Science Education Standards and Assessment 1996; Committee on Revising Science and Creationism, National Academy of Sciences and Institute of Medicine of the National Academies 2008; National Center for Science Education 2008). Therefore, the textbook definitions that included both parts of this code presented the essential or “baseline” information about evolution.

The second code was applied to any definition that contained additional information about evolution that was not contained in this “baseline.” A definition would receive this code if it contained any mention of Charles Darwin (see glossary definition of book 17 in Table 1),¹ genes or genetics (including mutations and changes in genes or their frequency; see glossary definition of book 5 in Table 1), adaptation (see glossary definition of book 1 in Table 1), natural selection (see summary definition of book 1 in Table 1), the creation of new species (see glossary definition of book 17 in Table 1), and/or the transformation

¹ We did not include Darwin in the “baseline” definition because he was not explicitly included in the definitions provided by any of the sources mentioned in the previous paragraph. In addition, we argue it is critical that students do not equate evolution with Darwin, as evolutionary theory was developed and influenced by other scholars before and after Darwin.

of an existing species (see glossary definition of book 1 in Table 1), as well as if it described evolution as a central principle of biology (see in-text definition of book 14 in Table 1).

The third code was applied to any definition that provided inaccurate information about evolution; this information could be partially or totally incorrect. When coding the descriptions of evolution for his study, Linhart (1997) identified descriptions that *equated* evolution with natural selection, increased complexity, or progress; none of the definitions in our sample included these concepts. We did, however, find definitions that contained other inaccurate information. A definition was coded as containing inaccurate information if it indicated that evolution was a guided process (see in-text definition of book 30 in Table 2) or just a belief (see glossary definition of book 24 in Table 2). We included the first item because it implies the presence of an intelligent agent or agency; we included the second item because students may think that evolution is not well supported by the evidence if it is described as a belief. A definition also received the “inaccurate information” code if it simply described evolution as change over time (see summary definition of book 1 in Table 1). This statement is at best partially accurate since it does not specify the nature of the change. If the change was explicitly described (anywhere within the definition) as being genetic, this code was not applied to that definition.

The fourth code was applied to any definition that provided a non-biological definition of evolution. More specifically, a definition received this code if it described cultural change as evolution and/or stated that cultures evolve (see text box definition of book 11 in Table 1). The focus on culture is to be expected since the textbooks were anthropological, and we included this code because textbooks that provide non-biological definitions of evolution may confuse students, who may conflate biological and cultural evolution.

All of these codes enabled us to determine if the definitions provided in the textbooks were accurate, as well as if they contained “baseline” information and/or additional information about evolution. In addition, comparing the codes applied to each definition provided by a single textbook allowed us to ascertain if evolution was defined consistently within a textbook. The use of this coding regime enabled us to answer our second research question regarding the content and consistency of the definitions, as well as the part of the third research question that compares the definitions within CA and PA textbooks.

Data Analysis

The aim of this analysis is to provide insight into a possible source of student confusion regarding evolution. Thus, it is

critical to assess the presentation of evolution in textbooks, including both consistency and accuracy of the presented information, as well as differences between the various sections within the textbook to present information. We provide our results in the context of each individual research question provided above, first addressing the definitions presented in each section, followed by an analysis of the consistency and accuracy of these definitions. In the latter analyses, we specifically address to what extent the definition presented in each section includes components of a “baseline” definition or provides additional and/or incorrect information. Finally, we present the results of the comparison between CA and PA introductory textbooks. In addressing the final research question, we also return to our focus on comparing textbook sections.

Research Question 1 To what extent do the textbooks provide a definition of evolution in the sections that students are most likely to read?

Twenty-three of the 31 textbooks in our sample (74.2%) provided a definition of evolution in at least one section, and Table 3 presents the number of textbooks that provided a definition in a particular section or sections. Approximately one fifth of the textbooks that had chapter summaries provided a definition of evolution in this section, while approximately three fourths of the textbooks that had glossaries and text boxes provided a definition of evolution in these sections. A majority of the textbooks also provided in-text definitions of evolution, though the percentage (54.5%) was not as high as the percentage for the other sections.

