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GRADES FIVE AND SIX STUDENTS' REPRESENTATION OF MEANING IN COLLABORATIVE WIKI WRITING

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Abstract

This paper examined grades 5 and 6 students' participation in wikis while writing reports on social studies topics. An analysis of eight wikis showed that students represented meanings they had constructed about their topics by engaging in knowledge telling practices (e.g., introducing, stating, or repeating information or an idea and developing previous ideas with examples, statistics or other information) more frequently than they engaged in knowledge transforming processes, such as drawing conclusions, identifying cause-effect relationships, or making inferences or judgements. Our research shows that Bereiter and Scardamalia's model (1987) is useful to inform the development of tools for assessing students' demonstration of their understanding of concepts in content area writing.



This research took place in a classroom setting where two grades 5 and 6 teachers co-taught a social studies unit involving students in collaborative research and writing on a wiki. The inspiration for our study was the action research that we conducted with two grades 5 and 6 teachers, Kyrle and Sara (all names are pseudonyms), who were interested in harnessing wikis as a tool for a social studies unit. We were interested in ways to assess students' collaborative essays using standards that went beyond typical writing assessment criteria, such as content, organization, vocabulary, sentence structure, and conventions (e.g., Ontario Ministry of Education, 1999; Spandel, 2013) in order to incorporate students' representations of the knowledge that they constructed about the subject area content. Our analysis of students' wiki writing centered on these research questions: (1) How and with what frequency did participating grades 5 and 6 students represent the meanings that they constructed about their group topics in their collaboratively-written essays, composed on wikis? (2) Are there gender or grade level patterns in students' representation of meanings in the collaboratively-written essays?

Our research provides emerging insights into students' approaches to communicating meanings that they have constructed about social studies topics in essays composed collaboratively in wikis. Drawing on the research analyzing students' written syntheses of information from multiple sources, and mindful of the ever-expanding use of wikis across grades and subject areas, we designed a study examining students' representations of meaning in wiki writing.

We begin this paper with a review of research on wiki use in classrooms and on students' synthesis of information in their writing, together with a description of the theoretical underpinning of our research. We then describe the classroom context and research methods, outlining our inductive analysis of student writing with a focus on ways in which students represented meaning. Following a presentation of results, we discuss what we have learned about how students represent meaning in their writing and the implications for writing assessment in content areas.

Literature Review

Wikis and their Use in Classrooms

Wikis are online environments that foster the collaborative creation, revision and editing of texts (Leuf & Cunningham, 2001). They are ideal spaces for collaborative writing in classrooms because they provide opportunities for

everyone within a group to contribute and make it possible to include links to web pages, visual images, and audio and video information in texts (Nicol, Littlejohn, & Grierson, 2005). Although the most widely-known wiki, Wikipedia (Wikipedia.org), is accessible to anyone with internet access, teachers often choose to create accounts in other commercial systems, such as pbworks (<http://www.pbworks.com/education.html>) or wikispaces (wikispaces.org) for classroom projects. These wikis are free and have security features that allow teachers to restrict access to anyone outside the class.

Teachers' and students' experiences with classroom wikis have been the focus in previous research conducted at the postsecondary level, where wikis were used for discussing assigned readings (Heafner & Friedman, 2008; Mathew & Felvegi, 2009); for discussing class activities (Arnold, Ducate, & Kost, 2009; Kessler, 2009); and for collaboratively creating glossaries and other compositions (Elgort, Smith, & Toland, 2008; Hughes & Narayan, 2009). At the elementary level, researchers have observed students using wikis to give their opinions about the possibility of a human colony being established on Mars (Pifarré & Fisher, 2011); to create biographies of a famous person and a poster on school hygiene (Woo, Chu, & Li, 2013); and to create an information brochure for parents about their school (Mak & Coniam, 2008). Additionally, wikis have been used in elementary classrooms for solving mathematics problems (Lee, 2012).

Although previous studies of classroom wikis use have provided a wealth of information about students' high levels of motivation to write and about the ways in which wikis facilitate students' writing processes, they have not examined the ways in which students represent meaning in their wiki writing. Given that demonstrations of content understanding is a goal of much of the writing that students do in content area classes (Vacca, Vacca & Mraz, 2011), such research is needed to add to our understanding of wikis' potential for supporting students' learning within content areas.

Students' Writing Processes and their Synthesis of Information in Writing Theoretical model of writing processes.

