Vol. 3, No. 1, November 2007 pp. 116-133

Reflecting Education
http://reflectingeducation.net

The CONTEXT tool – going beyond the narrative

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ABSTRACT

This paper discusses a new teaching and learning tool, CONTEXT, which utilises computer technology to support analytical thinking in students. The tool uses a combination of computerized concept mapping and hypertext writing in a wiki to engage the learner in thinking deeply about the complex material that is being studied. This paper presents a draft of a theoretical model aimed at explaining the interplay between the cognitive and the technological aspects of CONTEXT.

The CONTEXT tool was trialled in a small-scale case study, aimed at assessing the potential of the tool. An A-level history class participated in the case study. Two class sessions were planned in collaboration with the class teacher and subsequent interviews were held with some of the participating students to gain feedback. The data gathered from the case study were analyzed using the model as a framework.

Although the implementation of CONTEXT explored in this paper was far from optimal, the tool showed potential for promoting a coherent understanding of the studied material in the students. Overall the students found CONTEXT useful and motivating to work with. Although serious modifications of the tool are needed, the teacher was interested in continuing the development of CONTEXT for next year's students and broadening the application of the tool.

INTRODUCTION

As educators in the age of emerging technology, we face important questions such as what do we want to teach and how do we make the technology help us? The skill set required to function in society has changed. Having knowledge at the ready is of less use today than it was just a couple of decades ago, with access to information being practically limitless. Instead, a different set of skills is valued: analytical skills and the ability to adapt and update knowledge when necessary (Säljö 1999). The ability to find and process information requires highly developed analytical skills and a sound understanding of the field in question. The challenge for educators is how to foster these abilities in our students.

The current educational system seems to struggle with these demands. Spiro and Feltovich write about the inflexibility of young people's knowledge, their inability to transfer the knowledge from the classroom into the real world and prevailing misconceptions in students even at high levels of education (Feltovich, Spiro et al. 1992, Spiro, Coulson et al. 1988, Spiro, Feltovich et al. 1992). The teacher who was interviewed in connection with the case study that is the basis for this article, expressed similar concerns with the quality of his students' learning: "*Many A-level students tend to fall into the narrative trap, even quite able students*". In other words, his students are not readily able to break out of the

 ISSN 1746-9082

narratives presented in their textbook, they regurgitate them at the exam, even if the narrative that they have learned does not perfectly fit the essay question.

This article presents CONTEXT – a possible solution to some of these problems. CONTEXT is a simple didactic and technological tool designed to promote analytical thinking about the material being studied. The tool was first conceived in order to meet my own needs for a thinking aid and an effective tool to organize complex information. Since, the idea, that seemed to work for my needs, was transformed into a tool that could potentially meet the needs of school pupils. This paper is a report of a first explorative case study aimed at assessing the potential of the tool in a classroom environment.

THE CONTEXT TOOL

CONTEXT is a didactic and technological tool that is designed to promote deep and coherent understanding of complex material. It seeks to engage the learner in actively constructing knowledge and in exploring the knowledge domain in depth. The tool is a combination of computerized concept mapping and hypertext writing in a wiki. It is used for creating an interlinked online knowledge repository in a wiki and a corresponding concept map. Each bubble on the map represents a page on the wiki and, conversely, each wiki page represents an important concept in the material. Each concept on the map is directly linked to the wiki page, so when studying the map the relevant in-depth information can be accessed with a single click. In this fashion, the combination of wiki and concept map provides an interlinked textual and visual knowledge base. At the same time the map provides a useful "road map" to the wiki allowing for easy orientation and navigation and reducing the cognitive load of working with the tool (Thüring, Hannemann et al. 1995).

The main technological ingredients in CONTEXT are concept mapping and hypertext writing. The former can be seen as representing the overview level and the latter the level of detail. The technology is the medium that allows the student to move seamlessly between them.

Concept mapping (Novak, Cañas 2006, Novak, Gowin 1984) is aimed at aiding the learner to construct meaningful knowledge. Its foundation is in Ausubel's assimilation theory of cognitive learning, which holds that meaningful learning is achievable only when the learner is able to connect the learning task at hand to what he already knows (Ausubel, Novak et al. 1978). Meaningful, interconnected knowledge is what enables the learner to break out of the set narratives of the learning material and construct their own arguments. In a sense the map can be used as a road map to finding answers to specific questions: new narratives can be constructed by following the paths of the links or by making new paths.