Four of the textbooks (12.1%) provided a definition of evolution in only one section. Seven textbooks provided a definition in two sections; this represented 24.1% of the 29 textbooks that had at least two sections. Finally, 12 textbooks provided definitions of evolution in three sections; this was 46.2% of the 26 textbooks that had at least three sections. (See Table 3 for information regarding the specific sections within a textbook that provided a definition.)

Research Question 2 To what extent do the definitions presented in the sections of the textbooks provide an accurate and consistent description of evolution? Furthermore, does the accurate information include a “baseline” definition of evolution, and/or does it go beyond this definition?

Table 4 presents the results of our coding process (unlike Table 3, the percentages in this table were based on the number of textbooks that actually provided a definition of

Table 3 Frequencies and percentages of textbooks that provide a definition of evolution in a particular section(s)

Section	Cultural anthropology	Physical anthropology	Total
Glossary	9 (56.2% of 16)	11 (91.2% of 12)	20(71.4% of 28)
Summary	3 (21.4% of 14)	2 (20% of 10)	5(20.8% of 24)
Text box	4 (57.1% of 7)	7 (100% of 7)	11(79.6% of 14)
In-text	10 (55.6% of 18)	8 (66.7% of 12)	18(54.5% of 33)
Only one section	4 (22.2% of 18)	0	4(12.1% of 33)
Glossary only	2 (12.5% of 16)	0	2(6.7% of 30)
In-text only	2 (11.1% of 18)	0	2(6.3% of 32)
Two sections	2 (11.8% of 17)	5 (41.7% of 12)	7(24.1% of 29)
Glossary and summary	0	1 (9.1% of 11)	1(4.2% of 24)
Glossary and text box	0	2 (28.6% of 7)	2(15.4% of 13)
Glossary and in-text	1 (6.3% of 16)	2 (16.7% of 12)	3(10.7% of 28)
Text box and in-text	1 (14.3% of 7)	0	1(7.1% of 14)
Three sections	6 (40% of 15)	6 (54.5% of 11)	12(46.2% of 26)
Glossary, summary, and in-text	3 (23.1% of 13)	1 (10% of 10)	4(17.4% of 23)
Glossary, text box, and in-text	3 (50% of 6)	5 (71.4% of 7)	8(61.5% of 13)

The frequencies provided within the parentheses indicate the number of textbooks which included the section(s) indicated by the row. Books lacking the specific sections were not included in the percentage count

evolution in a particular section). Firstly, none of the definitions of evolution provided in any section of any textbook included both components of our “baseline” definition of evolution: descent with modification *and* common ancestry. Furthermore, none of the definitions included the term “common ancestry.” Almost two thirds of the textbooks that provided a definition of evolution in their summaries mentioned “descent with modification”; this phrase was included in one fourth of the textbooks with glossary definitions of evolution, 16.7% of the textbooks with in-text definitions of evolution, and none of the text box definitions of evolution. Due to the small size of the sample and subsamples, we did not conduct any inferential statistics, nor will we discuss relatively minor differences in percentage or frequency.

Secondly, while relatively few textbooks provided the “baseline” definition of evolution, 80% of the textbooks that provided a summary definition received the “additional information” code, as did three fourths of the textbooks that provided glossary definitions, over 60% of the textbooks with in-text definitions, and just over half of the textbooks with text box definitions. Similarly, 80% of the textbooks that defined evolution in a chapter summary received the “inaccurate information” code, as did two thirds of the textbooks with in-text definitions, 60% of those with glossary definitions, and 54.5% of those containing text box definitions. Finally, none of the textbooks that defined evolution in their summaries received the “cultural definition” code, though about one fourth of the textbooks with glossaries and text boxes and 16.7% of the textbooks with in-text definitions did so.

