EssayCritic: A Computer Supported English Essay Critiquing System using Latent Semantic Analysis

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Outline

- Design approach
  - Empirically motivated
  - Theory-based
- Latent semantic analysis (LSA)
- EssayCritic: Architecture and user interface
- Findings from two classroom studies
  - Individual essay writing (Hong Kong)
  - Pair writing (Norway)
- Similarities and differences
- Directions for further work

Design approach of EssayCritic

- Empirically motivated
  - Identifying knowledge society practices
  - Building computer support for them
- Theory-based
  - Design (writing as design)
  - Meaning (criteria for design quality)
  - Communication (pre- and post conditions for collaborative design)

Identifying knowledge society abilities

- According to experts and popular literature our basic skills need to be supplemented with the abilities required for 21st century knowledge work (*knowledge society abilities*)
- Experts disagree on what these should be and how to prioritize among them, e.g.

Examples of suggested abilities

- Popular literature
  - Imagination and creativity, ability to work in groups, communication, information-seeking and information sharing, problem solving abilities, argumentation, digital literacy
- Bereiter & Scardamalia (1997, 2002)
  - Working with knowledge objects to clarify meaning (improvable ideas, world 3 objects)
  - Making schools into knowledge building organizations
- Chee Kit Looi (2007) -- ICCE 2007 keynote address last week
  - Problem identification, brainstorming, prioritizing, concept mapping, action analysis

Knowledge society abilities 2

- In the European Knowledge practices laboratory (KP-Lab) project two of our aims are
  - Identifying emerging practices for the 21st century
  - Developing tools for supporting these practices and for transforming current practices into new ones
- In one case study we have identified two practice that were key to take part in for new employees entering a product development company
  - Joint artifact development
  - Multidisciplinary team work

Theory-based approach to design supported by empirical findings

- A socio-cognitive conceptual framework
  - *design* – Meaning (Latent semantic analysis)
  - *design & use* – Design (Reflection in action)
  - *use* – Communication (Common ground, Intersubjectivity)
- The framework can inform the design of tools and help us understand the use of tools as part of social activity
  - Operationalizing theoretical ideas in concrete artifacts
  - Making sense of user interaction data

Latent Semantic Analysis (LSA)

- The "cognitive component" of the conceptual framework (Landauer et al.)
- A theory as well as technique
  - *A theory of word meaning* and text comprehension
  - Originated as a method for query in hypertext (large text-based information spaces) to find good results
  - *A mathematical technique* for rapid comparison of two segments of texts (from words to documents)
  - In our case comparing student essays with teacher's model texts

LSA cont'd

- Computing the similarity of meaning of words and passages by statistical analysis of a large database of related text samples
- Larger and more complete corpus gives more precision in identifying similarity between texts
- Topics that are in the model texts but not in the students' essays can be detected and serve as a basis for automated advice given to the students
- There are different applications of LSA other than student advice giving (e.g. information retrieval)

Reflection in action

- The "creative component" of the framework
- A theory of design that provides a model of what professionals do when they design (Schön, 1983)
- Design is characterized as rapid transition of action (acts of doing design) and reflection
- Reflection is triggered by "back-talk," expert reading of partially completed design artifacts
- Reflection-in-action has been operationalized in domain-oriented design environments (Fischer)
- Back-talk is operationalized by automated critics

LSA-based critiquing

- The goal of computer-based critiquing is to automatically generate "back talk" to students for how to improve their essay under revision
- The critiquing component compares a newly created artifact within a model space in order to distinguish good from incomplete designs
- This requires that the model domain is well understood (implying that a database of good examples can be collected and processed)

A critiquing system for English composition

- Essays are treated as textual artifacts, consisting of themes (topics) as basic building blocks
- The EssayCritic based on LSA give two forms of feedback
  - Critique (missing themes)
  - Praise (covered themes)
- Automated critiquing is useful
  - Supplementary teacher feedback
  - Accessible on demand (e.g. outside school hours)

