

A Model to Augment Critical Thinking and Create Knowledge through Writing in the Agricultural Social Sciences

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Abstract

Effective writing instruction is essential to the development of a competent and diverse 21st century workforce in the agricultural social sciences. Writing instruction can be illustrated using a model framework that describes its relationships, elements and characteristics. Therefore, the purpose of this study was to use a mixed-method research design to develop a model to augment critical thinking and create knowledge through writing in the agricultural social sciences. Writing instruction in the agricultural social sciences is effective if the writing process is supported by students' confidence, cognitive processes and content knowledge, which are influenced by students' discourse knowledge and social context. The illustrative model is a model of reality because it is a graphical representation of physical relationships between concepts. It presents writing in the agricultural social sciences as a complex integrated system—each element has a relationship with other elements within the system—that requires the layered writing process to be embedded in context-specific knowledge domains, cognitive processes and societal influences. This model has the potential to guide practice and provide a foundation for scientific discovery, but more research is needed to understand the interactivity, interdependence and interrelationships among its elements.

Introduction

The writing research base has grown and become diversified since its seedling stage in the late 1960s (Alamargot and Chanquoy, 2001; Nystrand, 2006). However, heterogeneity of writing models is a problem even though diversified writing models provide the profession with the opportunity to progress toward the development of writing theory (Alamargot and Chanquoy, 2001). Writing models and theories started as general and descriptive. Yet, they have become more functional by defining and describing specific sub processes

of writing and their relationships to the more complex process of writing (Alamargot and Chanquoy, 2001). Models provide writing researchers with an analytical definition of writing and the writing process and help them focus on specific elements of writing while visualizing the larger complex system (Alamargot and Chanquoy, 2001). Models, grounded in research, are still needed by not only researchers to further the research base of writing but also practitioners who rely on researchers to discover new ways to teach writing (Pritchard and Honeycutt, 2006) in a variety of disciplines.

Teaching writing in agriculture is important (Jackson, 1972) because it helps students think critically, gather and comprehend information and gain content knowledge (Cobia, 1986). When integrated into the course content, writing becomes an outlet for students to learn content-related material (Aaron, 1996) and a form of knowledge assessment (Ryan and Campa, 2000). Nilsson and Fulton (2002) stated that writing assignments were the most used form of evaluation in agriculture capstone courses and the most important outcome measure was communication skills. Instruction related to the development of scientific and technical writing skills within the disciplines is needed because too many courses include writing as a component and not as a way to develop content knowledge (Howard et al., 2006). Using writing as a way to learn helps students engage in course material, breakdown complex ideas and constructs (Ryan and Campa, 2000) and increase their intellectual capacity, helping them transition from college students to employees more efficiently (Epstein, 1999).

Effective writing instruction is essential to the development of a competent and diverse 21st century workforce in the agricultural social sciences (Aaron, 1996; Cobia, 1986; Coorts, 1987; Jackson, 1972; Walker, 2011). Because employers, alumni, faculty and students

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ranked communication as a preferred soft skill (Crawford et al., 2011), improving students' ability to communicate is among the top seven needs of curriculum in agriculture (Coorts, 1987). Employers seek employees who have technical agriculture knowledge and the ability to creatively and effectively disseminate information; therefore, students need skills in technical agriculture, communications, data collection and time management (Walker, 2011).

Writing instruction in the agricultural social sciences can be illustrated using a model framework, described by Hayes (2006) and Phillips (1996) as a framework that contains the ideas, relationships and elements researchers believe guide a specific area of inquiry. Kitchel and Ball (2014) said that conceptual models are used in agricultural education as "visual diagram[s] or description[s] indicating relationships between or among variables" (p. 190) because models describe phenomena but do not predict it (Shoemaker et al., 2004). Scientists can develop theoretical frameworks, structure hypothesis, select variables, choose research designs and develop instruments using an underlying model (Phillips, 1996), which can be categorized as "models 'of reality' or 'models 'for' reality'" (Geertz, 1973, p. 93). A model of reality is a "what is" or conceptual model — a graphical representation of physical relationships between concepts (Geertz, 1973). Whereas, a model for reality is a "how-to" or procedural model—a description of a process or task and how to complete the task (Geertz, 1973).