Thirdly, to determine if the information provided in a single definition of evolution was *contradictory*, we separated the definitions based on whether they (1) only received the codes for “descent with modification” and/or “additional information,” (2) only received the codes for “inaccurate information” and/or the cultural definition, or (3) received both types of codes (see Table 4). A contradictory definition would be one that contained both types of codes (#3); it is contradictory in the sense that it provides both accurate and problematic information about evolution. We define this information “problematic,” as it is either inaccurate or provides a non-biological definition of evolution.

More than one third of the definitions of evolution provided in the glossaries and text boxes received the code for “descent with modification” and/or “additional information,” as did more than one fourth of the in-text definitions and one fifth of the summary definitions. Almost half of the definitions appearing in the text boxes received the codes for “incorrect information” and/or “cultural definition,” as did more than one third of the in-text definitions and one fifth of the glossary and summary definitions. Finally, 40% of the glossary and summary definitions received inconsistent codes, as did one third of the in-text definitions and 18.2% of the text box definitions. (See Table 4 for data regarding textbooks that received only one code, as well as the specific codes applied to textbooks with inconsistent definitions.)

Finally, to ascertain if the definitions provided by different sections of the same textbook were *consistent*, we determined if at least one of the definitions received at

Table 4 Frequencies and percentages of definitions that received a given code

Code	Glossary			Summary			Text box			In-Text		
	CA (n=9)	PA (n=11)	Total (n=20)	CA (n=3)	PA (n=2)	Total (n=5)	CA (n=4)	PA (n=7)	Total (n=11)	CA (n=10)	PA (n=8)	Total (n=18)
Received “baseline” definition code	0	0	0	0	0	0	0	0	0	0	0	0
Common ancestry	0	0	0	0	0	0	0	0	0	0	0	0
Descent with modification	4 (44.4%)	1 (9.1%)	5 (25%)	2 (66.7%)	1 (50%)	3 (60%)	0	0	0	3 (30%)	0	3 (16.7%)
Received “additional information” code	7 (77.8%)	8 (72.7%)	15 (75%)	3 (100%)	1 (50%)	4 (80%)	2 (50%)	4 (57.1%)	6 (54.5%)	7 (70%)	4 (50%)	11 (61.1%)
Received “incorrect information” code	5 (55.6%)	7 (63.6%)	12 (60%)	2 (66.7%)	2 (100%)	4 (80%)	2 (50%)	4 (71.4%)	6 (54.5%)	5 (50%)	7 (87.5%)	12 (66.7%)
Received “cultural definition” code	2 (22.2%)	3 (27.3%)	5 (25%)	0	0	0	2 (50%)	1 (14.3%)	3 (27.3%)	3 (30%)	0	3 (16.7%)
Only received include “descent with modification” and/or “additional information” code	4 (44.4%)	4 (36.4%)	8 (40%)	1 (33.3%)	0	1 (20%)	1 (25%)	3 (42.9%)	4 (36.4%)	4 (40%)	1 (12.5%)	5 (27.8%)
Only received “descent with modification” code	1 (11.1%)	0	1 (5%)	0	0	0	0	0	0	0	0	0
Only received “additional information” code	1 (11.1%)	4 (36.4%)	5 (25%)	1 (33.3%)	0	1 (20%)	1 (25%)	3 (42.9%)	4 (36.4%)	3 (30%)	1 (12.5%)	4 (22.2%)
Only received “cultural definition” and/or “incorrect information” code	1 (11.1%)	3 (27.3%)	4 (20%)	0	1 (50%)	1 (20%)	2 (50%)	3 (42.9%)	5 (45.5%)	3 (30%)	4 (50%)	7 (38.9%)
Only received “cultural definition” code	0	0	0	0	0	0	1 (25%)	0	1 (9.1%)	1 (10%)	0	1 (5.6%)
Only received “incorrect information” code	1 (11.1%)	3 (27.3%)	4 (20%)	0	1 (50%)	1 (20%)	1 (25%)	3 (42.9%)	4 (36.4%)	2 (20%)	3 (37.5%)	5 (27.8%)
Received contradictory codes	4 (44.4%)	4 (36.4%)	8 (40%)	1 (33.3%)	1 (50%)	2 (40%)	1 (25%)	1 (14.3%)	2 (18.2%)	3 (30%)	3 (37.5%)	6 (33.3%)
“Additional information” and “incorrect information” codes	1 (11.1%)	2 (18.2%)	3 (15%)	0	0	0	0	0	0	0	3 (37.5%)	3 (16.7%)
“Additional information”, “incorrect information”, and “cultural definition” codes	2 (22.2%)	1 (9.1%)	3 (15%)	0	0	0	1 (25%)	1 (14.3%)	2 (18.2%)	1 (10%)	0	1 (5.6%)
“Descent with modification”, “additional information”, and “incorrect information” codes	1 (11.1%)	1 (9.1%)	2 (10%)	1 (50%)	1 (50%)	2 (50%)	0	0	0	2 (20%)	0	2 (11.1%)