Common ground in communication

- It accounts for the "social component" of the framework
- Common ground is important to any account of language use that appeals to "context" (Clark, 1996)
- When two or more students collaborate they need to have a common ground before they can collaboratively design
- The common ground is a platform (an object) on which participants can take their understanding to the next level
- Clark identifies *self-awareness* and *mutual awareness* (overlapping areas) as steps to building a common ground
- The goal is the mutual belief that the partner has understood one

Interaction analysis excerpt 1 (CG)

Time	*Stud*	*Spoken utterance*	*Body language*	*Comments*
5:05	Betty	ok..... Say more about .. convention..... people at any time and place and user can be contacted		Shifts from Word to EC, reads the feedback
5:15	Betty	u::h, didn't we say something about this already?		Changes back to Word
5:16	Mandy	**Yes**, we did ...		
5:18	Betty	..Ok, let's write some more about it...		
5:18	Mandy	...sure we wrote about it but did not use exactly those words... ***yes...?***		
5:21	Betty	***Hmm***, where did we write it....?		
5:28	Betty	**Here**! (silently reads from essay)		
5:31	Betty	For example the world gets smaller…		Reads from essay
5:33	Mandy	**yeah**... **right**..... we can write something like... wherever people are .. they can be reached ...		
5:43	Betty	uh huh...	Writes on PC	

Legend: **Boldface**: acknowledged CG; ***bold-italic***: CG not yet established

Intersubjectivity: Context of CG

- A socio-cultural (externalized) account of common ground
- Emphasizes that multiple common grounds exist for the same utterance, dependent on the context, and this context is referred to as *intersubjectivity* (Rommetveit)
- Analyzing intersubjectivity can unravel the subtle micro-processes of collaboration in taken for granted team work
- Communication, collaboration and design will not succeed without a common ground and participants' knowing about each others' different interpretations of the common ground
- This is accomplished in practice when the participants adopt (take on) the attitude of the different others (G.H. Mead)

Interaction analysis excerpt 2 (IS)

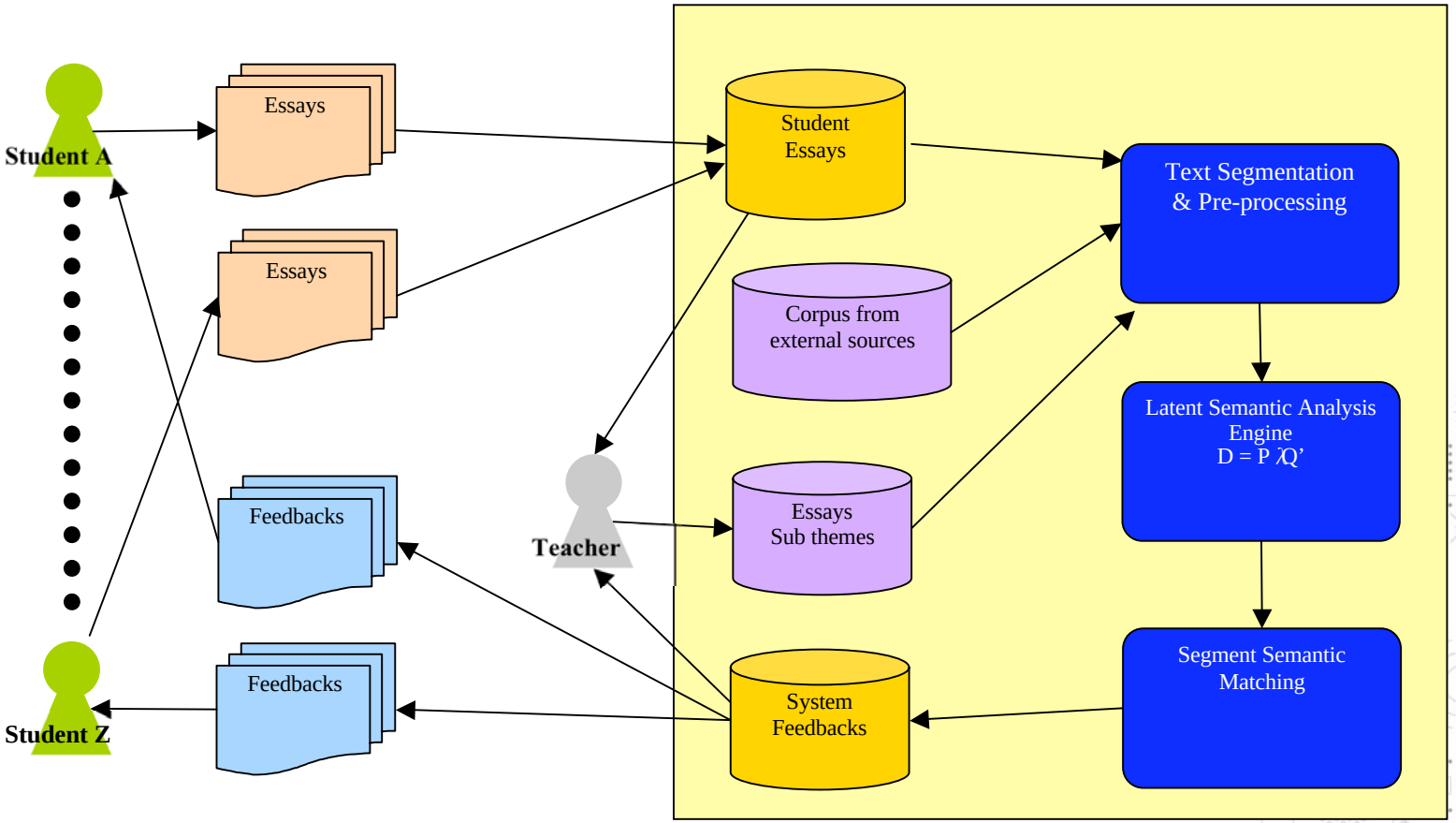
Time	*Stud*	*Spoken utterance*	*Body language*	*Comment*
5:54	Betty	.. people can always contact you	Betty looks at Mandy who looks back	Seems to have eye contact
5:56	Mandy	***Yes, or no.. yes m..***	Looks back on screen	
6:01	Betty	You.... at least if you have power and…. (silent voice)	Betty looks at Mandy	
6:05	Mandy		Laughs to confirm	
6:07	Mandy	**Aaanndd**…	Betty writes on PC	