Models should present a subject in a way that it has never been presented before by opening a door to new light (Hayes and Flower, 1980b). "*As a profession grows...—value assumptions are redefined, knowledge is extended and skill is perfected—but it is the acquisition of knowledge and the organizing of it into meaningful patterns[,] which enriches professional practice*" (McKay, 1969, p. 393). Models are the foundation of research and should be constantly investigated (Phillips, 1996) because research guides practice and the adaption and modification of the original model framework (Hayes, 2006; Phillips, 1996).

Like many professions, a model of writing grounded in research is needed in the agricultural social sciences because writing programs are discipline, institution and industry specific and one model of writing cannot function in all settings (Fulwiler and Young, 1990). Therefore, the purpose of this study was to use a mixed-method research design to develop a model to augment critical thinking and create knowledge through writing in the social sciences of agriculture. One research question and two objectives guided this study:

1. What writing elements contribute to a model of writing in the agricultural social sciences?
 - 1.1. Synthesize data previously collected using a review of literature, stakeholder interviews and a Q sort.
 - 1.2. Develop a model of writing that augments critical thinking and creates knowledge.

Method

The method used in this study was part of the reporting for a larger dissertation research project, A model to augment critical thinking and create knowledge through writing in the social sciences of agriculture (Leggette, 2013). The Texas A&M University Institutional Review Board approved the study protocol and all participants provided informed consent prior to participating in the study.

A model to augment critical thinking and create knowledge through writing in the agricultural social sciences grew out of the idea that certain writing elements augment students' ability to become critical thinkers and knowledge creators. The model "of" reality (Geertz, 1973) was developed using a mixed-method research design because multiple paradigms of research methods are important in understanding social complexities (Greene and Caracelli, 1997). Methods are "carriers of different paradigm elements that—when combined—enable us to see our data in enriched and new ways" (Riggin, 1997, p. 87). In mixed-method component designs, methods are combined at interpretation and conclusion with three specific designs: triangulation, complementarily and expansion. This mixed-method study was designed to establish triangulation using a combination of inquiry paradigms, which serves as a way to "minimize study biases that derive from inherent design weaknesses" (Caracelli and Greene, 1997, p. 23).

Model development began with problem identification, which was followed by using consistent stories from contextual experts as the basis for model development (Ford and Sterman, 1998; Morecroft, 1985; Morecroft and van der Heijden, 1992). The model of writing in the agricultural social sciences provides a framework for effective writing instruction that augments critical thinking and creates knowledge. The mixed-method study was completed in three phases and the data were collected between February 2012 and April 2013. Each phase was analyzed independently and built on the prior collected data. In addition, the data collected during phase one and two were reviewed, analyzed and reported as one study that guided the model development in phase three. The phase two findings that contributed to the model are reported by phase and not by individual participant.

The first phase of the study was a qualitative review and evaluation of writing theories and conceptual models using the pragmatic and methodical theory evaluation criteria proposed by Dudley-Brown in 1997. The Google Scholar, Texas A&M University library and WorldCat.org search revealed three theories and seven conceptual models. Additionally, a qualitative coding (Saldaña, 2013) template as well as personal experiences teaching and researching writing were used to document the description, inclusion and exclusion evaluation criteria and typical exemplars for each of Dudley-Brown's (1997) criterion.

The second phase of the study included semi-structured interviews, focus groups and Q-sorts with

teams of experts who had a wide range of expertise, providing researchers with varying perspectives to guide the model development process (Morecroft, 1985; Morecroft and van der Heijden, 1992). Developing models is the pooling of knowledge into a framework that can be applied to a scenario and used to interpret real events (Morecroft and van der Heijden, 1992). To develop conceptual models, a researcher must use “elicitation, articulation and description of knowledge ... [of] system experts” (Ford and Sterman, 1998, p. 310).