Hypertext is at the other end of the overview-detail continuum. Hypertext is familiar to most people as the "stuff" that makes up the Internet. The term "hypertext" was introduced by Ted Nelson *"to mean a body of written or pictorial material interconnected in such a complex way that it could not conveniently be presented or represented on paper."* (1965). In hypertext units of information are connected by clickable links, so that the user can jump

freely between related information stored anywhere in the hypertext system and in a sense become co-author of the text by creating new narratives or paths through the material (Landow 1997).

Using hypertext in education is argued to be beneficial because it encourages the learner to take a more exploratory and diverse approach to learning and to take initiative. It also helps to break up larger tasks into manageable sub tasks and aids construction of structural knowledge (Khalifa 1998, Nielsen 1995, Stanton, Stammers 1990). On the basis of the current body of research the beneficial effects of reading hypertext are uncertain, but the literature suggests that active production of hypertext is in many ways a useful learning technique (Braaksma, Rijlaarsdam et al. 2002, Pohl, Purgathofer 2004 and others).

Recently an easy and convenient medium for producing hypertext has emerged: the **wiki** (Leuf, Cunningham 2001, Tonkin 2005). A wiki is a piece of server software that allows the user to edit online content using nothing other than an Internet browser. A wiki editing window looks like a text editor and is very easy to use; therefore no prior knowledge of web authoring is necessary. The term "wiki" is derived from the Hawaiian word "wikiwiki" meaning "superfast" and this is a good description of how it feels to work with a wiki. Wikis can be used collaboratively to great effect, the most famous example being Wikipedia (http://wikipedia.org/), an online encyclopaedia edited by users worldwide. Wikipedia is only a few years old, but with its over 1,203,000 articles (English version, June 2006) it is already much larger than the Encyclopaedia Britannica. Some wikis need installation on the user's computer, but others, like PBwiki, the wiki used in this project, only require a free online registration. This makes web editing easily accessible to people without much knowledge of ICT.

The concept mapping software and the wiki can potentially facilitate a learning aid that invites the learners to collaborate and to discuss. The ease of restructuring the concept map on the screen at a click of a mouse will, if used correctly, facilitate an iterative and creative learning process. The ease of access to the information on the wiki from any computer at any time encourages the learners to construct and reconstruct their knowledge at any time, including outside the formal learning situation. Combining the affordances of the two electronic tools will help the learners to keep track of their own and the group's learning by using the concept map to aid navigation of the wiki and to keep an eye on the structure of the growing body of hypertext. The hypertext, conversely, can hold a vast amount of material providing room for great depth of study and showing the designated, conceptual links between the details of a complex topic.

Computerized concept mapping and the wiki are the technological side of CONTEXT. The tool must not in itself be regarded as a technology or a "program". This would suggest that it could be installed on the computers in a "plug and play" fashion and work magic from there. On the contrary, CONTEXT is to be seen as a tool – much like a ruler or graph paper; such tools only gain their meaning through application. As Martin (2003) points out: the technology may provide rich opportunities for deep and meaningful learning, but it's always up to the teacher to utilise this potential, to not let it go to waste. To this can be added that not only the teacher is responsible, but also the designer of the "learning

opportunity". Therefore, the rest of this article concentrates on one concrete application of the tool and discusses the cognitive effects the tool could initiate in this application.

THE "CONE MODEL"

No single theory of learning or cognition seems to fit the diverse range of effects that the combination of technology and practice in CONTEXT could potentially offer. Therefore, for the purpose of this first exploratory study, a model has been constructed to aid searching for and clarifying analytical categories that could aid the understanding of the tool, while going beyond the technological input. The model emphasizes the possible relationships between the technological and didactic elements in CONTEXT and possible interpretations of these within the frameworks of several learning theories. Here, only a brief description of the model will be given (for a deeper discussion see Shuyska 2006).

The "cone model", as it is termed (Appendix 1), shows the most important elements in CONTEXT and is a first attempt at representing their interplay. It is not a finished theoretical model of the tool and was developed at the same time as the tool itself. It has served as an analytical tool in both the design of CONTEXT and as a lens in the analysis of the data from the case study.

The aim of CONTEXT is represented at the bottom of the model and is the students' achievement of "coherent understanding" of the material that they are working on. This term draws strongly on the concept of cognitive flexibility (Feltovich, Spiro et al. 1992, Spiro, Coulson et al. 1988, Spiro, Feltovich et al. 1992).