Legend: **Boldface**: acknowledged CG; ***bold-italic***: CG not yet established

EssayCritic

- System architecture
  - Developed at HKBU
- User interfaces
  - Student interface
    - Critique mode
    - Praise mode
  - Teacher interface (not shown)
  - Administrator interface (not shown)

System architecture



EssayCritic: Critique mode

Text written by students on the assigned topic

Collaborative writing

Feedback generated by computer

Covered Sub-themes

Suggested Sub-themes:

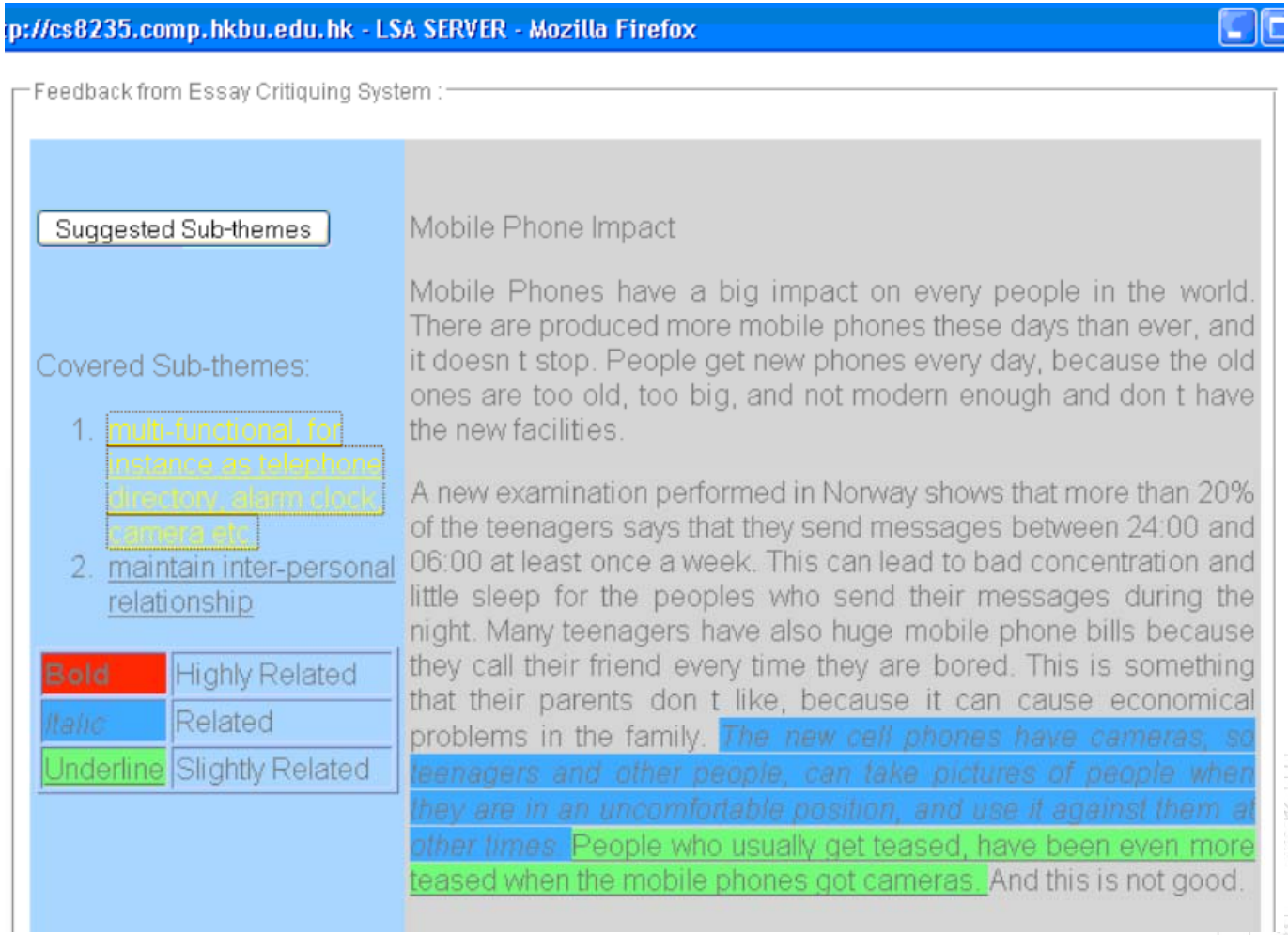
- Say more about: convenient. Users can contact people at any time and place, and users can be contacted everywhere too
- Say more about: a popular communication device, especially for emergency
- Say more about: may cause damages to brain/ cause cancer
- Say more about: annoy people/ disrupt everyday life.
- Say more about: users should adopt appropriate telephone manner

Mobile Phone Impact

Mobile Phones have a big impact on every people in the world. There are produced more mobile phones these days than ever, and it doesn t stop. People get new phones every day, because the old ones are too old, too big, and not modern enough and don t have the new facilities

A new examination performed in Norway shows that more than 20% of the teenagers says that they send messages between 24:00 and 06:00 at least once a week. This can lead to bad concentration and little sleep for the peoples who send their messages during the night. Many teenagers have also huge mobile phone bills because they call their friend every time they are bored. This is something that their parents don t like, because it can cause economical problems in the family. The new cell phones have cameras, so teenagers and other people, can take pictures of people when they are in an uncomfortable position, and use it against them at other times. People who usually get teased, have been even more teased when the mobile phones got cameras. And this is not good

EssayCritic: Praise mode



Two research designs

- Hong Kong experiment (quantitative approach)
  - Two groups (with and without use of EssayCritic)
  - Questionnaire
  - Interview with students
  - Final essay version marked by two teachers
- Norway case study (qualitative approach)
  - Participatory observation in computer lab
  - Video recording, following one student pair
  - Questionnaire
  - Telephone interview with teacher after marking

Findings from the studies

- Hong Kong experiment (February 2007)
- Norway case study (April 2007)

Quality of essays, excerpts (HK)

Group	N	Mean	S.D.
Treatment	14	387.86	85.06
Control	14	361.57	67.30
Overall	28	374.71	76.44