Bereiter and Scardamalia's (1987) model of composing has informed our research examining grades 5 and 6 students' synthesis of information in their collaborative wiki writing. They present two writing processes. One process, knowledge transforming, involves a "two-way interaction between continuously developing knowledge and continuously developing text" (p. 12). Writers exercise strategic control over the shaping of their writing, assessing and revising their

writing in order to achieve their communicative goals. In the knowledge transforming process, writers develop a deeper understanding of the topic. Described as no less important, but certainly less demanding, the knowledge telling process is where writers “make maximum use of natural human endowments of language competence and of skills learned through ordinary social experience” (p.5) to produce text that requires only the level of planning and goal setting of everyday conversation. In the knowledge telling process, revision involves assessing how well the information is expressed. Knowledge telling is not an early stage of knowledge transforming. Instead, it reflects a different intention on the part of the writer—to communicate information. In contrast, knowledge transforming emerges from intentions to develop deeper and new understandings while achieving social communicative goals.

Bereiter and Scardamalia’s (1987) model of writing processes provided an overarching framework for our analysis of the ways in which grades 5 and 6 students represented the meanings that they had constructed about social studies topics in their collaborative wiki writing. Kyrie and Sara informed students in class mini lessons that they wanted students to “make [their] own meaning and not just copy the ideas from the websites and books.” In our inductive analysis of student writing, we sought to describe the ways in which students carried out knowledge transforming. We also found ways in which students engaged in knowledge telling, however, as students communicated information in sentences and paragraphs that were very similar to the ones in the original sources.

Previous research on students’ synthesis of information.

Research informing our study has examined the process of synthesizing information from multiple information sources in wiki and non-wiki settings. Teachers regard synthesizing as both effective in deepening students’ knowledge and a demanding, difficult task for students at all levels, including those at the college level (Mateos & Solé, 2009). Previous research has shown that older writers tend to be more successful in writing coherent syntheses with well-connected ideas than younger writers (Mateos & Solé; Spivey & King, 1989; Segev-Miller, 2004). Younger writers “tend to take ideas from the different texts without providing the necessary links between them” (Mateos & Solé, p. 437). When middle-grade students synthesized information from multiple print sources in their pen-and-paper writing, for example, they tended to list information from the original sources, rather than integrating and transforming it (Lenski & Johns, 1997).

Much of the research examining students' synthesis of information in their writing has taken place in controlled settings where students were given a number of texts to read and synthesize in written compositions (Mateos & Solé, 2009; Spivey & King, 1989; Segev-Miller, 2004). The researchers' analysis of students' written texts focused on how students used the original source materials in their syntheses. Mateos and Solé's analysis, for example, used these codes to describe university students' written syntheses:

- integration and connection of the information from both texts around a structuring theme
- selection of ideas necessary for producing the synthesis
- appropriateness of the interpretation, as measured by the presence/absence of incorrect content
- content elaboration: copying, paraphrasing, introduction of new terms (p. 439)

Similarly, in their deductive analysis of postsecondary students' wiki writing about selected Finnish novels and historical events, Sormunen, Heinström, Romu, and Turunen (2012) looked for examples of the following in students' writing: copy-pasting; (exact copying of original source); near copy-pasting (slightly edited copying of original text); paraphrasing (major change beyond technical editing of original text); and own text (comments expressing writer's thoughts in writer's words).

Method

Participants and Wiki-Writing Context

The research participants were 18 girls and 24 boys. The students were in single-grade classes in Year 1 and in combined-grade classes in Year 2. In Year 1, there were 30 grade 6 students in one class and 28 grade 5 students in the other class, with equal numbers of girls and boys in each class. In the Year 2 combined-grade classes, there were 30 students in one class and 29 students in the other. Across the two classes in Year 2, there were fewer grade 5 students (25) than grade 6 students (34) and more boys (15 in grade 5 and 20 in grade 6) than girls (10 in grade 5 and 14 in grade 6). Participating students were assigned to a particular wiki based on their topic preferences, which produced groups with a mix of abilities.

Of the 12 wiki groups that the teachers created each year, we randomly selected four groups—two grade 5 and two grade 6 wiki groups. In our Year 2

sample there was one grade 6 girl and one grade 6 boy who had also been in our grade 5 sample in Year 1. The girl was in the littering group in grade 5 and the plastic waste group in grade 6. The boy was in the plastic waste group in both grades. All other sample students in Year 2 grade 6 wiki groups had not participated in the wiki project in grade 5. Because there were greater numbers of boys in the Year 2 classes, our sample contains many more boys than girls for that year. Wiki topics and the number of girls and boys in each group can be found in Table 1.