Eight semi-structured interviews (Lindolf and Taylor, 2011) with faculty who taught a writing-intensive course during fall 2011 or spring 2012 were used to define the role of writing in the agricultural social sciences (noted as Phase 2.1 in the results). Faculty were identified using a simple random sample (Wiersma and Jurs, 2005) of the purposive sample. Interview questions were developed based on the concerns of writing instructors and researchers, a review of literature and the theoretical paradigms and conceptual models of writing identified in phase one of the study.

Student focus groups (Krueger and Casey, 2000) were conducted to understand students’ experiences in and attitudes about writing-intensive courses in the agricultural social sciences (noted as Phase 2.2 in the results). Students were identified using a purposive sample. Fifteen students participated in three focus groups. Focus group questions were developed based on phase one of the study and the interviews with faculty. The questions were modified after each focus group if needed.

Q sorts were conducted with faculty, students and current and former administrators in the College of Agriculture and Life Sciences (noted as Phase 2.3 in the results). Q methodology bridges the gap between the qualitative and quantitative research paradigms to measure subjectivity (Tuler et al., 2005). Three faculty members, four students and three administrators sorted 37 specific statements related to writing factors that augment critical thinking and create knowledge in the agricultural social sciences. Data collected from phase one of the study, the interviews and the focus groups were used to develop the Q-sort statements.

The conceptual model was developed during phase three of the study. After conducting phases one and two, key components of and factors related to writing were documented to facilitate the model development. Each phase of data collection was revisited to determine what elements and concepts should be included in the model. Each Q-sort statement was not incorporated into the writing model because

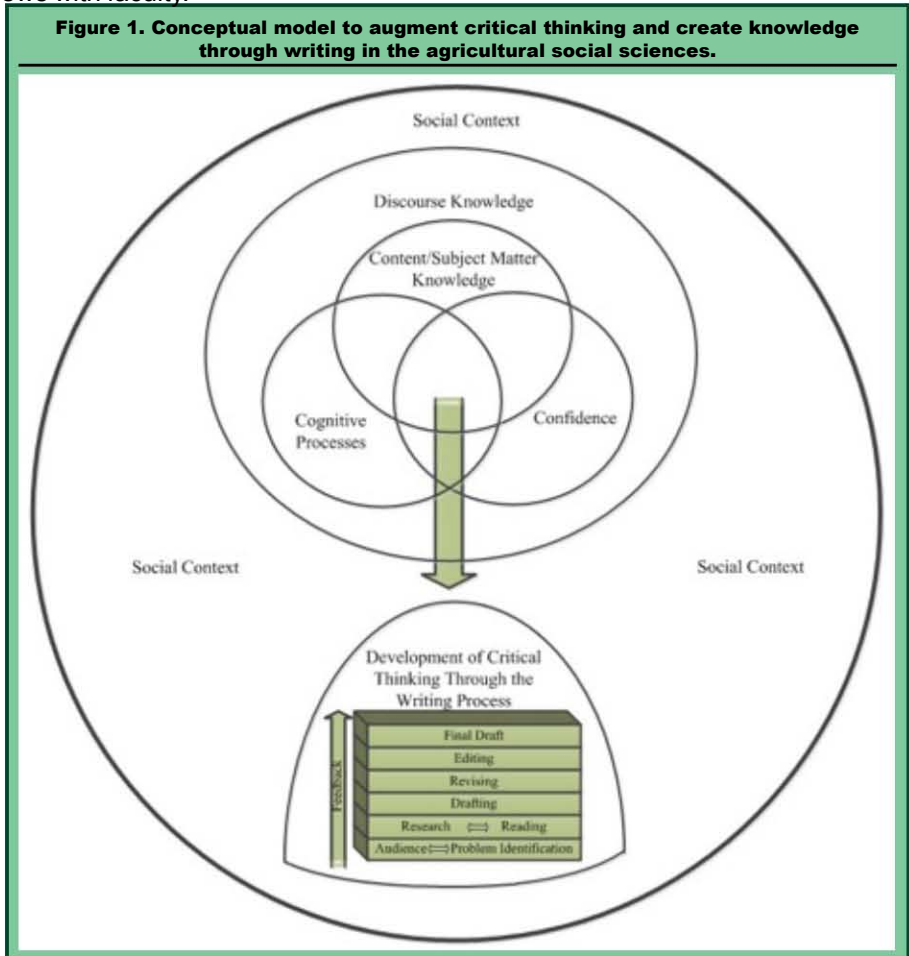
of conflicting research. Additionally, common statements and themes were condensed and restructured for the best possible presentation. A diagram was constructed based on the field work and the interviews “to illustrate the connections ... and to interpret the system’s likely behavior” (Morecroft, 1985, p. 14). The condensed statements and themes were placed into a graphical representation, as suggested by Morecroft (1985), to portray the writing elements that augment critical thinking and create knowledge in the agricultural social sciences.