Percentages are based on the number of textbooks with a definition of evolution in the specific sections tabulated. Books without these particular sections were not included in the percentage count

least one code that contradicted the codes applied to the other definitions; a contradiction was defined in the way described above (i.e., accurate versus problematic). For example, a textbook with a definition in the glossary that received a code for “additional” information and also with a text box definition that received a code for “cultural” information would be considered *inconsistent*. No single textbook provided a definition of evolution in all four sections; thus, no textbook provided a consistent definition in all four sections. Twelve textbooks provided a definition of evolution in three of the four sections (see Table 5); the definitions provided in five of these textbooks were consistent (i.e., did not receive contradictory codes). These five textbooks were 41.7% of the 12 textbooks that provided definitions in three sections and 15.2% of all 33 textbooks. Seven textbooks provided definitions in two of the four sections (see Table 5). Five of these provided definitions that were consistent. These five textbooks comprise 71.4% of the seven textbooks that provide definitions in two different sections and 15.2% of all of the textbooks in our sample. (See Table 5 for information regarding which specific sections and Table 6 for information regarding codes received by textbooks that contained contradictory definitions.)

Research Question 3 To what extent do the textbooks written for a CA course differ from those written for a PA course, in terms of the topics addressed by the first two questions?

There were a few differences between CA and PA textbooks in regard to whether or not evolution was defined in a particular section. The glossaries and text boxes of CA textbooks were less likely to provide a definition than those in PA textbooks (see Table 3). CA and PA textbooks also differed in regard to the number of

sections that provided a definition of evolution. All four of the textbooks that provided a definition of evolution in only one section were CA textbooks, while five of the seven textbooks that provided definitions in two different sections were PA textbooks. (See Table 3 for information regarding the specific sections within a textbook that provided a definition.)

In terms of the content of the definitions, there were a few differences as well (see Table 4). The majority of the glossary definitions that received the “descent with modification” code were in CA textbooks, as were all of the in-text definitions that received this code. The percentage of CA textbooks with summary definitions that received the “descent with modification” code was also slightly higher than the percentage of PA textbooks, though the frequencies were very close. CA textbooks were more likely than PA textbooks to have summary and in-text definitions that received the “additional information” code. In addition, PA textbooks were more likely than CA textbooks to provide definitions in each section that received the “inaccurate information” code, though the percentages were close for the glossary definitions. Finally, all of the textbooks that had in-text definitions that received the “cultural definition” code were CA textbooks, and a higher percentage of CA textbooks with text box definitions received this code.