Gender	Year 1				Year 2			
	Grade 5		Grade 6		Grade 5		Grade 6	
	Littering	Plastic Waste	Water Sanitization	Plastic Waste	Homelessness	Polluted Water	Plastic Waste	Poverty
Girls	2	1	3	4	1	1	3	1
Boys	2	3	3	2	4	4	3	5

Table 1: Wiki Topics and Wiki Group Members

Preparing students for the wiki task

In both years, Kyrie and Sara collaboratively taught a social studies unit on global issues. They told us in interviews that they instructed their students in the safe and effective use of online tools, specifically blogs and wikis during the first term of the school year. Kyrie and Sara posted a summary of the group collaboration assessment criteria that were generated in these lessons on each wiki:

- Group Cooperation (in-class and online)
- Time on task
- Cooperative
- Respectful
- Organized
- Prepared
- Regular contribution

During our classroom visits, Kyrie and Sara gradually introduced their students to online tools, beginning with homework blogs. Here they posted assignment questions for the students to answer from home. In this way, the students became familiar with navigating online and posting comments. In one lesson, for example, the teachers printed the students' homework blog entries from the previous evening (identifying an item in their homes and the country in which it was made). They gave these print-outs to the students who were placed in

groups of four. The students then sorted the items using any category rule that they chose. Generally, students sorted by country and then by type of item. Following this group work, in a whole-group activity, the students called out the countries in which their chosen items were made and their teachers marked the countries on a world map.

Later in the school year, Kyrie and Sara set up small group wikis and guided the students through the navigation features and new tools. They introduced the social studies project and posted information about the assignment on each wiki (found in Appendix A). They also modelled ways to search for online sources for the research topics, how to determine if a website was appropriate (for the students' ages and reading levels), how to scan text and images for relevant information, and how to organize information using the categories that would later be used for the social studies wiki project (e.g., Physical, Environmental, Economic, Political, and Social - they used the acronym, PEEPS). To begin a lesson about the PEEPS topics, Kyrie and Sara handed out photographs to each student and asked the students to consider to which of the five categories their image belonged. The students then posted their images under category headings, which had been tacked to a wall in the hallway (the teachers often used the hall space for activities because the halls were very wide and there were very few other classes on the third floor that would be disturbed). Students then discussed their rationales for categorizing the images with others who had used the same category. Following a whole-class discussion during which students and teachers talked about the characteristics of each category using the images as examples, students wrote about each of the PEEPS categories, using at least three of the images in their definitions of each category.

During one of our after-school action research meetings, Kyrie and Sara co-planned with us a series of lessons on grouping jot notes into paragraphs because we had observed that students were having difficulty creating cohesive paragraphs. Jot notes was the term that Kyrie and Sara gave to notes that students created from their readings. The following examples of jot notes, representative of jot notes from all 12 wiki groups, come from the grade 5 polluted water wiki group's wiki in Year 2:

- fish poisoned and contaminated from industrial waste
- obvious places where pollution is caused such as factories dumping chemicals in the water areas
- heat and oil can be a source of water pollution
- sewage and chemicals dumped into the great lakes

In the first jot note-to-paragraph lesson, Kyrie and Sara used a SmartBoard to demonstrate how to organize 20 or so jot notes according to what they had in common. The teachers did a think-aloud and invited students to provide their thoughts about which jot notes seemed to go together and what idea/topic they had in common. Kyrie and Sara then gave each group envelopes with strips of paper containing jot notes that they had created from the book *One Well* (Strauss, 2007). The two teachers asked the students to organize the jot notes by their common topics and then tape together the jot notes that belonged together. The students then were asked to discuss what each group of jot notes had in common. Figure 1 is a photograph of one group's jot note groupings.