Results and Discussion

Writing is often shaped and carried out in a complex environment guided by the attitudes and feelings of not only the writer but also the society and people who surround him or her (Flower, 1994). In 2009, the National Council of Teachers of English stated that a new model of writing needed to include social awareness and audience because “neither social nor cognitive theory makes genuine sense without the other” (Flower, 1994, p. 33). The conceptual model to augment critical thinking and create knowledge through writing in the agricultural social sciences (see Figure 1) introduced here postulates that students in the agricultural social sciences develop critical thinking skills and learn through writing if certain elements are present.

This writing model has two characteristics that set it apart from other models: the encompassing influence

Figure 1. Conceptual model to augment critical thinking and create knowledge through writing in the agricultural social sciences.



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of the agricultural social context and the depiction of the writing process as a layered process that occurs as a result of students' ability to think critically while developing a product using a research-based foundation. The writing process depicted as the center of the model draws on the layering concept because focus group participants (Phase 2.2) claimed "writing is a layering process" that requires students to develop and build on information as part of constructing text. The writing process is only as strong as students' social context and their ability to lay an empirically sound foundation that supports the process.

The first layer is audience and problem identification (National Council of Teachers of English, 2009). The interpretation principle of critical thinking is developed in the first layer of the writing process because students must interpret and understand the problem while they are identifying their target audience. Focus group participants (Phase 2.2) emphasized that students must "understand the topic from all points of view and see the topic through the eyes of their readers" before moving onto the second layer of the process. Target audiences within the agricultural social sciences include agricultural researchers, practitioners and consumers. Therefore, students must be prepared to interpret the needs of diverse audiences, which forces students to "understand a side they have never experienced" (Phase 2.2). Although sometimes students may interpret the audience before interpreting the problem, the two are situated at the base of the layering process because an effective writer interprets the target audience and the problem using empirically sound evidence (Phase 2.2).

The second layer is conducting research related to the audience and problem identified as part of the first layer in the writing process. Students develop the ability to analyze information and enhance their critical thinking skills while analyzing the facts and information they found by researching the problem (Phase 2.3). To create and transform new knowledge, students must spend time researching and reading (Phases 2.1, 2.2; Bereiter and Scardamalia, 1987; Ryan and Campa, 2000). Writing is understanding how concepts are connected and explaining that connection to an audience identified in the first layer of the writing process (Orr, 1996). Agricultural social science students serve as the dissemination channel between the industry and the public (Phase 2.1). Therefore, they should gather information from a variety of sources and disseminate the information to larger populations (Walker, 2011). During the research layer, students begin to understand the intricate pieces of the topic and how those pieces become parts of a larger whole. Students should use the knowledge they have about the audience and problem and combine it with the knowledge they gained during the research process to transform knowledge in the draft product (Bereiter and Scardamalia, 1987; Ryan and Campa, 2000).

