Using Writing to Promote Thinking in a First Year Agriculture Course[1]

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Abstract

This study was conducted to determine the usefulness of writing in promoting thinking in a first year undergraduate agriculture course at the University of the West Indies. In 2003/2004, 145 students were divided into groups and assigned a research paper. The students were invited to submit drafts for feedback and were given the scoring rubrics for assessment. They were required to submit a group score. The assessment criteria for the content were selection of relevant information, analysis, and synthesis of their own views. The students preferred topics that seemed to require mainly information collection. With a maximum score of 5, the lecturer's mean score for selection of information and for analysis was 3.30 ± 0.98 and 2.65 ± 0.98, respectively. Out of a maximum score of 4 for synthesis of a point of view, the lecturer's mean score was 1.68 ± 0.12. The students' inadequate analytical skills limited their interpretation of the topics, identification and questioning of new concepts or issues, and use of information for synthesis. The group scores were significantly ($P < 0.001$) higher than the lecturer's scores for all criteria and few groups sought feedback. Further interventions to improve the effectiveness of writing to promote higher order thinking skills are suggested.

Introduction

Undergraduate university and college education has increasingly become student-centered with much focus being given to helping students learn and acquire the skills necessary for life-long learning. The most basic skill is thinking. The notion that all students can learn is consistent with the belief that students can be taught to think effectively (Fisher, 2001; Halpern, 1994; Schiever, 1991). Constructivist theories of learning form the basis of student-centered teaching and learning methodologies and suggest that students construct knowledge and learn by active engagement (Huba and Freed, 2000).

Writing is one of the most common methods used to develop students' thinking and learning (Bean, 1996). Good writing requires that students must have knowledge and comprehension of a topic, and also competence in the higher-order thinking skills identified by Bloom (1956) as analysis, synthesis and evaluation. Consequently, teachers use writing to strengthen students' ability to interpret, analyze, synthesize and evaluate (Bowering, 1993; Farmer, 1993; Parpart, 1993). Langer and Applebee (1987) found that students achieved better learning outcomes when their activities involved writing than by merely reading. Light (2001) reported that the relationship between the amount of writing in a course and the level of students' engagement was much stronger than other important factors that affect their engagement and that students wanted to master writing more than any other skill. Mastery in writing assisted students to take more responsibility for their own learning and empowered them by providing a sense of effectiveness and accomplishment (Risinger, 1987).

Johnson et al. (1994) advocate group or cooperative learning strategies based on a large number of studies that have demonstrated that in comparison to individual efforts to learn, cooperative learning resulted in higher achievement and greater productivity by all students, long-term retention, improved time on task, and higher level thinking. Lowry et al. (2004) indicated that collaborative writing was extensively used in academia, industry and government and was likely to increase because of its many potential benefits including improved learning, new ideas, and better quality documents. In the undergraduate agriculture degree program at the University of the West Indies in Trinidad and Tobago, in the Caribbean, the research paper has been used traditionally to assess students' learning. This is authentic assessment because the graduates of this program proceed to careers in areas such as planning, project formulation, education, management agricultural consultancy or research where preparation of such papers is a fairly common task that is sometimes conducted by a team. Therefore, it may be possible to improve the authenticity of the assignment and students' thinking and learning by using a collaborative writing approach.

Integrating the elements of learner-centered assessment is a pre-requisite for using writing to develop students' thinking skills (Elbow, 1997 and Herrington, 1997). These elements include setting valid and authentic tasks that communicated high expectations, clarifying the assessment criteria for

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students and providing them with prompt feedback (Huba and Freed, 2000; Walvoord and Anderson, 1998). Therefore, the objective of this study was to assess the extent to which the research paper assigned to groups of first year students in an introductory agriculture course, promoted students' thinking and learning when scoring rubrics and feedback were provided.