Cognitive Flexibility Theory was developed by Rand J. Spiro et al. in the late 1980s and early 1990s. Their work grew out of a concern with the failure of traditional teaching methods to aid advanced knowledge acquisition, which is the stage between introductory and expert learning (Spiro, Coulson et al. 1988). Whereas in introductory learning it is enough to be familiar with the existence of overall concepts and be able to reproduce what you have been taught, this is not enough when the stage of advanced knowledge acquisition is reached – here deeper understanding is required:

> "Acquiring and retaining a network of concepts and principles about some domain that accurately represents key phenomena and their interrelationships and that can be engaged flexibly when pertinent to accomplish diverse, sometimes novel objectives, is a reasonable definition of understanding in that domain" (Feltovich, Spiro et al. 1992 p.181)

The authors present reading hypertext material as a strategy for enabling learners to form a better understanding of the subject studied by allowing them to "criss-cross conceptual landscapes" (Spiro, Jehng 1990).

Coherent understanding is a slightly broader term than cognitive flexibility, putting greater emphasis on a "bird's eye" overview of the material and suggesting a more multifaceted picture of how the desired kind of learning may be formed.

The rest of the model represents possible "ingredients" or paths to reaching coherent understanding through the use of the proposed technology. Not all of the elements were explored in the project, some being merely suggestions for further research. The influences of the collaborative nature of the task and of possible motivational effects of collaboration on learning and coherent understanding were not treated in depth in the course of this project, but were included in the model as a possible avenue of future investigation. Similarly, the perspective of the collaborative map and wiki as a potential way of creating a knowledge building community was not treated, mainly because of the short time scale of the project.

The learner's approach to learning (Marton, Säljö 1997) is included as one of the possible influences on attainment of coherent understanding. Here, understanding is partly seen as a product of the approach to the material, distinguishing between deep and surface approaches, where the surface approach focuses shallowly on the literal sense of the text and the necessity to read and understand it, whereas the deep approach focuses on the speaker's intended meaning and the relation of concepts. This view of understanding is included as one of the elements in the model to demonstrate one of the aims of CONTEXT, that is to refocus students' attention from the narratives of the textbook, which are treated superficially, to deep analysis of the text, which building a meaningful concept map necessitates.

Attention was also paid to the motivational effects of working with technology. Motivation was seen in light of what Passey, Rogers *et al.* (2004) describe as the desirable motivational effects of ICTs. They describe ICT as influencing students' goals, interest in the activity, conception of ability and hopefully even adding intrinsic motivation to the task. They point out that the first and most achievable motivational effect of technology is the creation of situational interest, which is a powerful motivating factor, but also an unstable effect that depends on the continuation of the motivating situation which disappears as the novelty wears off. It was this motivational effect that was clearly seen in the case study, but it does not mean that it cannot be transformed into other, more stable types of motivation. The potential for this transformation was not treated in this study.

The broad and flexible term "coherent understanding" was thus not explored from all the suggested viewpoints in this instance. It was primarily used as a working term in the study to describe the desirable ability to move between levels of abstraction, to flexibly and deeply analyse the material and to construct meaningful narratives about the material.

THE CASE STUDY

CONTEXT was used in the final part of the school year to aid revision of material on the history of the Russian Revolution. Revision was considered a good testing ground for CONTEXT because the students were already familiar with the material that they were to write on the wiki and the tool could therefore be introduced in a relatively short space of time.

The case study consisted of (i) two working sessions with the class teacher (both of which were audio recorded), (ii) two classroom sessions (two hours and one hour in length), which were one week apart, and (iii) a short planning session with the teacher between the two sessions. (iv) Short follow up interviews (also audio recorded), 10-15 minutes long, were conducted with six students immediately after the end of the second class session, and (v) finally a closing interview with the teacher. The initial working sessions with the teacher were directed at establishing a shared understanding of the potential use of CONTEXT in the classroom and planning the class sessions. The follow up interviews with the students and the teacher concerned the thoughts, feelings and experiences that had been gained in working with the tool.

