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The Techno-Pedagogical Pivot: Designing and Implementing a Digital Writing Tool

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***Abstract*—**In educational technology, the idea of innovation is usually tethered to contemporary technological inventions and emerging technologies. Yet, using long-known technologies in ways that are pedagogically or experientially new can reposition them as emerging educational technologies. In this study we explore how a subtle pivot in pedagogical thinking led to an innovative education technology. We describe the design and implementation of an online writing tool that scaffolds students in the evaluation of their own informational texts. We think about how pathways to innovation can emerge from pivots, namely a leveraging of longstanding practices in novel ways has the potential to cultivate new opportunities for learning. We first unpack Infowriter in terms of its design, then we describe some results of a study in which we implemented an intervention which included our designed application.

***Keywords*—**Design, innovation, learning, technology, writing.

I. Introduction

IN this paper we describe a design for a technology-supported intervention and give details on a study that took place in two middle schools in the upper Midwest. This intervention employed a tool we designed to scaffold the evaluation of one's own text once a first draft has been completed. The Info writer application accomplishes this by making it possible for students to select portions of a text and tag or identify sections of it related to the type of writing they are creating—in this case academic informational writing as outlined in the Common Core State Standards of the United States. Once identified, each section of text is turned into a moveable, multiply connectable oval or node to be used in creating a mapped representation of their written text.

In the following sections, we outline how educational technology can be designed based on a techno-pedagogical pivot instead of via a breakthrough from the tech industry. This pivoting created a scaffold to aid students by employing well known concept mapping technologies in a way that opened up learning opportunities that were both pedagogically sound and experientially unique. Herein we outline our design and describe some of our findings related to an intervention we created and deployed using InfoWriter, a tool for the self-evaluation of writing.

In the next section we first position the practice of using emerging technologies in academic settings before outlining recent scholarship on revising writing.

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II. Literature Review

In terms of educational technology, the rhetoric on innovation for learning is usually linked to cutting edge technological breakthroughs [1]. While a focus on new technologies is important, some researchers have posited that leveraging well known technologies in novel ways within learning spaces places them within the range of what can be called emerging technologies for education [2]. In this technology-supported educational design we trained our efforts on the difficulties that come with getting students to meaningfully revise their academic writing.

When developing writers compose and revise their academic texts, the practices they employ are partially influenced by the features of the writing platform they use. As writing classrooms have been infused with computers, researchers have inquired as to the impact of tools such as word processing programs on practices of writing and revising [3]. While word processing allowed writers at all levels to easily reorganize, elide, delete, and add to their texts in meaningful ways from one draft to another, research has borne out that developing writers employing word processing applications mostly concentrated on minor or surface-level features when revising [4]. Researchers and educators have searched for tools and applications capable of supporting students in realizing meaningful edits in their texts.

One popular way of carrying out prewriting tasks pivots on the use of concept mapping. Concept maps provide external depictions of concepts and ideas and, through the use of proximity, color, connecting lines, and arrows, illustrate how they interrelate [5]. This type of practice predates the use of computers and came out of educational psychology around the 1960s. Its use within educational psychology had to do with understanding cognition, specifically "subsumption," wherein novel ideas provoke a reorganization of schema that already exist [6]. Within the field of writing, concept mapping was used to support metacognition by scaffolding developing writers as they brainstormed about and pre-organized their compositions [7]. Since the late 1990s, concept mapping has been a well-used practice in educational settings as a tool for learning [8] as well as for demonstrating understanding [9]. Concept mapping, while having proven itself to be supportive of student growth in a range of learning contexts, had not been leveraged in support of writing revision.

The potential for concept mapping to support organization, ideation, cognition, metacognition, and evaluation convinced us of the potential for a techno-pedagogical opportunity. In the

following section, we describe how employing concept mapping in a new way in the writing classroom makes new practices and discoveries possible in terms of realizing transformative revision of academic texts [10].

III. Infowriter a Description

The application we created is a tool that maps texts based on their semantic features. It is browser-based and supports developing writers as they evaluate and remediate their texts. The design is informed via theories of literacy, literacies, and Western systems of education [11]. Infowriter makes it possible for students to build representations of concepts, evidence, and other elements.

Text is ingested into the application, in the workspace the text wraps down the left 3/7ths of the page in a single column. When students move the cursor over their writing on the left, a genre-specific menu of node elements appears on the right (Fig. 1). Node elements include Preview, Concept, Definition, Evidence:Fact, Evidence:Statistics, Evidence:Quote, Example, Opinion, Concluding Statement, and Comment/Note-To-Self and directly correspond to the Common Core State Standards for informational writing at the Middle School level.