Methods

AG16B Introduction to Agriculture, a course offered to first year students pursuing the B.Sc. programs in Agriculture or Agribusiness, was chosen for this study. The course is team-taught and consists of four modules, including Crop Production in the Caribbean, on which this paper is based. During the lectures, video shows and field classes, students are encouraged to ask questions and discuss their views. In group discussions, they identify main ideas, issues or concepts in written material, reasons or evidence for stated views and conclusions and orally respond to them. Their peers and the lecturer provide oral feedback.

In the second semester (January to May) of the 2003/2004 academic year, the class was given three weeks to prepare a research paper of 900 to 1000 words. The learning objectives relevant to the content of the paper were that students would be able to

1. Expand their knowledge of a topic by gathering relevant information,
2. Develop the ability to analyze information and its usefulness,
3. Formulate and communicate their own views based on evidence.

The class was divided into 24 groups, each consisting of six students, and each group selected the topic of its paper from a list of 16 topics (Table 1) that covered the main themes of the Crop Production module. To ensure that all themes were addressed, a topic was assigned only to the first three groups that selected it. The students were instructed and provided with written information on the assignment including the learning objectives, the criteria for assessing the content of the paper and the scoring rubrics for each criterion which means that scores were indicated for different levels of achievement. Students were advised to submit drafts of the paper for feedback and further guidance in interpreting and using the rubrics.

The assessment criteria for the paper included information selection, analysis and synthesis (Table 2). Students were asked to use the scoring rubrics to assign two sets of scores to their group's paper, an individual score and the group score after the group

Table 1 Main themes in the course module and topics of the research paper

Themes	Research topics
A. The origin of agriculture	1. The origin of crop production in the Fertile Crescent 2. The origin of crop production in South East Asia . Pre-Columbian crop production in tropical America 4. The importance of tools in the origin of agriculture 5. The importance of fire and water in the origin of agriculture
B. Production of traditional food and export crops	6. The importance of corn in the agriculture of Tropical America 7. Crop production among indigenous people of the Caribbean today 8. The history of cocoa production in Trinidad 9. The history of arrowroot production in St.Vincent 10. The history of nutmeg production in Grenada 11. The agricultural role of botanic gardens in the Caribbean
C. WTO agreements on trade in agricultural products	12. Major implications of plant variety patent legislation for crop production in the Caribbean 13. Major implications of the WTO's Sanitary and Phytosanitary Measures for crop production in the Caribbean
D. New crops	14. The potential of under-exploited indigenous fibres as new crops in the Caribbean 15. The potential of under-exploited indigenous fruits as new crops in the Caribbean 16. The potential of under-exploited indigenous medicinal plants as new crops in the Caribbean.

assessment. Both scores were to be submitted with the final paper. Each student was also required to score the contribution of other group members, and the mean of these scores and the group score was used to determine the score that the individual team member received for the paper (Bean, 1996). The lecturer returned the papers to the groups with a score for each criterion and suggestions for improving deficient areas. Only the lecturer's and groups' scores were considered in this paper.

The scores were analyzed using descriptive statistics and an independent t-test was used for each criterion to determine whether the differences between the mean scores assigned by the lecturer and by the students were significant. The written feedback on the papers was also analyzed.

Table 2 Rubrics and scores used to assess the content of the research paper

Criteria	Standards and Scores				
	5	4	3	2	1
Knowledge and comprehension	Relevant, comprehensive , accurate and up-to-date.	Relevant, comprehensive , with few inaccuracies or out-of-date-information.	Relevant, insufficient coverage, with few inaccuracies or out-of –date information.	Relevant, but poor coverage and several inaccuracies or out-of –date information.	Much irrelevance
Analysis	Identifies key concepts, issues and relevant theories (where applicable), the reasons or evidence, context, comparison with previously known concepts, issues, theories.	Identifies key concepts etc, but misses a few of the supporting reasons, evidence or context. Comparisons with previous concepts etc	Identifies some key concepts etc, but misses some of the supporting reasons , evidence or context. Comparisons with previous concepts	Identifies some key concepts etc, but the support is very weak. Limited comparison with previous concepts etc.	Identifies few key concepts etc, with no support or comparison with previous concepts etc,
Synthesis		Uses information to compose a balanced, well-supported opinions and conclusions	Uses information to compose well-supported opinions and conclusions but more balance is necessary	Limited use of information to compose opinions and conclusions and more support and balance are necessary	Very limited use of information to compose opinions and conclusions without support.