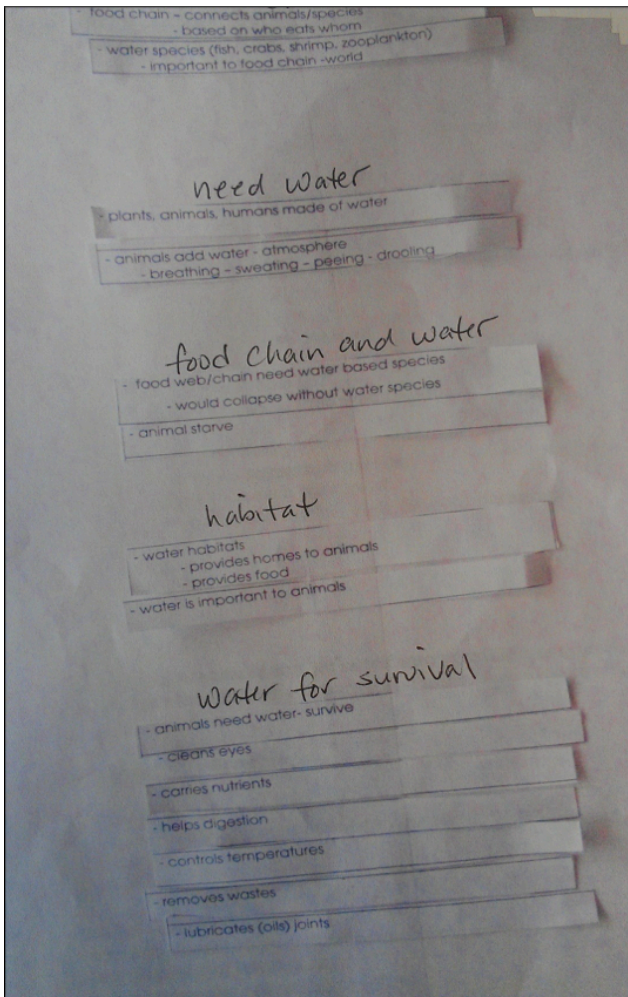


Figure 1. Topic categories created by one group of students

The two teachers provided links to relevant web sites that they had previewed and deemed to be appropriate to their students' ages and reading levels and to each group's topic. They did not restrict the students to gathering information only from the websites they had previewed. Examples of the websites previewed by the teachers are:

- <http://www.endpoverty2015.org/> - This website was created by the UN Millennium Campaign, established by the UN Secretary General Kofi Annan in 2002 to support achievement of goals adopted in the Millennium Declaration, signed in 2000.
- <http://www.onedrop.org/en/default.aspx> - The organization, One Drop, was founded in 2007 by Cirque du Soleil founder, Guy Laliberté. It is dedicated to ensuring that potable water is accessible to everyone in the world.

Data Sources

Data for our research study were gathered from March-June in Year 1, during 11 classroom visits, and again from March-June in Year 2, during 15 classroom visits. Data sources include observations of whole-class lessons taught collaboratively by the two teachers, and observations of eight groups of 4-6 students writing together to write about global social issues on their wikis. We used these data to contextualize our analysis of the essays.

We gathered eight pieces of writing in total, two from each of the grade 5 wiki groups and two from each of the grade 6 wiki groups each year. The grade 5 wiki groups' writing varied greatly in length. The Year 1 littering group's collaborative writing was the shortest (244 words in 15 sentences) and the Year 1 plastic waste group's collaborative writing was the longest (1371 words in 60 sentences). The grade 6 wiki groups' collaborative writing ranged from 545 words written in 28 sentences (written by the water sanitization group in Year 1) to 1116 words in 62 sentences written by the plastic waste group in Year 2. Across both years the average number of sentences was 33.75 and average length in words was 660.5 words in the grade 5 collaborative writing and 907 words in 43 sentences in the grade 6 writing.

One of the (best) collaborative essays from our sample of eight essays, written by a Year 2 grade 5 wiki group, can be found in Appendix B. The coding for the first two paragraphs is identified. We describe our inductive coding process of the collaboratively-written essays in the following section, following a description of the ways in which our coding differs from that of previous studies examining students' syntheses of information from multiple sources.

Data Analysis

We drew upon Bereiter and Scardamalia's (1987) knowledge transforming and knowledge telling model in our examination of the ways in which Kyrie's and Sara's grades 5 and 6 students represented the meanings that they constructed in their collaboratively-composed wiki writing. Our analysis of students' collaborative wiki writing was underpinned by a view of students' written texts as their representations of the meaning that they have made from their reading of multiple sources and their background knowledge and experiences (Beal, 1996; Olson, 1994). We used a parallel constructivist approach in our analysis of the texts, as our process involved "integrat[ing] the [students'] words with relevant prior knowledge" (Beal, p. 221) to make inferences about students' meaning-making about the topics. Our view of the meaning-construction processes involved in reading texts points to a limitation in our method—our views of what constitutes a conclusion or a confusing sentence or what is considered peripheral or incorrect information, are influenced by our prior experiences and knowledge and may not reflect universal views.

