BrainBank Learning – a Topic Maps E-portfolio system for Meaningful Learning

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Abstract
In this article we present BrainBank Learning, a web based learning tool for building of individual topic maps. The application is developed inspired by constructivist learning strategies, and has as a purpose to support so called meaningful learning and good learning strategies. We also want to present experiences from research and practice when it comes to use of BrainBank Learning. The learning tool is described as a way to build the user’s e-portfolio by linking external and produced learning resources to the learner’s knowledge map. The application is also discussed in relation to modern evaluation methods like evaluation of the learner’s e-portfolio. Finally, version 3.0 of BrainBank Learning is presented, included some new features, taking the application even further in the direction of being a modern toll for e-portfolio.

BrainBank: - a strategy for meaningful learning
BrainBank Learning (BBL) is a pedagogical tool for learning of terms and development of learning strategies, in a lifelong and life wide perspective. The tool is developed by Cerpus AS, over a three-year period with empirical testing. (Lavik and Nordeng, 2004, Nordeng et al., 2004, Lavik et al., 2004, Nordeng et al., 2005). The learners work in BBL via the Internet by using a standard web browser. Every learner has his own individual account in the application. Topics the learner meets in the teaching is entered and described in BBL. The topics are then connected, where the learner is invited to describe the associations between the topics. In this way, the learner constructs his own personal network of topics and associations, a topic map that represents the learner’s documented knowledge.

The purpose of documenting the learning process in this way is to stimulate a deeper understanding of the knowledge as well as the ability to use the knowledge map for navigation, and finally to reuse the knowledge structure later. By attaching images, text, video clips and sound clips to the topics in BBL, the learners can construct their own digital e-folios in a topic map structure. BBL was originally built in a constructivist pedagogical tradition (Wilson, 1996, Jonassen and Rohrer-Murphy, 1999) where David Ausubel’s theory about so called ‘meaningful learning’ has been one of the sources for inspiration (Mintzes et al., 2000, Ausubel, 1963). Furthermore, the tool is inspired by Joseph D. Novak and his colleagues’ ideas about knowledge building (Novak, 1990, Novak, 1991, Novak and Wandersee, 1991, Novak, 1977). Even if the application has some similarities with Novak’s “concept mapping” there are some clear differences. BBL is not merely hierarchical in its structure, but it can handle large and complex knowledge structures, again connected to digital contents. This gives the tool a future potential as a powerful e-portfolio tool.

BrainBank Learning is the first application that uses the Topic Maps (TM) standard (Biezunski et al., 1999) in a pedagogical context and focus on the following TM elements: topics, associations, occurrences.

The BrainBank project
Phase one of the BrainBank project was carried out at Alsvåg Primary and Secondary School, in March 2001 – June 2003. The research report from the project, written by Kristin Bjørndal (PLP, University of Tromsø) (Bjørndal and Knudsen, 2003), shows that BBL works as a motivator for the
learners that enjoy building the knowledge. From a pedagogical point of view, BBL seems particularly promising when it comes to learning strategies and adapted learning.

Pupil 1: “You become more aware of what you read when writing keywords. You pay more attention.”

Pupil 2: “I have to read more concentrated to be able to make keywords and see associations.”

BBL as an evaluation tool, experiences from practice

BrainBank Learning is currently being tested in three projects:

- In a project partly financed by Høykom (government funding program for building of broadband and development of digital content, [http://www.hoykom.no](http://www.hoykom.no)) BBL is tested in primary schools in the three Norwegian municipalities of Bø, Sortland and Øksnes.

- In the project “Transparent Learning”, financed by Cerpus AS, Nordland Fylkeskommune (County of Nordland) and Innovation Norway BBL is tested in three high schools in the county of Nordland.

- In a project partly financed by “Transparent Learning” ([http://www.fleksibel-laering.uio.no](http://www.fleksibel-laering.uio.no), Norwegian only) BBL has been tested in three master-preparing courses at the Institute for Molecular Biology at the University of Oslo.

Some follow-up research is now carried out on parts of this activity. While waiting on the results from the research we will now share some of the experiences from the classroom from these projects.

BBL for teaching

BrainBank Learning has been used with various didactical methods and in various methods of teaching. At most times, the learners (alone or in smaller groups) have created keywords (topics) into their brainbanks after a class, lecture, practical tests and in-group work. The learners have had to reflect on learnt material and hence gotten a repetition of it. The learners have, as a minimum needed fifteen to twenty minutes for this process. The learners have also worked with activities related to the learnt material. Instead of writing the answers on paper, the activities have resulted in topics in BBL.

Group work and project work has been important methods of work for the class, and the results from these processes have been taken into BrainBank Learning. Here, the pupils also have been able to discuss with other pupils to come up with “good” topics, which they in turn enter into BrainBank Learning. Another variant of this is that pupils have been working with a topic that they are presenting for the others. The pupils did this first, in groups, made some good associations between central topics. The results from the group work are then presented as a visualized topic map. This topic map was then used as a starting point for fruitful reflection and discussion.

The teacher did also publish central topics to the learners as a starting to point for further building of knowledge. The pupils did create their own description and created new associations for new or existing topics. This method has been experienced as some kind of problem solving and is highly motivating. From a teacher’s pedagogical point of view, this has also ensured that central topics have become a part of the learners’ knowledge domain. Sometimes, pupils have had as an extra task to search for and attach useful resources from the Internet to the topics. The teachers have also used the same approach and functionality to publish topics with important resources attached to the learners.