Results and Discussion

Topic Selection and Thinking Skills

Of the 24 groups in the course, 23 submitted papers. Approximately 57% of the groups selected topics related to traditional crop production in the Caribbean, topics related to the origin of agriculture, new crops or the World Trade Organization's (WTO) regulations were selected by 17%, 17% and 9% of the groups, respectively. Students' perception of the nature of the task and their interests would have influenced the choice of topic. The attractiveness of topics on crop production in the Caribbean, particularly those that dealt with the history of production, might be partially attributable to the social science background of most of the students and to their possible perception that they had already mastered the required cognitive skills for an assignment based on such topics.

Selection of Information

The mean score for the selection of information was 3.3 (±0.98) out of a maximum score of 5. The level of performance of the knowledge and comprehension skills displayed in the selection of information for the paper was satisfactory across topics in all the themes since 83% of the groups got a score of ≥ 3 (Table 3a). Most groups were able to relate the information they collected to concepts (96 %) and issues (74 %) discussed in the classroom. However, the theories associated with the origin of agriculture were recognized by only two of the four groups that did this theme. For 14 (61%) of the groups, 90% or more of the content was relevant and only two groups (9%) had less than 50% relevant content. Irrelevant information was presented where there was lack of knowledge e.g. the geographical location of Tropical America, or misunderstanding of a concept such as "indigenous" or "fiber crop." Some groups revealed a lack of comprehension by misinterpreting the topic. For example, two papers on "The importance of corn in agriculture in Tropical America" ignored the phrase "in agriculture" and focused on crop utilization. Another paper, on "Crop production among the indigenous people of the Caribbean today," ignored "today" and presented instead information on pre-Columbian agriculture that had been already discussed in the classroom.

The comprehensiveness in the coverage of the topics varied. Papers on the history of various traditional export crops were the most comprehensive, but lacked current information. The latest dates

for the information on arrowroot, cocoa and nutmeg were 1961, 1984 and 1993, respectively. These shortcomings indicated limited interpretation of the topic. In several papers, especially those that addressed topics on crop production in the Caribbean, information was repeated which suggested that some papers were prepared by combining the contributions of group members without a clear, common focus.

Analysis

The objectives of the assignment indicated that the students were expected to go beyond knowledge and comprehension skills and to utilize others that had been practiced in classroom discussions, such as analyzing information, formulating a point of view and drawing conclusions. The mean score for analytical thinking was 2.65 (±0.98) out of a maximum score of 5. Table 3b shows that 52% of the groups achieved a score of ≤ 2, and 22% and 26 % received a score of 3 and 4, respectively. Both papers that addressed the "WTO regulations" received a score of 4.

Only 34% of the groups expanded their discussion of the selected topic to include information on new theories, concepts, and issues. Even fewer (22%) presented supporting evidence, reasons, or explanations of the context in which these new theories, concepts, or issues were proposed or arose. These gaps clearly contributed to the lack of comprehensiveness. Two of the four groups that selected topics on the "Origin of Agriculture" theme were able to establish links