We attempted to address this limitation by working together to analyze the data, discussing differences in our views of how students were representing meanings until we came to consensus. Our inductive data analysis process involved reading through four of the collaborative writing samples and identifying the kinds of meaning-making that students seemed to be demonstrating in their writing. Initially, we analyzed each sentence in these writing samples, describing in detail how students represented meanings that they had created (e.g., provides a statistic from jot notes about Canadians carrying plastic bags with no connection to previous sentence about San Francisco banning plastic bags, asks a rhetorical question using statistics from jot notes—unrelated to the issue statement in previous sentence). We then created codes from these specific descriptions. We noted that students wrote general beginning- and end-of-paragraph statements, drew conclusions, made general statements, exhorted readers to take action, added personal touches, repeated ideas, elaborated on ideas using statistics and examples, made judgments, provided information unrelated to the topic, provided inaccurate information, identified cause- effect relationships, and created confusing sentences through bringing together two unrelated ideas, or through the use of non-standard syntax.

Because frequencies were very low for some of these codes and because we found overlaps and redundancies, we refined our initial codes. In the refining process, we arrived at one code to describe what students did to show that they

were transforming or reworking the information and two codes to describe how students generated content but left the ideas intact, what Bereiter and Scardamalia (1987) deem to be a demonstration of knowledge telling processes. Of the three codes listed below, we see the first two codes as being more representative of knowledge telling practice and the last code as being more representative of a knowledge transforming practice.

- Introduces/states/repeats information or idea
- Develops previous idea with examples, statistics or other information
- Draws conclusions/makes inferences/judgements/identifies cause-effect relationships

Additionally, we found that sometimes the meanings were inaccurate or incomplete (to the best of our knowledge and experience). We generated three codes to describe ways in which students appeared to attempt to rework information from the original texts, but their attempts resulted in their demonstration of an incomplete or inaccurate understanding of the content. We were not always present while students contributed to the collaboratively-written essays, and thus were unable to gather information systematically about the students' thinking processes while writing. This would have allowed us to differentiate between students' incomplete or inaccurate meanings constructed about the topic and possible writing difficulties.

The three codes were as follows:

- Brings many pieces of information together in confusing way
- Includes information that has peripheral or no relationship to topic
- Presents incorrect information

We then applied these six codes (examples from students' writing for each code are found in Table 2) to all eight essays.

Ways in Which Students Demonstrated Knowledge Telling and Knowledge Transforming

Codes	Examples from Participating Students' Writing
Introduces/states/repeats information or idea	In Canada homelessness is a serious problem. Everyone must be aware about this serious issue and take action.
Develops previous idea with examples, statistics or other information	There are an estimated 200,000-300,000 people that are homeless in Canada Regina, Victoria and Edmonton stopped using plastic bags
Draws conclusions/makes inferences or judgments/identifies cause-effect relationships	Even if people would give some money to someone with less than them, it is still a small amount and they don't really care to do more. The political impact is that the government has to make meetings and talk about water pollution and how to stop it instead of more important things across the world like child labour.

Ways in which Students Represented Incomplete/Inaccurate Meanings

Codes	Examples from Participating Students' Writing
Brings many pieces of information together in confusing ways	Also some ministries like the ministry of natural resources would be affected if and when Canada has plastic almost everywhere (which it's on it's way there). There are diseases in the water and water is a natural resource; therefore they have no choice but to drink it.
Includes information that has peripheral or no relationship to topic	A lot of people such as grandparents (or people under stress) need a way to relax and fishing is normally really relaxing especially for grandparents. A man was in poverty and had to go find shoes for himself so he took some stick and 2 plastic bottles and made flip-flops.
Presents incorrect information	Litter can also melt the Rocky Mountains witch means people can not ski!!! Many people are pushed (farther) into debt when there is a strong economic growth.