The third layer is drafting (National Council of Teachers in English, 2009). Drafting includes producing mul-

iple drafts to gain practice writing, to develop skills in condensing and refining information for a specific audience and to enhance critical thinking skills by making inferences and explaining facts based on research (Phases 2.2, 2.3). Alamargot and Chanquoy (2001) postulated that delimiting and adapting text and developing and presenting ideas in text are important parts of the writing process. However, surface-level writers typically produce one draft and do not spend substantial time in the preparing, thinking and revising stages of the writing process (Lingwall and Kuehn, 2013). To become deep writers who engage in reflection and revision, students must spend time moving between the third and fourth layer of the writing process (Phase 2.1)

The fourth layer is revising, which is a layer that beginning writers often fail to work through because they do not know how to properly revise text (Epstein, 1999; Maimon et al., 2007; Vilardi, 1986). Revising, however, is instrumental in students' ability to evaluate meaning of the text they produce (Phases 2.1, 2.2). As students evaluate meaning, they enhance their critical thinking and reasoning skills. Extensive revising, however, is a characteristic of knowledge crafters, which is the expertise level of writing and often takes 20 years of maturation, instruction and training to achieve (Kellogg, 2008). Therefore, students in the agricultural social sciences should have "instruction and training in revising multiple times during the process to better develop and present text" (Phases 2.1, 2.2, 2.3). Because revision is more than cosmetics, students should attend to the reader's perspective; review the paper and its parts; and add, delete and move text as needed during the revision process (Epstein, 1999; Maimon et al., 2007; Vilardi, 1986).

The fifth layer of the writing process is editing. The editing process is tedious because writers must polish the product (e.g., shorten sentences, delete empty words, delete extraneous material) and make final changes before publication (Maimon et al., 2007; Vilardi, 1986). As students in the agricultural social sciences edit their product, they are enhancing their critical thinking skills by evaluating their work using grammar and mechanics rules. However, focus group participants (Phase 2.2) said that many students in the agricultural social sciences are "not fluent in basic grammar and mechanics" and too often instructors spend class time "teaching the basics of writing." If the content is not presented using proper grammar and mechanics, "the written word is not effective" even though the product contains factual information (Phase 2.1). Therefore, effective writers have writing process knowledge, industry and discipline knowledge and writing conventions and editing knowledge (Beaufort, 1999).

The sixth and final layer of the writing process is the final draft. Although writing is a continual process and a product can always be refined (Phases 2.1, 2.2), the final draft should be complete, present a well-developed message to its audience and meet the content, mechanics and style requirements set forth

by the defined audience. After students submit the final product, they should engage in self-regulation by spending time reflecting on the writing process. Deep writers spend time reflecting and identifying ways to enhance their writing in the future (Lingwall and Kuehn, 2013).

An important piece of the model is the rich, timely feedback that guides the writing process (Phases 2.1, 2.2, 2.3; Hayes and Devitt, 2008; National Council of Teachers in English, 2009). Roberts-Nkrumah (2005) found that “writing is thinking and that it is a process” (p.22) that must be completed in the presence of feedback. Dunsford (2006) explained that students made more revisions if they received oral feedback than if they received written feedback.

Formal feedback has three sources: instructor, peer and self (Phases 2.1, 2.2, 2.3). Instructor feedback should be provided at each stage of the writing process. Students become effective writers by being guided through the process (Phases 2.1, 2.2) not “by continuously writing and making the same mistakes” (Phase 2.3). For example, students should complete small assignments in class that lead to larger more, in-depth writing assignments because instructors can provide incremental feedback at each layer of the writing process (Phase 2.1). “Teacher comment influences student revision choices[,] and the more directive the teacher comment, the better chance the students will revise their texts successfully” (Dunsford, 2006, p. 17). In contrast, peer feedback does not increase students’ ability to think critically and create knowledge because “poor writers do not help poor writers become more effective writers” (Phase 2.3). To become effective writers, students must be “guided by writers who can write themselves” (Phase 2.3). In addition, students should become critical assessors of their own writing to provide them with a deeper learning experience (Leggette et al., 2013)

Students in the agricultural social sciences demonstrate critical thinking through the writing process because they must work through the process to solve a problem and deliver the solution in written form (Phase 2.3). The objective of critical thinking is “to assess the truth of statements, the validity of an argument, or the soundness of a proposal and come to a judgment” (Henderson, 1972, p. 46). Critical thinking is demonstrated during the writing process at varying levels because students have the opportunity to interpret, analyze, infer, explain, evaluate and self-regulate, which Stedman (2015) noted as instrumental in the critical thinking process. Critical thinking skills can be improved through writing assignments that promote the use of students’ logical thought processes and problem solving skills (Hayes and Devitt, 2008; Schmidt et al., 2002; Strachan, 2008; Tapper, 2004). Tapper (2004) believed that clear thinking often leads to clear writing. For students to identify an audience, identify a problem, conduct research, produce multiple drafts, revise thoroughly and critically, edit for writing mechanics and produce a final draft, they

must be able to think critically, apply old knowledge to new situations and transform new knowledge (Phases 2.1, 2.2).