Table 3 Scores for information, analysis and synthesis, according to the themes of the research papers

a. Scores for information

Themes	Scores				
	1	2	3	4	5
	No. of groups				
Origin of agriculture (n = 4)	0	1	1	2	0
Crop production in the Caribbean (n = 13)	1	2	6	4	0
New crops (n = 4)	0	0	2	2	0
WTO regulations (n = 2)	0	0	1	0	1
Total no. of groups (n = 23)	1	3	10	8	1

b. Scores for analysis

Themes	Scores				
	1	2	3	4	5
	No. of groups				
Origin of agriculture (n = 4)	0	3	1	0	0
Crop production in the Caribbean (n = 13)	2	4	4	3	0
New crops (n = 4)	0	3	0	1	0
WTO regulations (n = 2)	0	0	0	2	0
Total no. of groups (n = 23)	2	10	5	6	0

c. Scores for synthesis

Themes	Scores			
	1	2	3	4
	No. of groups			
Origin of agriculture (n = 4)	2	2	0	0
Crop production in the Caribbean (n = 13)	5	8	0	0
New crops (n = 4)	2	2	0	0
WTO regulations (n = 2)	0	1	1	0
Total no. of groups (n = 23)	9	13	1	0

between new theories and factors such as climate and the invention of tools. Similarly, the groups writing on the "New crops" theme were able to relate to other concepts such as "agricultural diversification," "markets," "food security" and "poverty alleviation." One group compared the economic impact of the arrowroot industry and the banana industry that succeeded it, but generally students did not integrate familiar concepts, theories and issues with new ones that they identified during their research. The analyses in those papers on the "WTO regulations" theme demonstrated independent thinking, whereas the other papers tended to include mainly those relationships or underlying factors identified by their sources.

These results showed that most groups lacked enabling skills such as interpretation, and interpretation of meaning (Schiever, 1991) and the analytical ability that was required for more comprehensive research and use of the information they collected. Greetham (2001) regarded analysis as probably the most useful thinking skill because it brought clarity to a task and provided direction and ideas. Larson (1982) recommended reference to the assignment simply as a 'paper' to promote independent thinking since the term 'research paper' might encourage students to perceive the major tasks as collecting and presenting facts and the opinions of others.

Synthesis

The mean score for synthesis was 1.68 (± 0.12) out of a maximum score of 4, and all papers, except one, were awarded a score of ≤ 2. The only paper with a score greater than 2 was one on the "WTO regulations" theme (Table 3c). Seven groups (30%) clearly stated an opinion or a focus for their paper and ten groups (44%) presented a conclusion. Only 17% of the groups had a stated focus or opinion and a consistent conclusion. Also, the validity of most conclusions was weakened by the lack of supporting evidence.

Based on the selection of information and the structure of their content, the papers generally fitted the chronologically ordered type or encyclopedic type of cognitively immature writing (Bean, 1996). Piaget's theory of the development of specific cognitive skills at different ages may explain this immaturity (Bean, 1996). According to this theory, the students were operating at the concrete operational level that relies on the ability to recognize and to classify, instead of at the more cognitively mature formal operational level that involves more abstract thinking such as generalizing and concluding. Apparently, students did not easily transfer the level of thinking they had practiced verbally in the classroom to this writing assignment. However, Schiever (1991) and Bean (1996) advise that writing can be used to develop higher-order thinking if students are given practice in writing on topics that overtly demand this skill. The topics related to the WTO regulations were possibly clearer in their requirement for higher-order thinking which contributed to better analysis and synthesis by students who wrote on these topics.

Use of Rubrics

Although 23 groups submitted group scores only for eight groups did each group member submit a group score. Four members each of another four groups submitted this score. There was much inconsistency in the group scores among group members and only for two groups did all members submit the same score for each assessment criterion. Consequently, where variations existed, the group scores were taken as the mean of the scores submitted by the group members. The students' scores were all significantly ($P<0.001$) higher than the lecturer's scores. The modes of the students' scores were almost always perfect scores and the range of their scores for each criterion was less than that of the lecturer (Table 4).

Given the apparent lack of participation of many students in deriving a group score and the intra-group discrepancies of the submitted scores, it was not clear to what extent the students seriously used the rubrics to assess their performance. The rating of their performance as excellent suggested a significant deficiency in their understanding of the rubrics and their ability to use them effectively. Their assessment was also related to their perception that the purpose of the assignment was to provide information.