Table 1. Descriptive statistics on essay length in number of words

Group	N	Mean	S.D.
Treatment	14	13.38	1.74
Control	14	12.66	1.23
Overall	28	13.02	1.53

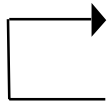
Table 2. Descriptive statistics on essay score (max. score 20)

Question	very useful	useful	unuseful	very unuseful
The suggestions on the missing sub-themes in your essay provided by this system are:	0 (0%)	14 (100%)	0 (0%)	0 (0%)
The covered sub-themes in your essay indicated by the system are:	1 (7%)	12 (86%)	1 (7%)	0 (0%)

Table 4. Number and percentage of student responses to question 2 and 4.

Writing process (Norway)

- Patterns of working in pairs
  - Incomplete utterances supplemented by body language
  - Common ground is prerequisite of collaborative writing
  - Intersubjectivity established through body language
  - Multiple rounds of revision
  - Driver-navigator division of work
- Stages of production with automated critique
  - Writing (what to write: *navigator*; typing: *driver*)
  - Reflection (discussing how to make use of critique)
  - Revision (stimulated by critique)



High school lab set-up in Norway

Findings across the two studies

- Most of the students liked the system and thought it could help them to improve their essays
- They were not set back by being critiqued, but instead were challenged by it, like in a game (i.e. make the computer give me praise and not critique)
- It helped many of the low achieving students to be more active in class
- According to an interview with the Norway teacher it improved the essay quality for this group of students
- About 10% high achieving students in both Hong Kong and Norway (2-3 in each study) were critical to EC and believed essay critiquing would inhibit student creativity

Shortcomings and open issues

- Scaffolding was supported by critiquing, but fading away (a technique commonly used by instructors and parents towards learners) was not
- Some students brought up relevant topics in writing that was not mentioned by the EC praiser
- Should students be able to "teach the critic" about new topics to be included in the corpus?
- We do not know if critiquing will have an impact on learning, e.g. if the students who did better in our study will continue to do so without the critic

Summary and conclusions

- EssayCritic was easy to use and improved essay writing for most students who participated in the two studies
- The process of writing revealed that students were practicing a knowledge society ability
  - Collaborative designing a common artifact
- More work is needed to address the shortcomings identified

Plans for future work

- Collaborative writing
  - Composing groups of students with different cultural backgrounds in order to practice working in multidisciplinary teams and to identify the challenges and opportunities of this
  - How to support this technologically across distance
- Individual writing
  - A high school (Kowloon Tong) experiment in use of the EssayCritic is currently underway
  - Common research design across the two cultures

Related work

- Previous work on LSA and current spin-offs to commercial products (CU Boulder and elsewhere)
- Domain oriented design environments (Fischer)
- Meaning making and intersubjectivity in CSCL (Stahl, Suthers)
- Knowledge building (Scardamalia & Bereiter) and progressive inquiry (Hakkarainen, Leinonen, et al)
  - Intentional learning --> CSILE
  - Progressive inquiry --> FLE
- Knowledge creation and trialogical learning (KP-Lab project in Europe)

Recent publications

- Cheung, W.K., Mørch, A.I., Wong, K.C., Lee, C., Liu, J., Lam, M.H. (2007). Grounding Collaborative Learning in Semantics-based Critiquing. *Int'l J. Distance Education Technologies*, 5(2), pp. 40-55.
- Nygård, K.A. And Mørch, A.I. (2007). The Role of Boundary Crossing for Knowledge Advancement in Product Development. *Proceedings Int'l Conf. Computers in Education (ICCE 2007),* in T. Hirashima et al. (Eds.) Supporting Learning Flow Through Integrative Technologies, IOS Press, Amsterdam, pp. 183-186.
- Wong, C.K.C, Lee, F.S.L, Lee, C.F.L, Cheung, W.K.W, Mørch, A.I and Liu, J (2007). A Pilot Study on the Impact of the Web-based Essay Critiquing System on Writing at the Tertiary Level. *Proceedings of 2007 Int'l Joint Conference on e-Commerce, e-Administration, e-Society, and e-Education*, Hong Kong, August 15-17, 2007.