Methodology

The sampling strategy used in this study was convenience sampling. This strategy, being undesirable for larger studies (Neuman 1999, Robson 1993), was sufficient in this case, because the study was conducted without any intention of generalization, and was purely directed at exploring the tool and formulating issues for further research. One year 12 history A-level class participated in the study. The class was chosen because of the teacher's interest in the tool and his more general interest in working with computer technology in his teaching. Also, he was willing to invest time and effort into the project and, being an experienced history teacher, he could bring the necessary expertise to the final planning stages of the study. It was the teacher's decision, which one of his classes was to be introduced to the tool.

The six students for the follow up interviews were also chosen by the teacher, and were to the best of his knowledge representative of the different ability groups and attitudes in the class. This strategy was chosen because, due to the short duration of the case study, it was not possible to gain a picture of the students' attitudes and abilities, and the teacher was considered the best route to choosing students, who could provide a reasonably representative sample.

Because of the very small scope of the study, triangulation of the sources of evidence and methods was crucial (Yin 1994). Therefore, the study made use of participant observation, interviews with both students and the teacher and of analysis of the physical artefacts produced in the course of the class exercises. The data gathered in the study consisted of interview transcripts of teacher and student interviews and of the maps and wiki pages produced by the teacher and by the students. Furthermore, some observation notes were gathered during the class sessions.

The two interviews with the teacher prior to the class sessions had the character of both interviews and workshops. Practitioner participation in the design of the tool and its implementation was deemed very important in this study and therefore the intervention was largely designed in collaboration with the class teacher. Not only did he need to understand the tool and its purpose in depth in order to conduct the lessons using the tool, he was also very keen on developing the tool and bringing his own ideas into play. This was a valuable contribution, which helped ensure that the tool was not removed from the practical reality of the classroom.

The interview questions for the six short student interviews were designed to gauge their opinions about working with the tool and were structured along the main themes of the cone model. Questions were formulated about the students' motivation while working with CONTEXT, their attitudes towards technology, their attitudes towards collaboration in general, and their group work in the class exercise in particular. Also a number of questions were posed about the students' understanding of the kind of learning required to enable them to do well in the history course and the exam, and how they perceived use of CONTEXT as fitting in with these understandings.

The maps and the wiki used in the analysis were in the final ones produced by the students and the teacher. No attempt was made to capture the development of these documents, because this was the first time that the students were introduced to the tool. It was anticipated that the first many changes in the map and wiki would reflect the students' getting to grips with the technology and the ideas of the tool, and this, although it merits a study of its own, was not the main focus of the study.

The data analysis was structured around trends predicted in the cone model (Appendix 2), but also looking beyond it at evidence that could not be incorporated in that particular representation of the tool. Thus some broad coding categories were created from the cone model (such as "effect of technology on student motivation"), and others were constructed while studying the interview transcripts and observation notes (such as "purpose of use of the tool") (Lyons 2000, Miles, Huberman 1994). In the first reading the interviews were coded according to the predicted trends. On subsequent readings more attention was paid to utterances that pointed in other directions than those predicted by the model. Due to the small nature of the project the transcripts were only read in detail by me, and the findings subsequently discussed with my supervisor. In order to ensure the validity of the findings all of the data were coded ensuring that nothing remained outside the coding scheme. The transcripts were then specifically investigated for contradictory utterances within each code. The coding was rather coarse, focusing on the meanings of entire chunks of conversation in their context and not on the meanings of single words. This approach was chosen in order to get a good overall picture of the interviewees' impressions of the tool rather than to analyse every student's personal experience.

The planned observation of the students' interactions when working with the wiki and the map was a strong limitation of this study. In the classroom sessions it quickly became evident that it was impossible to stand back and observe the students because they needed help with getting to grips with the technology and the purpose of using the tool. Therefore, the observation notes amount to only anecdotal evidence, which none the less was a useful addition to the more structured data of the interview transcripts, the maps and the wiki articles.

The class sessions

At the beginning of the first class session CONTEXT was presented to the students as a tool that could aid their learning and revision. The teachers then posed the focus question (Novak, Cañas 2006) for the map to the class. After a brief teacher-directed discussion, where the main concepts were drawn up on the map, the teacher distributed the topics to

groups of students (the groups were determined by the teacher in advance). They then proceeded to write articles on the wiki about the assigned topics (the resulting wiki is available at http://1917.pbwiki.com/). The students had the aid of the materials that they had been using through the year in the form of their textbooks. Additionally, the teacher had prepared a small collection of web links that could be used as well. To link the wiki pages into one big map for the whole class, the students were asked to come to the teacher's computer to include their page in the map.