Elbow (1997) observed that grading often imposed a teacher-centered focus and distracted students from developing their own thinking. He recommended more practice using low stakes writing assignments with minimal grading, such as pass/fail,

Table 4. Comparison of the Group Scores and the Lecturer's Scores for Information Selection, Analysis and Synthesis (n = 23)

Values	Scores for Information		Scores for Analysis		Scores for Synthesis	
	Group	Lecturer	Group	Lecturer	Group	Lecturer
Mean score	4.51 (±0.45)	3.27 (±0.98)	4.15 (±0.38)	2.65 (±0.98)	3.67 (±0.38)	1.68 (±0.57)
Mode	5.0	4.0	4.0	2.0	4.0	2.0
Range of scores	3.7 – 5.0	1.0 –5.0	3.6 –5.0	1.0 – 4.0	2.8 – 4.0	1.0 – 3.0
T statistic	5.30		6.33		15.73	
Critical t value (two tail)	2.08		2.08		2.08	
P value (two tail)	<0.001		<0.001		<0.001	

to build students' confidence and ability. Eventually high stakes writing with slightly more complex but explicit grading schemes could be used.

Feedback

Only two groups submitted drafts of their papers for feedback. One of the papers addressed the "WTO regulations" theme and the other, the "New crops" theme. These drafts showed the same deficiencies as the papers that had not been submitted for feedback. One paper was revised and obtained the highest scores for information, analysis and synthesis. The other paper was not revised because the group explained that it did not have adequate time to do so. Therefore, the potential of feedback for enhancing students' writing and thinking was demonstrated but students have to be encouraged to access and use it. Bean (1996) and Herrington (1997) emphasized that if students are to recognize writing as a process that is integral with thinking, they must be encouraged to revise their papers in the same way that expert writers do. A paper submitted without revision was merely a first draft or an incomplete paper and hence, a cognitively underdeveloped task. Possibly, the students generally did not access formative feedback and use the rubrics because these were new learning experiences or because of poor time management. Therefore, the effectiveness of this assignment might be strengthened by building in deadlines for the submission of drafts at specific stages and by allowing students adequate time to complete the paper.

Summary

This was a study on preliminary efforts to use writing to promote thinking in an undergraduate, first year agriculture course. Students were required to work in groups to prepare a research paper and were provided with scoring rubrics, and offered feedback. The results showed that their knowledge and comprehension skills were satisfactory, but their analytical skills were inadequate. This deficiency manifested in limited interpretation of the topic. Also, although they collected new, relevant information, most groups did not identify new theories, concepts and issues, and relate them to those previously discussed in the classroom. Consequently, students did not synthesize well. Apparently, most students perceived that the assignment required collection and presentation of information instead using the information to formulate their own views, therefore, they did not exhibit strong competence in higher-order thinking skills. Many students did not use the rubrics and among those who did, the high group scores they awarded to their papers indicated their underestimation of the level of performance required by the assessment criteria. The higher scores obtained by the group that used feedback to improve their paper demonstrated the potential of feedback to enhance students' thinking and writing skills.

In conclusion, a writing strategy for enhancing the thinking skills of undergraduate agriculture students is beginning to emerge. The provision of rubrics to clarify the requirements of the thinking tasks and for self-assessment, and feedback are important first steps but other components in the strategy are required to maximize their effectiveness and that of the writing exercise as a whole. More writing practice is required with changes to the nomenclature of the assignment and the provision of topics that overtly demand independent thinking. A critical element, though, is to transmit to students that writing is thinking and that it is a process. Therefore, future efforts to use writing to promote thinking in this course will emphasize this process approach and feedback will be provided to support paper revision. Realistically, however, the chances of success of this enterprise will be considerably strengthened not merely by improvements to a writing assignment within one module of one course but by reinforcement throughout the entire course.

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