The three elements that surround the writing process embedded in critical thinking are content knowledge (Phase 2.2; Beaufort, 1999), cognitive processes (Deane et al., 2008; Hayes, 1996; Hayes and Flower, 1980a; Kellogg, 1996) and confidence (Phase 2.1). Content knowledge is important in understanding and communicating about the topic. Employers seek employees who not only have technical agriculture knowledge but also have the ability to creatively and effectively communicate agriculture information using simple language (Walker, 2011). Before communicating about a problem, students must identify and research the problem during the first and second layer of the writing process (Phases 2.2, 2.3). Without understanding the topic, students in the agricultural social sciences cannot disseminate technical agricultural information to a larger, more specific audience (Phase 2.2).

Cognitive processes, as defined by Deane et al. (2008), are domain knowledge, working memory, informal/verbal reasoning, linguistic skills and social evaluative skills. Domain knowledge provides support in the “planning stage (when the writer must decide how to structure the text) and in reading (when the reviewers or the reader must decide how the material is in fact organized)” (Deane et al., 2008, p. 19). Domain knowledge can increase writing quality because the writer’s familiarity with the topic of the story connects with the working memory and together they are a key component of the writing process (Deane et al., 2008). “Writing performance depends critically upon being able to recall relevant knowledge and manipulate it in working memory” (Deane et al., 2008, p. 20). Prior knowledge relevant to the topic as well as working memory affect the quality of students’ writing (Deane et al., 2008) because writing is more than putting words on paper. It is “setting goals, formulating problems, evaluating decisions and planning in the light of prior goals and decisions” (Bereiter and Scardamalia, 1987, p. 363). Writing, therefore, is instrumental in students’ decision making abilities and their capacity to solve problems (Phase 2.3).

Furthermore, students’ confidence is an important part in students’ ability to write and think critically (Phase 2.1). Students’ competence is guided by their confidence in their abilities to perform complex writing tasks. Bereiter and Scardamalia (1987) recommended that instructors “involve students in investigations of their own strategies and knowledge because ... students should see it as their responsibility to help each other develop their knowledge” (p. 363). Part of developing is struggling to transform knowledge and gaining experience by working through problems associated with writing (Phase 2.1; Bereiter and Scardamalia, 1987). Often times, students lack confidence in their ability to write and in their position as an expert on a given topic (Phase 2.1). For students to become effective writers, they must

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develop confidence in themselves and competence in their abilities (Phase 2.1).

Content knowledge (Phase 2.2; Beaufort, 1999), cognitive processes (Deane et al., 2008; Hayes, 1996; Hayes and Flower, 1980a; Kellogg, 1996) and confidence (Phase 2.1) are situated within discourse knowledge. The discourse community defines the types of writings that occur within the boundaries of the environment (Beaufort, 1999). It is a common misconception that writing is a general skill that can be used across disciplines and professions without some level of adaptation and modification (Beaufort, 1999). However, "discourse communities exhibit a particular network of communicative channels, oral and written, whose interplay affects the purposes and meanings of the written texts produced within the community" (Beaufort, 1999, pp. 18–19). A discourse community could be different for two writing tasks in the same discipline because the discourse community is defined by the audience (Beaufort, 1999), which is why it is important that students clearly and correctly identify their audience at the beginning of the writing process (Phase 2.2). A mistake at the beginning of the process could have negative impacts throughout the duration of the assignment. Therefore, students in the agricultural social sciences should understand how to communicate within their content area as well as how to communicate within the larger agricultural industry (Phase 2.1).