For homework the students were asked to read all the articles that had been produced on the wiki and to prepare group presentations on their respective topics with an emphasis on the links between their areas and areas explored by other groups. The focus on cross-links was chosen to encourage the students to analyse the map in detail and to add more richness to the knowledge structure that was already created on the map and wiki.

The next session began with the student presentations. Some groups had not focused on the link task at all; others stayed on task and showed a remarkable degree of creative and analytical thinking. I was adding links to the map, which was projected on the board behind the students, as the group presented them. Although the presentations were of varying quality, the class between them managed to add a certain degree of complexity to the map (see Appendices 3 and 4).

Finally the students were asked to add further links to printed copies of a map that the teacher had drawn in a session with me in advance of the lesson (Appendix 5).

FINDINGS

Two trends that were predicted in the cone model came strongly through in the interviews: technology's motivating effects and using the concept map and the wiki for promoting cognitive flexibility.

Motivation

All interviewees said that they thought that concept mapping and wiki writing had been fun and interesting to work with. Some students expressed their motivation in terms of being allowed to play with the technology as being the main contribution to "the fun": *"I think it just makes it a bit more interesting and just...it sort of breaks up the lesson – rather than just every lesson being in the same room and working...working from books and stuff like that. If you… have a bit of technology it makes it a bit more interesting."*

In the short time that the tool was trialled in the classroom, the situational interest overshadowed any potential of other forms of interest stemming from the tool. It will require further investigation of longer duration to establish whether CONTEXT is capable of promoting more lasting interest in the material and in the process of learning.

Cognitive flexibility

The other major theme in the interviews was how working with the concept map and to some degree also with the wiki, influenced the students' view of the material they were studying. Even though students tended to express their purpose in terms of memorizing the material and not in terms of learning, they often talked about the material in relatively meaningful ways and often in terms of cognitive flexibility. Some students expressed their experience as "seeing the big picture" or "seeing it in context". Both the map and the wiki were seen as idea-ordering tools: *"Eh… just cause you've got all these… ehm... ideas in your head but it's just easier if you got like a ... a picture of it... visually you can look at. So you have the link – I think that's better."* And *"You know it's like I would look at them* [the wiki articles] *and then I'd look at what I wrote and then I'd look… and I'd try and like... put ideas together and get a better understanding of what I thought."*

One of the students also talked about the movement between the general and the detail levels: "I think like having things in diagrams… like spider...spider-grams...it is a good way of learning... and then especially if you can click on different things and read about it as well..."

Affordances of the wiki

In general the students made some very encouraging comments about working with the tool. There was one major issue that, though it was represented in the cone model, was completely overlooked both in the preparation of the exercise, in class and in the subsequent interviews: the utilization of the wiki's linking capability to create an interlinked knowledge base "underneath" the map. This was one of the main purposes in utilizing the wiki instead of for example just attaching word documents to the map. Instead, the students used the wiki as they would normally use a word processor. One student explicitly stated that the wiki writing was just like another essay writing task. In the preparation of the exercise the utilization of the wiki's linking capability was a difficult concept to convey to the teacher, especially, because the links within the wiki are not crucial to the basic function of CONTEXT. Therefore, the focus of attention was on how to make the connection between the wiki and the map function both conceptually and practically. Also, as time was limited, we simply did not reach the stages of more advanced exploration of the tool. Achieving linking to wiki pages created by other students seems to require more time and a specifically directed effort. This has been a valuable lesson that must be taken into account in all further explorations of CONTEXT.

Other issues

There were a number of other trends that were not predicted in the Cone model, but came up in interviews and in observation. Two of these were use of the tool to promote "lazy" ways and for undesirable social interaction.

One of the interviewees was a student, who according to the teacher was struggling to follow the course. He came across in the interview as being smart and creative, but admitted openly to being lazy. When asked to clarify why he thought the tool was useful he

answered that *"…it's quite easy with the whole map you can read about whatever you want to read about, you don't have to look it up in a book."*. Using the wiki as a "shortcut" for revision is not an intended purpose of CONTEXT, but this is an issue that undoubtedly will surface in most environments. This attitude also points to the fact that this particular student did not gain any new motivation or interest in the history of Russian Revolution or in his own learning, although he may be motivated to participate in the exercise again by the technology, the novelty of the approach and by the knowledge that the outcome of the exercise will be a welcome "shortcut" to use for revision.