Table 2: Codes Used to Analyze Collaborative Writing

Based on previous research (Lenski & Johns, 1997), we expected that there would be greater numbers of sentences reflecting students' knowledge telling processes than knowledge transforming processes. We hoped that students were engaging to some degree in the more reflective knowledge-transforming processes in their writing, however. We also expected and hoped that there would be significantly greater instances of sentences involving knowledge telling and transforming processes when compared with sentences in which students used processes that resulted in the representation of inaccurate/incomplete meanings.

Our research findings are limited by the small sample and by what was possible in the action research context. Data were gathered in an instructional setting established by the teachers. The research question arose as we talked with Kyrie and Sara in our after-school meetings and found out about the challenges they were facing in implementing a new teaching practice. As a result, we were not in a position to set up a control group, nor to create additional writing tasks that would have allowed us to compare students' independent writing with their wiki writing. Because we were not present at all times when the students wrote, we were not able to gather data systematically on students' thinking and decision-making processes, nor about meanings they intended to communicate in their writing. The results of our analysis must be interpreted with these limitations in mind. We offer the following results as emerging insights into students' representations of meaning in collaboratively-written essays.

Results: Ways in Which Students Represented Meaning in Collaborative Essays

Across the two years 78.5% of the sentences in the grade 5 small-groups' collaboratively-written compositions and 71.9% of those written by grade 6 peers reflected knowledge telling and knowledge transforming practices (see Table 3). In contrast, 28.1% of sentences in grade 5 wikis and 21.5% of sentences in grade 6 wikis represented meanings inaccurately/incompletely. The students engaged in knowledge telling and knowledge transforming practices more frequently than they represented meaning inaccurately/incorrectly.

Some of the sentences (22.8% of participating grade 5 wiki groups' essays and 12.4% of grade 6 groups' essays) reflected students' engagement in knowledge transforming processes. However, the students were more likely to create sentences that involved knowledge telling processes (introduced or summarized the topic of their paragraph, repeated information previously stated, or that added examples, statistics and other information), than to engage in knowledge-transforming

processes (e.g., drew conclusions, made inferences/judgments or identified cause-effect relationships).

Bringing ideas together in confusing ways was the most common way students in both grades represented meaning inaccurately/incompletely (11.7% of grade 5 students' sentences and 7.2% of grade 6 students' sentences). Although there were no patterns in comparisons of girls' and boys' sentences, we found puzzling grade-related patterns. Knowledge transforming processes were found with greater frequency in grade 5 essays (22.8%) than in grade 6 essays (12.4%). Further unexpected grade comparisons were found in the relative percentages of sentences that represent inaccurate or incomplete meanings, as grade 6 essays were slightly more likely to contain sentences that brought ideas together in confusing ways and almost three times as likely to contain sentences with information that was only peripherally related to the topic.

	Percentage of Sentences in Grade 5 Wiki Writing n = 135 sentences	Percentage of Sentences in Grade 6 Wiki Writing n = 178
<hr/>		
Sentences Demonstrating Knowledge Telling and Transforming Processes		
Introduces/States/Repeats Information/Idea	28.8	29.8
Provides more Information about Previous Idea with Examples or Statistics	27.4	29.8
Draws Conclusions/Makes Inferences/Judgements/Identifies Cause-Effect Relationships	22.8	12.4
<hr/>		
Percentage of All Sentences Showing Knowledge Telling or Transforming Processes for each Grade	78.5	71.9
<hr/>		
Inaccurate/Incomplete Representation of Meaning		
Brings Ideas Together in a Confusing Way	15.6	17.4
Peripheral or No Relationship to Topic	3.7	9.6
Presents Incorrect Information	2.2	1.1
<hr/>		
Total Sentences Representing Inaccurate/Incomplete Meanings for Each Grade	21.5	28.1
<hr/>		

Table 3: Ways in Which Students Represented Meaning in Eight Collaboratively-Written Essays (Percentages)

Conclusions and Implications

Students' Representation of Meaning in Wiki Writing

In their collaborative wiki writing, participating students represented meanings they had constructed about their topics in a variety of ways: by introducing, stating, or repeating information or an idea (knowledge telling processes); by developing previous ideas with examples, statistics or other information (knowledge telling processes); and by drawing conclusions, identifying cause-effect relationships, or making inferences or judgements (knowledge transforming processes). Students engaged in knowledge telling processes to a greater degree than they engaged in knowledge transforming processes, a finding that was consistent with previous research on elementary students' written syntheses (Bereiter & Scardamalia, 1987; Lenski & Johns, 1997).

