Enabling the Collective to Assist the Individual: CoREAD, A Self-Organising Reading Environment

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Abstract: CoREAD, software that enables learners to collaborate indirectly while reading a text, was designed using a self-organising systems approach. Using CoREAD learners highlight portions of the text they deem important. The font colour of the text is then modified based on the collective history of learners’ actions, indicating the importance of the text sections (e.g. red for high importance). This dynamic text becomes a tool for future learners as they read the text and decide which sections are important. In this manner, the learners themselves – often an untapped resource - assist each other. Results from a pilot study suggest that the software enables relatively stable patterns – “collective wisdom” about the text - to emerge from the indirect collaboration of the learners.

Educational Context: Problem

If learners in post-secondary institutions are to become successful life-long learners, particularly in professional and learned disciplines, then they require the ability to read disciplinary texts (journal articles, research reports, literary analyses, etc.). Such texts are constantly being published and so the knowledge they collectively contain is therefore very dynamic. As such, typical textbooks can not adequately reflect, in real-time, this changing knowledge base. However, educators have good reasons for using textbooks. Textbooks are designed to cover numerous topics very quickly and in a manner that (it is hoped) will be “easier” for students to understand. One might well ask if the skills required to read textbooks so as to perform well on assessments are the same skills needed to grasp disciplinary texts? Does this prepare students to learn from and be critical of disciplinary texts, for example? (also see J. S. Brown, Collins, & Duguid, 1989)

However, disciplinary texts might prove challenging for many students who may need assistance. Feedback during learning has been shown to be more beneficial than feedback after the fact. Therefore, assistance while reading is needed. One way to do so would be to analyse each text based on expert knowledge of the domain and then provide students with hints, guiding questions, additional resources etc. Unfortunately, this is very time consuming and unlikely to be adopted when the texts from year to year (or semester to semester) are constantly changing. A flexible and adaptive system was therefore sought.

The approach adopted here was to create software that enables learners to collaborate indirectly while reading a text. As learners read expository text a simple but crucial task for successful comprehension is locating the most relevant information within the text (A. L. Brown & Day, 1983; Winograd, 1984). Learners with limited prior knowledge about the subject matter being read will be at a particular disadvantage (Dole, Duffy, Roehler, & Pearson, 1991), as will those who are generally less capable readers. For this reason, the software designed enables learners to populate a text with information about the most important sections that can then be used by future learners. In this case, the learners themselves – often an untapped resource - assist each other.
Technology: Solution

CoREAD: Creating A Self-Organising System for Indirect Collaboration

Collaboration is usually a direct process whereby learners work together on a common product or activity either face-to-face or at a distance using standard communications technologies. However, self-organising systems (Bonabeau, Dorigo, & Theraulaz, 1999; Bonabeau & Theraulaz, 2000; Goldstone, 2006; Kennedy, Eberhart, & Shi, 2001) offer another possibility: learners collaborating indirectly through a digital environment (Dron, Boyne, & Mitchell, 2001; Dron, Boyne, Mitchell, & Siviter, 2000; Recker, Walker, & Lawless, 2003; Tattersall et al., 2005). In such cases, learners affect the environment through their actions but the environment, in turn, influences these actions by presenting learners with the community’s current “opinion”. Under the right conditions, stable patterns can emerge in the environment that reflect the learners’ “collective wisdom”.

Self-organising systems are characterised by the following properties (Bonabeau, Dorigo, & Theraulaz, 1999):

1. There are many individual agents acting, often simultaneously, using rather simple rules.
2. The agents act on their local information in their environment.
3. The environment plays a role by storing information.
4. The collection of agents is able to explore multiple solution paths, often through “random” exploration.
5. Positive feedback amplifies actions such that more and more agents engage in the same action, negative feedback counterbalances this tendency.

Ultimately, global level phenomena emerge from these local interactions - the agents’ collective behaviour becomes organised although there was no guiding plan or leader coordinating their behaviour.