Another unfortunate outcome of the classroom trial of CONTEXT was that some students used the wiki to bully others. As soon as the class familiarized themselves with the basic functions of the wiki, they invented an unintended social use for the pages. Students would post offensive comments on their pages and urge others to visit their pages.

Undoubtedly the victim of the jokes would have received a similar treatment through other means, had the wiki not been available. Still, the technology presented a new and interesting way to comment on classmates and may have initiated a new wave of "creativity" in bullying. Not suggesting that this should be a reason to restrict the use of wikis in the classroom, but this is an issue that needs to be thought through thoroughly before the next trial is put in place.

CONCLUSION

In conclusion, it is important to underline that this particular implementation of CONTEXT was very limited in terms of time and resources, and that these constraints largely shaped the implementation of the tool. Therefore, all the trends that begin to emerge from this case study must be seen in the light of how the class intervention was carried out practically. This is a whole dimension – and a very important one – that the cone model does not take into consideration. Because the tool is so general and can be applied in many different contexts, it cannot be concluded that this particular application of the tool would be the most suitable. The rather optimistic findings presented here must be seen as what they are: possible trends, discovered in the course of a very small case study. CONTEXT has been found to be beneficial in terms of encouraging students to think more actively about the material they study. At the same time some disruptive and unproductive sides of the tool have been discovered. CONTEXT needs to be developed and trialled over a much longer period of time before any more solid conclusions can be drawn. Eventually, the vision for CONTEXT is that it would be developed into a smoothly functioning technological tool and an accompanying set of "best practice" advice drawn from the trials and experiments that have been run in the course of its development.

The teacher who participated in this project is currently taking CONTEXT further with a new class. He is expanding its use beyond revision and introducing it gradually in the course of the year. Therefore the conclusion must be that CONTEXT has so far been a reasonable success and that it is worth the further development that is needed to make it a fully functional and usable learning tool that can be implemented broadly in schools.

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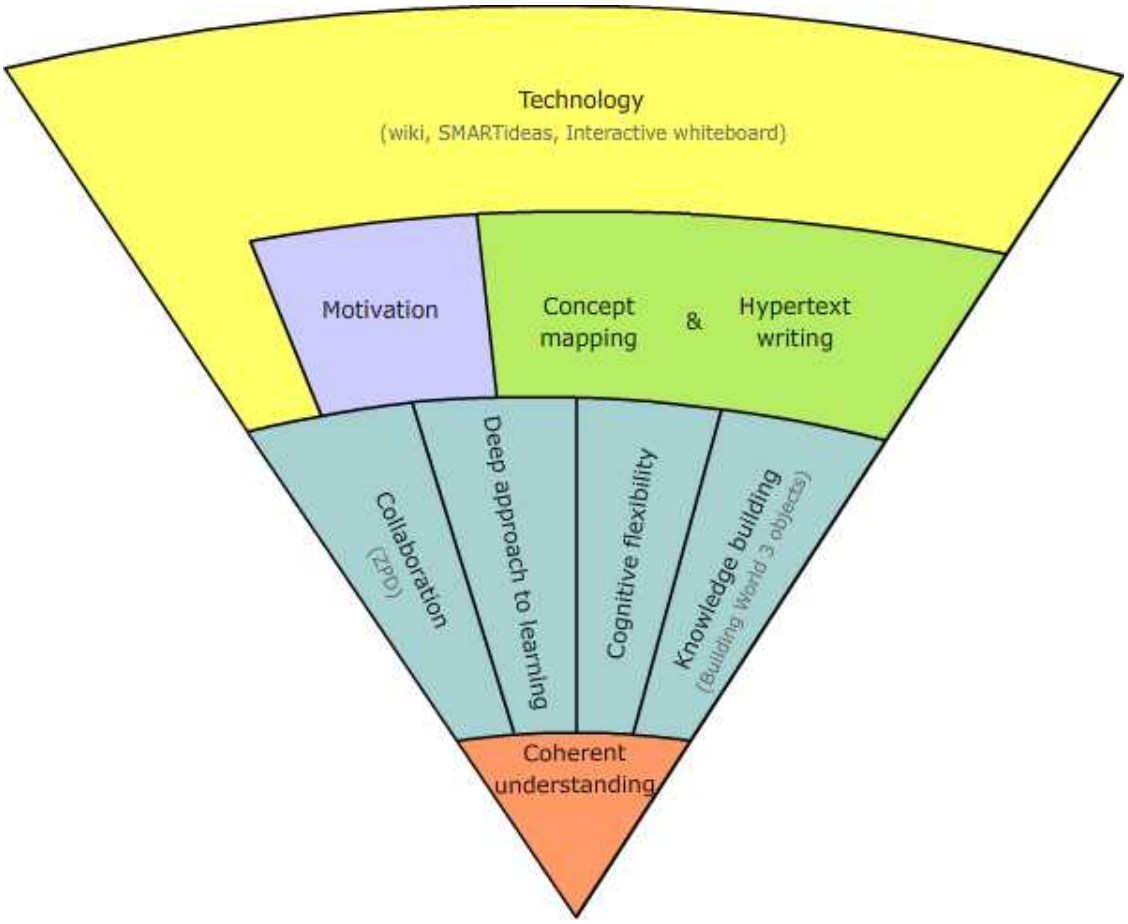
Jane Alexen Shuyska is a doctoral student at the Department of Education at the University of Oxford. She did her M.Sc. in E-learning in 2005-2006 and a M.Sc. in Educational Research Methodology in 2006-2007. She gained her undergraduate degree in Social Science at Roskilde University in Denmark in 2004.