We find it promising that students did engage in some knowledge transforming processes without formal instruction. We believe that these processes can be further developed through teachers' mini-lessons where modeling and think-alouds provide examples and show the thinking processes involved in transforming knowledge in their writing. Teachers' feedback on students' writing can further highlight what students do to transform knowledge in their writing and suggest ways to rework the information that the students have gathered to engage in knowledge transforming processes. The wiki-writing context, itself, provided informal scaffolding; all students, regardless of their writing abilities, had access to examples of these knowledge transforming processes as they read their peers' writing and discussed the writing in their wiki groups during school hours.

Gender and Grade Differences

There were no gender patterns in the types of sentences composed by individual students. However, there were grade differences indicating that the grade 5 students' writing was more likely to involve knowledge-transforming processes and less likely to represent inaccurate or incomplete meanings than the grade 6 students' writing. With the random selection of wiki groups, it is possible that the grade 5 groups we selected had students who were stronger in synthesizing and representing meanings than those in the grade 6 groups. Furthermore, as reported elsewhere (Authors, submitted), in all three plastic wiki groups, one student contributed significantly more than the group did. It is possible that this student was not one of the stronger writers in the two grade 6 and 1 grade 5 plastic wiki groups.

Additionally, previous research on topic familiarity helps us to understand these unexpected grade differences. This research shows that topic familiarity influences students' recognition of parts of their writing that may be unclear to readers and need revision (Beal, 1996; Butterfield, Hacker & Albertson, 1996). Beal explains:

with less familiar topics, children may not have the necessary background knowledge to make appropriate inferences to reconcile a discrepancy or to fill in missing information. Thus, the likelihood of successful revisions may be lower, even if children recognize that the text is not clear. (p. 226)

It is possible that the topics of grade 6 wiki groups were more unfamiliar to grade 6 students than the topics of grade 5 wikis were to the grade 5 students. The topics that appear to have been the most challenging to students (in a comparison of the topics for which wikis contained the greatest number of sentences in the "unclear representation of meaning") were the plastic waste and polluted water wikis in grade 5, and the water sanitization and plastic waste wikis in grade 6 (there were two plastic waste groups in our grade 6 sample).

Another possible explanation for the surprising differences between grades comes from research showing a relationship between the levels of difficulty of the source texts that students consult and their abilities to represent accurate meanings (Nash, Schumacher, & Carlson, 1993; Spivey & King, 1989). It is possible that the websites that grade 6 students chose to gather information contained more challenging content than the websites that grade 5 students consulted. If the grade 6 students had difficulty constructing meaning from the online sources, either because of the way that it was organized on the website or because of the vocabulary and syntactic sophistication of the text, they also would have struggled to represent meaning in the writing synthesizing information from these sources.

Although we did not carry out controlled experimental research and cannot generalize widely beyond our research context, we believe that our results provide helpful starting points for teachers who are seeking assessment tools for content writing, whether the writing is collaboratively written in wikis or independently written using pen and paper. We suggest that Bereiter and Scardamalia's model (1987) is useful to inform the development of scoring guides. As such, together with criteria that are typically included in scoring guides and rubrics in order to assess written products (e.g., content, organization, sentence structure, vocabulary, conventions), the assessment criteria could include some knowledge telling

processes (e.g., introducing, stating, or repeating information or an idea, developing previous ideas with examples, statistics or other information), and knowledge transforming processes (drawing conclusions, identifying cause-effect relationships, or making inferences or judgements) to assess ways in which students represent the meanings they have constructed about the topic.

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Appendix A

Wiki Task

ACT (Active Citizens Today)

Big Ideas Grade 5

How might a national citizen exercise their rights and responsibilities as a citizen? What process would you use to investigate and bring about change on a national issue?
How does your issue relate to PEEPS?

To which area in PEEPS is the issue in the article more strongly related?

Big Ideas Grade 6

How might a global citizen exercise their rights and responsibilities as a citizen?
What process would you use to investigate and bring about change on a national issue?
How does your issue relate to PEEPS?

To which area in PEEPS is the issue in the article more strongly related?

Success Criteria

Collaborative Wiki Writing

Contributing member on the wiki

Provides feedback to members

Shows an understanding of issue in relation to PEEPS

Organized thoughts

Evidence of research

Cite Resources (primary and secondary)

ACT (Active Citizens Today)

National/Global Issue that I will be researching is:

Remember your National/Global Issue and its connection to Canada and the world in relation to PEEPS.