Beyond the existence of a definition in different sections of CA and PA textbooks, differences in consistency were also observed. The CA textbooks were less likely than the PA textbooks to have text box and in-text definitions that only received the code for “descent with modification” and/or “additional information.” The only book with a summary definition that received at least one of these codes was a CA textbook (see Table 4). As one would expect given the previous finding, PA textbooks were more likely to have definitions in each section (except the text box) that only received at least one of the following codes: “incorrect

Table 5 Frequencies and percentages of textbooks that provided inconsistent definitions

Sections	Not receive contradictory codes			Received contradictory codes		
	CA	PA	Total	CA	PA	Total
Three sections	3 (50% of 6)	2 (33.3% of 6)	5(41.7% of 12)	3 (50% of 6)	4 (66.7% of 6)	7 (58.3% of 12)
Glossary, text box, and in-text	1 (33.3% of 3)	2 (40% of 5)	3(37.5% of 8)	2 (66.7% of 3)	3 (60% of 5)	5 (62.5% of 8)
Glossary, summary, and in-text	2 (66.7% of 3)	0	2(50% of 4)	1 (33.3% of 3)	1 (100% of 1)	2 (50% of 4)
Two sections	2 (100% of 2)	3 (60% of 5)	5(71.4% of 7)	0	2 (40% of 5)	2 (28.6% of 7)
Glossary and in-text	1 (100% of 1)	0	1(33.3% of 3)	0	2 (100% of 2)	2 (66.7% of 3)
Glossary and text box	0	2 (100% of 2)	2(100% of 2)	0	0	0
Glossary and summary	0	1 (100% of 1)	1(100% of 1)	0	0	0
Text box and in-text	1 (100% of 1)	0	1(100% of 1)	0	0	0

Percentages are based on the number of textbooks that provided a definition of evolution in the relevant sections

Table 6 Codes applied to the definitions provided in inconsistent textbooks

Books and sections	Additional information	Incorrect information	Cultural definition
Evolution defined in glossary, summary, and in-text			
Book #1 (CA)			
Glossary	x		x
Summary	x		
In-text		x	
Book #2 (PA)			
Glossary	x	x	
Summary		x	
In-text		x	
Evolution defined in glossary, text box, and in-text			
Book #1 (CA)			
Glossary		x	
Text box		x	
In-text	x		
Book #2 (CA)			
Glossary	x	x	x
Text box	x	x	x
In-text		x	x
Book #3 (PA)			
Glossary		x	x
Text box		x	
In-text	x	x	
Book #4 (PA)			
Glossary	x		
Text box	x		
In-text	x	x	
Book #5 (PA)			
Glossary	x		
Text box	x		
In-text		x	
Evolution defined in glossary and in-text			
Book #1 (PA)			
Glossary		x	x
In-text	x	x	
Book #2 (PA)			
Glossary	x		
In-text		x	

information” and “cultural definition.” (The frequencies are close for the text box and in-text definitions.) In summary, all of the definitions above were not contradictory; however, CA textbooks were more likely to be accurate than PA. Regarding the definitions that received conflicting codes, the percentages for CA books were substantially lower for summary definitions and higher for glossary and text box definitions, with the percentages for in-text definitions only seven points apart (in favor of PA textbooks).

(See Table 4 for information regarding the textbooks that only received one of the codes discussed above, as well as the codes received by the contradictory definitions.)

In regard to consistency between definitions within one book, three of the five textbooks that had three matching definitions were in a CA textbook. (See Table 5 for information regarding which sections). Three of five textbooks that provided two matching definitions were for a PA course.

Discussion and Implications

Research Question 1 To what extent do the textbooks provide a definition of evolution in the sections that students are most likely to read?

According to our analysis, almost three fourths of the anthropology textbooks provided a definition of evolution in at least one section. Most notably, it is surprising that not all of the textbooks provided at least one definition of evolution, given the central role of evolution in anthropology, particularly in PA, and cultural anthropologists' likelihood of discussing cultural evolution. In addition, as addressed below, CA and PA textbooks are roughly equally likely to not provide a definition, so this finding cannot be explained by claiming that CA textbooks are the ones that do not provide a definition. Since a sizeable minority (about 25%) do not provide *any* definitions of evolution, we advise faculty to review their textbook choices (even with changes in editions) and to consider adjustments if their textbook belongs to this minority. Although the role of a faculty member may seem to be an obvious point to some readers, this careful attention to textbook content needs to occur, given our findings.