Her main interest is in applying technology-based tools in secondary schools to promote valuable cognitive gains. She views technology as being a set of tools that can only gain meaning through intelligent application and is therefore working on designing sensible uses of technology suitable for classrooms. Her doctoral work is a continuation of her Masters projects, further exploring the use of computer based concept mapping and hypertext writing in wikis for promoting meaningful learning and understanding of highly complex material in A-level students. This study will have character of small scale design research with great emphasis on collaboration with practitioners and on designing uses for the tool that suit the teachers' needs.

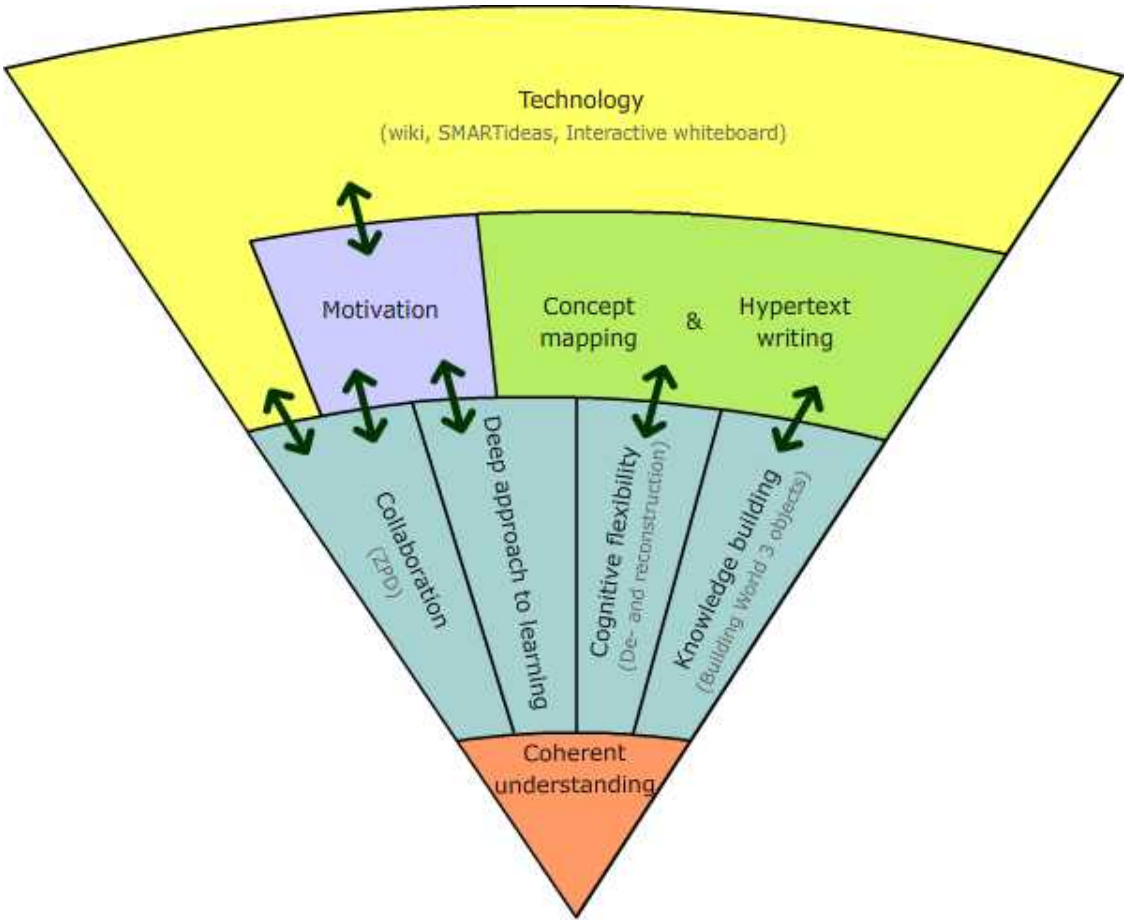
Separately from her studies Jane works on the JISC-funded "Thema" project (see http://wiki.oucs.ox.ac.uk/ltg-public/Thema), which investigates Masters students' use of ICT in the University of Oxford. Here she has a role of a part time research officer aiding with data collection, analysis and reporting. She is also a member of the MirandaNet Fellowship.