The elements within the conceptual model to augment critical thinking and create knowledge through writing in the social sciences of agriculture are intertwined and linked together by the social context of the writing environment (Phase 2.3). Writers internally and externally negotiate meaning. In the presence of negotiated meaning, individuals are freethinkers ready to share a unique understanding and conceptualization of information (Flower, 1994). Social context is a key in the development of writing proficiency (Phase 2.3; Deane et al., 2008). Socio-culture stresses that "community practices deeply influence what sort of writing tasks will be undertaken, how they will be structured and how they will be received" (Deane et al., 2008, p. 13). Therefore, the elements of writing in this model are joined together in an overarching social context because of its impact on students' development, presentation and understanding of text.

The illustrative conceptual model to augment critical thinking and create knowledge through writing in the agricultural social sciences is a model "of" reality (Geertz, 1973) because it is a graphical representation of physical relationships between concepts. It presents writing as a "complex integrated system" (Phase 2.3) that requires the layered writing process, which is built on a strong foundation of knowing and understanding the audience and topic, to be embedded in context-specific knowledge domains (Beaufort, 1999), cognitive processes (Deane et al., 2008; Hayes, 1996; Hayes and Flower, 1980a; Kellogg, 1996) and societal influences (Flower, 1994). The writing process is not independent of the system (Phase 2.2). The writing process must

be carried out within the complex system if students in the agricultural social sciences are to become effective writers, critical thinkers and knowledge creators.

Because text is developed during the writing process, the layered elements are the core of the complex system. Each layer of the writing process is present in all contexts, but the extent that the layer is present depends on the student's ability to think critically and on the context, situation and audience. Writing assignments, without regard to the level of complexity, could not be completed if the structured layering process was not part of the system. Therefore, the usefulness of the model is dependent on the presence and strength of the writing process. Additionally, although the writing process is the core of the complex system, it cannot stand alone. For students to reach a deep, elaborative level of writing, their writing process must be interactive with, be interdependent on and have an interrelationship with their confidence, cognitive processes, content knowledge, discourse knowledge and social context.

Each element contributes to the writing process and critical thinking, demonstrated through the layers of the writing process, and is co-dependent on the other elements. The importance of each element, however, is defined by the context, situation and audience of the writing assignment. As students move through the writing process, they draw from their cognitive processes, confidence levels, content knowledge, discourse knowledge and societal influences. Students may draw from the elements simultaneously or not at all during each layer of the writing process. If each element of the model is not present, however, the text that students produce may not be deep, elaborative level writing.

More research (e.g., structural equation modeling and/or discriminate function analysis), however, is necessary to understand the interactivity, interdependence and interrelationship among the model's elements. The areas of overlap within the model need to be investigated to determine their impact on the writing system. Moreover, more research should be conducted on how and to what extent each element impacts the writing process. The writing process layers are universal and widely applied but their importance in the process and impact on the system may be dependent on the context, situation and audience. Therefore, more research should be conducted to investigate how context, situation and audience impact the writing process layers and define the elements' degree of function within the model.

Summary

Writing has become an age-old communication medium that many scholars have investigated. However, writing is such a broad line of inquiry that researchers are still years away from understanding writing and knowing how to facilitate writing instruction, especially in the context of agriculture. Some would argue that writing is more about content development while others would argue that writing is more about grammar and mechanics. Yet, writing is not about content development or about

grammar and mechanics. Writing is a way for students in the agricultural social sciences to think critically, create knowledge and connect concepts.

Writing instruction is an important component of a higher education in agricultural sciences and natural resources. The agricultural industry is comprised of multiple disciplines and discourse communities and each one has a set of beliefs, values and opinions. Often times, students learn how to write for one discourse community instead of learning how to transfer their writing skills from one discourse community and writing task to another discourse community and writing task. Because writing is a way for students to become critical thinkers and knowledge creators, writing instruction should be intentionally implemented according to a conceptual model and should not occur haphazardly. Using this conceptual model as a basis for course modification will help students write to learn and understand across multiple disciplines and discourse communities and not just write to write.

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