Beyond the presence of a definition within a single book, it is noteworthy that there is also variation in which, and in how many, sections of the book these definitions appeared. About one tenth of the textbooks defined evolution in only one section. None of the textbooks provided a definition of evolution in all four sections, and almost one fourth of the textbooks that had two sections defined evolution in both of these sections. Of the textbooks that provided a definition in only one section, none provided this definition in the text box or summary. Three of the textbooks that defined evolution in two sections provided this definition in the text box, while only one of these books provided a definition in the summary. In contrast, the glossary was one of the sections that provided a definition for all but one of these seven books. All of the textbooks that had a definition of evolution in three sections provided a definition in the glossary and in the text, while four of these textbooks provided a definition in the summary.

Our findings reveal a surprising amount of mis-education on the topic of evolution in anthropology textbooks. This is indicated by the fact that anthropology textbooks are not likely to present a definition of evolution in any given section. Therefore, the results of our study point to the need to provide more definitions of evolution throughout anthropology textbooks. In particular, very few of the textbooks in our sample have a definition of evolution in their summary sections. It is also surprising that more textbooks did not make use of a text box

definition of the term. However, when a textbook has text boxes, this section appears to be a good resource for providing a definition of evolution within the sample. The in-text definitions are still good sources, however. The glossary appears to be a good source overall. Given the books within the sample, the glossary and text box appear to be the most useful sections (for finding a definition of evolution), whereas the summary appears to be the least useful. Therefore, we suggest that faculty direct their students to focus on the glossaries and text boxes and to ignore the summaries, at least when their students are searching for definitions.

We also want to draw attention to the sizeable number of textbooks with *in-text* definitions that do not provide definitions of evolution since the reader may (inaccurately) perceive this section as the best tool. As an additional note, it was surprising that very few of the books had a chapter glossary, even though previous research has indicated that students are highly likely to read them (Marek et al. 1999; Weiten et al. 1996, 1999). As authors and publishing houses continue to produce new textbooks for market purchase, we should not lose sight of the implications of formatting and editorial decisions. Authors and publishers should consider including sections that may be considered “extraneous,” because these may prove to be as important to student understanding as the text. Thus, issues brought to the fore with these results highlight the concern authors and publishing companies should show and possible steps that may be warranted during the editing process.

Research Question 2 To what extent do the definitions presented in the sections of the textbooks provide an accurate and consistent description of evolution? (Furthermore, does the accurate information include a “baseline” definition of evolution, and/or does it go beyond this definition?)

A central finding related to this question is that none of the definitions of evolution provided in any textbook mention *both* common ancestry and descent with modification. In fact, none of these definitions included “common ancestry.” “Descent with modification” was found in few textbooks within the total sample, though none of the text box definitions included this component of the “baseline” code. Faculty and researchers need to be aware that based on this sample, anthropology textbooks are not likely to provide students with the “baseline” definition of evolution.

This does not mean that the textbooks did not provide some accurate information regarding *the process or mechanism of evolution* in their definitions, however. A majority of all of the definitions provided additional

information about evolution, though these majorities were smaller for the text box and in-text definitions. In other words, the section that was the most likely to provide a definition in this sample was also somewhat less likely to provide accurate information, while the section that was less likely to provide a definition was more likely to provide additional accurate information. With that said, the majority of the definitions of evolution contained at least one inaccurate element. In addition, several textbooks included information about cultural evolution in a variety of textbook sections. Whereas the section that was the most likely to provide a definition was (somewhat) less likely to provide accurate information, the section that was less likely to provide a definition of evolution was more likely to provide a reference to cultural evolution.

Another issue as problematic as definitional accuracy is the occurrence of contradictory information. At least one third of the glossary, summary, and in-text definitions contained contradictory elements, while less than one fifth of the text box definitions did so. Thus, students appear to be roughly equally likely to find a definition that contains only correct information, only incorrect information, or conflicting information about evolution. In this study, we found that almost 60% of the books that defined evolution in three sections were inconsistent, whereas almost 30% of books that defined evolution in two sections were inconsistent. These findings have implications for those developing curriculum and the impact of curriculum on students' understanding of evolution.