Correspondence: Jane Shuyska, jane.shuyska@edstud.ox.ac.uk

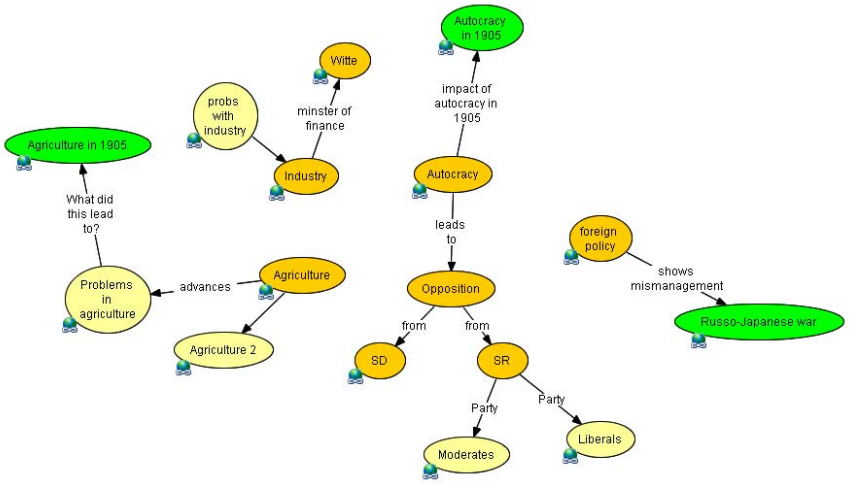
APPENDIX 1: THE 'CONE MODEL'



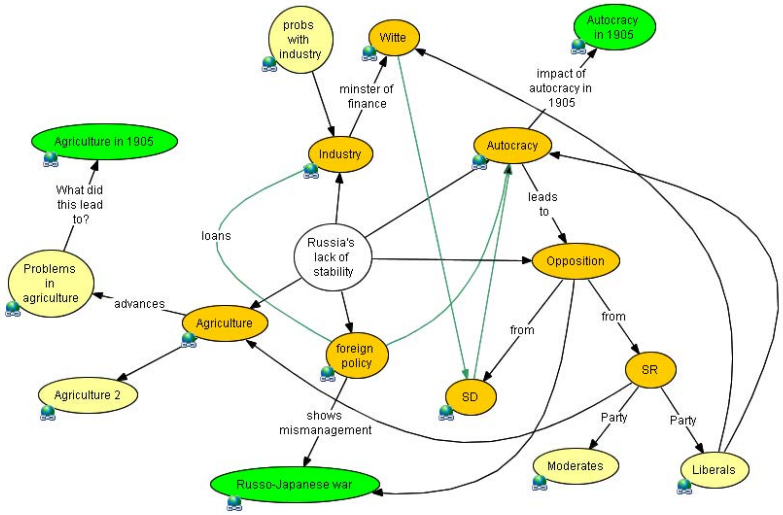
APPENDIX 2: ANALYSIS FRAMEWORK PROVIDED BY THE CONE MODEL



APPENDIX 3: CONCEPT MAP AFTER FIRST CLASS SESSION



APPENDIX 4: CONCEPT MAP AFTER PRESENTATION ROUND



APPENDIX 5: THE TEACHER'S CONCEPT MAP