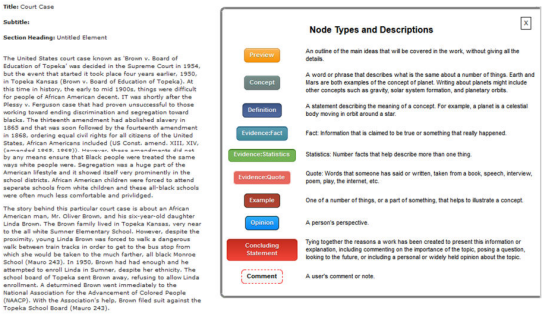

Fig. 1 Menu of Node Types within Infowriter

Students select the node element that most closely aligns with the text they have highlighted. With the text highlighted, clicking on one of the node type buttons causes the node menu to retract off the screen and creates the type of node that the user clicked within the middle and right side of the space. Each created node can be repositioned, connected to others, and exhibits the color related to that type.

Using this approach of text highlighting coupled with element type to generate nodes; developing writers build a map that corresponds with the genre-specific elements in their writing. Via connector arrows, connections are visualized between elements of their writing (Fig. 2).

Infowriter was designed to support developing writers in multiple ways as they expand their understanding of informational texts by giving them a list of elements their texts should include, supporting them as they reread their writing in search of those elements, and creating a way to visually show how those elements connect.

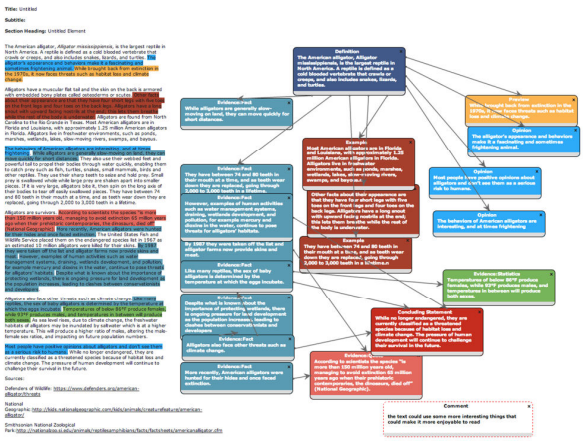

Fig. 2 Completed Map of a Student Text within Info writer

IV. Intervention and Methods

A. Intervention

More than 50 students from three schools in the US Midwest participated in our trial. Once they finished their first draft they used Infowriter during two class periods of 50 minutes each to map their writing with an eye toward using the mapping process to identify conceptual, structural, and organization candidates for revision.

This study was made possible by the teachers and students with whom we collaborated. After speaking with several teachers who expressed interest in implementing InfoWriter in their writing classrooms we worked with two of them to integrate our tool into their next informational writing assignment. Both teachers were looking for ways of getting their students to go beyond editing and making superficial changes to their drafts. As discussed in the literature review section, this is a common issue among teachers of academic writing. In informal conversations and interviews our two teachers identified some of their struggles to get their students to return to primary sources and/or to approach revising as an opportunity to make major changes to their compositions.

B. Methods

Over the course of the intervention, we conducted participant observations [12] during the writing, mapping, and revising process. We also interviewed twenty-three participating students at two of the schools after they finished writing their second draft [13], [14]. We used an analytical approach on a subset of thirteen participants wherein we described their maps, mapping processes, drafts, and interviews using codes [15]. In terms of our analytical process, we started by assigning base codes portions of each of our participants drafts, their maps, and their post-mapping drafts. We used comparisons of their pre and post-mapping drafts and also looked at their maps in relation to their texts.

Programmed in to InfoWriter is an administrative side that allows teachers and researchers the opportunity to 'step through' a student's creation of a map from beginning to completion. This feature allowed us to not only analyze their

finished maps but also made it possible for us to describe how they went about mapping their text—which we then also coded. We concluded by also coding transcriptions of the student interviews we conducted and then compared what students said in their interviews with what they wrote, how they mapped, and the extent to which they revised their texts. We wrote up memos—both descriptive and analytical—based upon multiple rounds of analysis. We undertook this analytical cycle for each of the thirteen students one after the other. Once we were finished we also coded the interviews we had with our two participating teachers.

Next we organized the base codes into groups and mappings and used those organizations to support initial chunking and theming. Finally we considered the resultant groupings and identified themes and worked to place them in the context of writing research, educational technology design, and literacy education [16].

V. Data and Findings

As we outline in the previous section, we compiled, read, and analyzed the writing and maps our thirteen students created and used these, along with statements they made in their interviews to make sense of the experiences they had with Infowriter. We juxtaposed and analyzed this data against and alongside of our observational notes and the interviews we conducted with the two participating teachers. We specifically placed our focus on the way Infowriter and between-drafts mapping supported our participating students in evaluating their drafts via rereading and mapping in preparation for creating a second, improved draft of their texts.

Our findings suggest that students approached writing and revising in a number of ways and with different levels of dedication and interest. Many preferred not to plan things out but instead just started writing. When it came to revising they generally thought of editing—fixing spelling, grammar, punctuation, and wording issues—as the goal instead of using revising as a chance to substantially alter the content and organization of their texts.

Using Infowriter changed the way students interacted with their texts during the formal revising stage. Students said that the node menu acted as a lens for text evaluation. They could look for one element type at a time or work their way down their paper looking for all types at the same time. As their maps came together they were able to notice things that were missing or needed reorganization. Students used the Comment node feature to make notes to themselves about what they needed to revise.