Research Question 3 To what extent do the textbooks written for a CA course differ from those written for a PA course, in terms of the topics addressed by the first two questions?

Our findings reveal some differences between the CA and PA textbooks. The glossaries and text boxes in CA textbooks were less likely than those in PA textbooks to provide a definition of evolution. Although books written for PA appear to be more useful in terms of providing information about evolution in more sections, the data show that, overall, textbooks for both CA and PA were equally likely not to provide a definition of evolution at all. This was a surprising result, given our assumption that CA courses may touch on the idea of evolution in the introductory sections, while PA courses would frame the entire course around common ancestry and descent with modification.

As for the content of their definitions, CA textbooks were more likely than PA textbooks to (1) include descent with modification in every section except the text box, (2) provide additional information in the summary and in-text definitions, and (3) include a cultural definition in the in-

text and text box definitions (see Table 4). CA textbooks appear to be more likely to provide accurate information, though they are also generally more likely to provide the potentially confusing “non-biological” definition. It must be noted, that PA books also presented a “cultural” definition of evolution, particularly in the glossaries. There was a higher percentage of PA textbooks that provided definitions in each section that contained at least one inaccurate element (although percentages were relatively similar for the glossaries). Overall, CA textbooks have higher percentages of definitions that only provide accurate information, while PA textbooks have a higher percentage of definitions that provide only problematic information.

In terms of contradictory information *within one definition*, CA and PA textbooks only differ in percentages. The percentages for CA books were substantially lower for summary definitions and higher for glossary and text box definitions, with the percentages for in-text definitions only seven points apart (in favor of PA textbooks; see Table 4). In addition, only PA textbooks had in-text definitions that contained both “additional” and “incorrect” information, while only CA textbooks had in-text definitions that received both of these codes and one of the other codes. In terms of the consistency of definitions *within one textbook*, the only difference between PA and CA books is that PA textbooks were the only ones to provide a definition in two sections that were inconsistent (see Table 5). In summary, our findings indicate that PA books are more likely to (1) present at least one definition of evolution and (2) have multiple sections that define evolution. In comparison, however, CA books were more likely to (1) provide a definition of evolution that included components of the “baseline” definition, (2) provide an accurate definition of evolution, and (3) provide less contradictory information within and between definitions. In addition, CA books were only slightly more likely to provide a “non-biological” definition of evolution.

Conclusion

Results of this study demonstrate that textbooks in anthropology, a discipline for which evolution is a central tenet, do not necessarily (1) provide a single definition of evolution, (2) provide an accurate definition of evolution when present, and (3) provide consistent definitions between textbook sections. While past research has focused on the content of textbooks in biological curriculum (Linhart 1997), very little attention has been paid to other disciplines that also stress evolution, such as anthropology. However, given that anthropology courses are often offered as part of a general education curriculum, the presentation of evolution in this context must be given equal attention.

We therefore repeat that future research must also address evolutionary curriculum in disciplines outside of the biological sciences.

We also have added to current literature and analyses in that we explored the consistency of definitions provided within one textbook, an approach that we feel has potential for future analyses. Thus, we have provided a necessary addition to the field of evolution pedagogy, providing instructors with a broader perspective of the importance of the presence and accuracy of information in university curriculum. To explore the implications of this project and possible future analyses, research could focus further on the connection between textbook use and actual student viewpoints and should include other disciplines that also address evolution (psychology, for example). A direct comparison between our research and that of others concentrated on other fields (i.e., Linhart 1997) is problematic, given differences in discipline objectives and research design. However we, like other authors, emphasize the importance of (1) presence of an accurate definition of evolution in textbooks, (2) the content of the definitions provided in the textbooks, and (3) the consistency of the definitions between sections of the same textbook. In the end, our study further emphasizes the role of the instructor in providing accurate information, in understanding how students use textbooks for study, and how this use may lead to misunderstanding.

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