CoREAD software (see Figure 1), designed and coded by the first author, attempts to create a self-organising system of learners where:

1. There are many learners reading a text, making decisions about what sections are important and highlighting them.
2. The learners base their decisions on the text section they are currently reading and do not have any direct interactions with other learners.
3. The text is modified based on the learners’ actions. The font colour of the text is altered to reflect the current collective opinion about the importance of each word (i.e. red for high importance, blue for moderate importance, and black for low importance). Technically, for each word an importance score is calculated based on a weighted (see 5 below) history of learners’ actions (i.e. highlighting or not). This score, ranging from 0 to 1, is then converted into one of the categories above with the moderate category ranging from .30 to .70.
4. Because the learners have different prior knowledge and reading skills they will each respond to the text differently. These differences in prior knowledge are essentially random and permit varied decisions about the importance of the text sections.
5. By viewing the current collective opinion learners are possibly influenced in their individual decisions about the text. If so influenced, this is a form of positive feedback; learners are more likely to highlight sections currently favoured by the group in a manner similar to the way that social insects follow pheromone trails of those who precede them (Bonabeau, Dorigo, & Theraulaz, 1999). To balance this, CoREAD places more weight on the actions of recent learners - a type of negative feedback. This allows any earlier contributions that were not subsequently reinforced by other learners to fade away (i.e. reset to black font).

Pilot Study

A pilot study was conducted to determine if 1) the learners would be influenced by the modified text presented to them and 2) sections of the text would then emerge and stabilise as “important” during collaborative reading. Seven undergraduate B.Ed. students read a chapter from How People Learn (Bransford, Brown, & Cocking, 1999) using CoREAD and highlighted sections they deemed noteworthy.
Positive Feedback (Influence)?

To investigate whether or not the students were influenced by the modified text presented to them the percent agreement between their actions (highlighting) and the current collective opinion (high or low importance) was calculated. In future research it will be necessary to use a control to determine if agreement is due to influence or merely similar decisions about the text that would have been made regardless of the modified text. If the student highlighted a section that was displayed in red (i.e. high importance) this was coded as an agreement. Similarly, if the student did not highlight a section that was displayed in black (i.e. low importance) this was coded as an agreement. Figure 2 shows that overall students typically agreed with the current collective opinion presented to them in the text; agreement was generally 80% or more. In one case (the third student) there was such a high agreement that it suggests the student was perhaps overly influenced.

Emergence of Stable Collective Opinion?

Given that each word in the text is given a new importance score after each learner reads the text it is possible to compute a correlation for any pair of learners. One way of defining emergence is when the importance scores no longer change much with the addition of learners to the system. Although it is highly speculative, given the small sample size, Figure 3 shows the correlations for pairs of learners separated by various “distances”. A distance of 1 means the pair of learners read the text one after the other and a distance of 2 means there was one learner between those being compared, and so on. Increasing correlations indicate increasingly similar importance scores as new learners read the text. High correlations for learners adjacent to each other (distance of 1) are to be expected since CoREAD makes only minor changes to the
importance scores at each step. However, increasing correlations for learners separated by greater distances means that the sections of the text deemed important are emerging (and those not important “fading”); there is a more and more stable collective agreement about the text emerging. The pattern in Figure 3 is consistent with this indicating increasing agreement across the learners.

The results of the pilot study indicate that CoREAD seems capable of supporting a self-organising system with emergent properties. Future research will investigate this further with larger groups of learners and examine whether this form of indirect collaboration results in real benefits to learners.

Implications, Uses, Dangers

CoREAD could potentially allow groups of learners in traditional and distance education courses to assist one another as they read difficult, disciplinary texts. The benefits of this would be that instructors would be free to add texts of greater difficulty to their courses and would be able to do so in a timely manner that reflected the changing knowledge in their domain. One danger, however, is that students could become dependent on the software, engaging in a kind of “social loafing” where they let other learners do the difficult work of reading the texts and then passively accept the group's current opinion. Future research using CoREAD in classrooms will be needed to examine this possibility.

Figure 2: Agreement between individual learners and the collective opinion displayed
Correlations between pairs of learners using word Importance Scores

![Graph showing correlations between pairs of learners]

**Figure 3**: Similarity between pairs of students separated in “time”

**References**