As show in Fig. 3, students who used the Comment nodes to identify elements in their texts that needed significant revision tended to make more meaningful revisions to their texts those students who did not use Comment nodes or did not use them to identify major issues in their initial drafts.

Overall although students were able to identify multiple issues in their drafts they often only followed through on a limited number of them—creating an inconsistent pattern of revising that leaves room for further design work. When asked about why they didn't follow through students said they either forgot or just didn't do it.

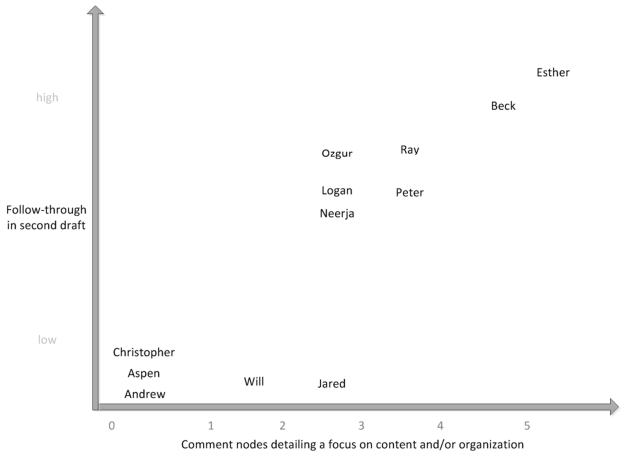

Fig. 3 Relationship between Comment Nodes and Meaningful Changes Applied to Post-Mapping Draft

VI. Discussion

InfoWriter's techno-pedagogical pivot aided students in their evaluation of texts they created. It changed how they read their initial drafts and made it possible for them to pin down different elements of the information-writing genre in their texts—thus potentially closing the gap between surface-level draft changes and transformative draft changes via revising. We see Infowriter and the intervention described above as moving the field one step closer to technology-supported practices capable of supporting students in making meaningful changes to their texts.

On the technical side, our participants were familiar with the idea of concept mapping and easily transferred previous understandings of mapping to the process of mapping their own texts. So instead of needing to train students on the use of the technical aspects of the web application, teachers were able to dedicate their time to supporting students in understanding the different node elements.

Our design created a novel approach to revision without using or creating a 'new' technology. This idea that something new can be cultivated on a pedagogical level instead of a technological level greatly increases the number of possible avenues for technology-supported innovation while at the same time diminishing the cost of design and development needed to calibrate factors such as interactional flow/HCI. Searching for and finding candidates for pivoting techno-pedagogically opens up reservoirs of untapped possibility by leveraging known technology in novel ways. In the case of Infowriter, pivoting techno-pedagogically gave researchers, students, communities, educators, and parents, tools and approaches to difficult problems like writing revision that are pedagogically innovative.

VII. Conclusion

In this paper we outlined the design and use of a tool for supporting the between-drafts mapping of academic writing.

In terms of design, we accomplished this not by adapting a new technology to meet our needs but instead by thinking pedagogically about the challenge of revising and then pivoting existing mapping technologies and practices for use in the writing classroom. While students did not transform their texts based on their use of Infowriter, they did demonstrate an ability to identify organization, conceptual, and elemental issues in their writing if given a tool that helped focus their rereading of their text.

Infowriter, as an intervention, is unique in terms of concept mapping applications because it supports students in the creation of maps that represent their writing. It allows them to identify and tag elements in their writing that correspond to the expected components of informational writing. The ability to build a diagram of one's thinking and writing create opportunities for students to evaluate a very complex system in a scaffolded way. By moving the practice of concept mapping from prewriting—where it typically occurs—to the between-drafts stage Infowriter becomes a technological innovation on a pedagogical level—facilitating more critical evaluation through rereading with the ultimate goal of bringing about meaningful revision.

Our data and findings point to the impact pivoting in a techno-pedagogical sense can have upon our approaches to the design of learning technologies, the teaching of writing, and specifically in our case, supporting students as they revise their writing. In some cases, our participants used InfoWriter as a tool for noticing what was missing in their texts. This noticing sometimes provoked a return to source material. Mostly students told us that they began the mapping process with rather negative feelings about writing, revising, and tended to see revising as editing. These opinions of revision as editing are at odds with how teachers and researchers see revision—namely as an opportunity to improve conceptual, organizational, and informational levels within a text. However while revision-as-editing is not how teachers and researchers would like developing writers to think about revision it is how most students think about it—both in and beyond our study [10].

In the case of designing Infowriter, contributing to efforts to better support developing writers as they self-evaluate their writing did not necessitate a technological breakthrough, rather it required a techno-pedagogical shift in using the familiar practice of concept mapping in a new way. This is not just an encouraging development for teachers of writing but it also reminds us that a multiplicity of possibilities exist in terms of creating innovative experiences for learners if we remember to consider the use of established technologies in our designs. This type of recycling or upcycling—technologically speaking—may not enjoy the sort of societal cache that inventing some completely new technology might have but, in this case, has proven that it has just as much potential for supporting learning in innovative ways while offering the advantages of being easier for students to understand, easier for designers to 'get right,' and faster to produce.

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