Wiki Collaboration- Due _____

- As a group you will co-construct your leaning about your chosen National/Global topic.
- Over the next 5 days, you will research your topic in relation to PEEPS and using the Success Criteria as a guide.
- All research will have to be sourced and put into jot notes.
- Information should NOT be copied from the Internet and/or a book but interpreted by you the reader into jot notes that will help your team understand you topic more clearly.
- It is essential to co-construct a page together this will directly be related to the Culminating Task
- Culminating Task-Due
- Challenge: To have your piece selected as the next National Geographic Front Cover to there newly published book on “Being an Active Citizen.” Use your expert wiki pages to help you complete your independent Front Cover, Back Cover and inside flap explanation.
- Design a cover page and title for a Non-Fiction Book that will introduce others to the issue and what has and can be done to help solve the problem.
 - Write the back cover for the book (200 word description of the national/global issue and an explanation of why it is important to you)
 - On the inside flap, write a brief explanation of how the images you selected on the cover represent PEEPS aspects of the issue

Appendix B

Collaborative Writing from Grade 5, Year 2

We included some of our coding for the first few sentences.

Codes:

- A - Introduces/states/repeats information/idea
- B - Develops previous idea with specific examples
- C - Shows cause and effect with specific examples

Codes Polluted Water: Grade 5, Year 2 Wiki Group's Essay

- A The people of Canada and other areas surrounding the Great Lakes are polluting and contaminating the Great Lakes.
- A Everyone must be aware about this serious issue and take action.
- C Politicians must work hard to manage and control the pollution and waste valuable time that could have been spent discussing other important issues, because when everyone is focused on this issue, no one pays attention to other important issues that should also be solved.
- B The governments of areas surrounding the great lakes must raise awareness about how to reduce the environmental impact on the environment.
- B For example, the Ontario government's aim is to protect drinking water in lake Ontario, one of the 5 great lakes.
- A Therefore, politicians and government must work to raise awareness and protect our freshwater and the Great Lakes.
- C Although the economic effect is not as large as the environmental effect, polluted water has an impact on families depending on fishing as their income because when you cannot fish, you have no income to support your family.
- C Also, because of the polluted water, we have to pay more money to clean water in water treatment plants.
- C Clean water becomes more expensive because it is harder to obtain.
- C Business surrounding the lake suffer because pollution reduces the amount of people who come to the lake and therefore the amount of customers and, as a result, the profit is low-paying.
- C Lastly, becoming homeless can affect your family because your kids will not be able to go to school because they work for money so they and their family can afford a living.

Therefore people will not have a enough money to sustain a proper life. Due to this pollution, fish and other animals are poisoned and contaminated from industrial waste and diseases travel up the food chain and infect many different species of animals. Where chemicals are washed into the water areas like oil from cars, pesticides from lawns, household chemicals pour down drains and into lakes. Harmful pesticides wash off from gardens and into lake Ontario and pollutes the water and aquatic life. Sewage chemicals dumped into the great lakes. Heat and oil can also be a source of water pollution. Obvious places where pollution is caused are places like factories dumping chemicals into the water areas.

Polluted water and fish are not fit for human/animal consumption and when animals eat other polluted animals drink polluted water or swim in polluted water. This can go up the food chain. Polluted water effects everything. Like the water some people get there from the seas, oceans, lakes. Not only that but we might use polluted water to water the trees and that could kill the trees that give us oxygen and if this continues soon forests will turn into waste land. Water pollution has a part in killing animals to extinction. In conclusion if we keep polluting our water our earth could die.

Because of polluted water people will not come to the beach, talk, play, and socialize so the level of social interaction is decreased. Therefore, pollution in the great lakes has a negative effect on not only the environment but the people living near or visiting the lake.

Water Pollution in the great lakes is a serious and important issue that must be solved. We can do this by supporting politicians who are taking action and raising awareness about this important issue. This issue has a very large environmental effect because when we pollute the water, we pollute aquatic and land animals living in the area. Diseases from contaminated waters travel up the food chain and, as predators we eat other infected animals, they, too become sick with the disease and could eventually die from it. Families who rely on fishing as their main or sole income are at a disadvantage because they no longer have a profit to support their family. Therefore, if this issue is not solved, it will be an overall loss for communities and ecosystems surrounding the 5 Great Lakes.

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