The project school has reorganized the school day, so that the pupils have had times to individual work with BBL through the week. The pupils have then been able to use the school’s computers, and this has given room for homework where the pupils specifically were to use BBL. The school has also reorganized the school day to give the pupils longer continuous periods to work at the time. The change to longer continuous work periods has had a positive effect for the work with BBL. Experience shows that 45 minutes often is too short a time to go through thorough process that BBL requires and stimulates.

BBL and formative evaluation

The teachers have used BBL to evaluate along the pupils learning process. This is done by regularly “taking a look” into the pupils brainbanks. Lacking or poor work will therefore be revealed quite early. Measures have then been implemented to help the pupils. In the opposite case, pupils with many relevant topics and good work have been given greater challenges and adapted activities to do.
Another interesting result is that the teachers experienced BBL and the pupils’ production there as feedback on their own ways of teaching. If there were many misunderstandings, or some important topics and associations have fallen out, the teacher could interpret this as a sign that his teachings didn’t quite hit the target as hoped, and that changes was needed.

The visualization feature in BBL was experienced especially fit to process evaluation. When doing group work, the groups were given a topic to find topics for, from the books lexica or the Internet. This was then used as the starting point for a group discussion where the group often ended up with a common knowledge structure. The group presented this to the rest of the class (by using the visualization functionality in BBL) about the topics and associations they had made. This was also a good starting point for a discussion about the subject in question, between the pupils, between the pupils and the teacher, between the group members, etc. In a more subject-like context, this stimulated to good discussions on the validity of the associations and in other occasions, missing associations. The teacher experienced this as a good learning process for all pupils in the class, and an excellent way of evaluating the pupils learning.

**BBL and summative evaluation:**

The teachers soon experienced that traditional tests for facts was too simple when the pupils were allowed to use BBL. Instead, there were done tests that were adapted to the use of BBL. In the simplest form, the teacher made tests containing central keywords (topics) and then the pupils had to make good descriptions. More advanced tests was made to encourage the pupils to describe associations as well. The tests were e.g. built around reflecting questions. Yet another method, was to set up central topics, and make the pupils associate between them. The pupils will then also have to make simple descriptions of the associations. Experience showed that these variants of tests and tasks effectively separated pupils understanding the learnt material from those merely able to reproduce pieces of it.

**BBL at the exams**

The first exams with BBL as a tool are planned in June 2005. The pupils will then be able to use BBL to prepare themselves and in the actual exams, as a practical way of displaying their knowledge. The teacher is planning to make questions from a main theme and six to seven sub themes, where the pupils shall choose three of the sub themes. The pupils will be told that at least one of the themes should be presented by using the visualization feature in BBL.

The pupils will present their topic maps (knowledge maps) with attached resources, and the conversation with the sensor will spring out of this. The pupils’ e-portfolio in a topic maps structure, and the presentation of it, will be the criteria for marking of the exams. In the evaluation and the marking is “Blooms knowledge taxonomy” used as a tool (Steine, 2001). This is because the teachers in the project found the same levels from this taxonomy in the pupils’ BBL production.

**Topic maps and portfolio assessment.**

**Portfolio as a method of assessment.**

http://www.pfi.uio.no/uniped/gpm/mapper.html

Portfolio assessment is a method inspired by Bakhtin, Vygotskij, Mead and Dewey, and is based on the theory that learning is a social activity and that social cooperation, dialogue and learning are closely connected. (Dysthe, 2001).

The method evaluates the learning process and the product of the work. The pupils/students pick out pieces of work that they want to be evaluated by, and collect those in a folder, either physical or
digital. The portfolio can content finished work, sketches, reflections, responses from teachers a.s.o. This makes it possible to document both the learning process and the knowledge that’s developed through the work. The dialogue is basic in the method. During the process, dialogues in-between pupils and between pupils and teachers are important. Knowledge develops through dialogue. Responses from teachers and co-learners give the learner possibilities to question and rethink their own understandings.

The portfolios are basically two different types:

- work portfolios
- presentation and assessment portfolios

Work portfolios are portfolios where everything connected to the specific work/task are collected (concerning a subject, topic, project a.o.). There can be several such portfolios.

Portfolios for assessment, exam or presentation are meant to express something about the process and the results of the work through a choice from the work portfolio. They are evaluated by a teacher or an external examiner and use specific criteria that are known for all parts. The products can be developed and improved until the final time for delivery. Process writing is a method that is closely connected with portfolio assessment. Many Norwegian teachers base the portfolio pedagogy upon the method of process writing.

The products can be of all formats; written text in different genres, pictures, film, sound a.s.o. It is the portfolio’s format that sets the limits of the content, but most, both physical and digital portfolios can actually contain a lot already. With an average PC most formats can be copied to a CD/DVD and kept in a folder of any kind. The portfolio can be used not only for the assessment of education, but also for instance in connection with job interviews, further studies, or as web-presentation.

What are the benefits from portfolio assessment?

According to Olga Dysthe (Dysthe, 2005) the most common arguments for using portfolio assessment are that the portfolio pedagogy will

- promote quality and continuity in the work of learning
- promote the pupil’s/student’s motivation for learning and knowledge of their own learning processes
- give a better basic of assessment than traditional exams
- emphasize the connection between issues, work effort, guidance, criteria, systems of assessment and knowledge acquirement

Portfolio assessment is a way of seeing different aspects of the knowledge development as a entirety. The portfolio will have possibilities to show how the learner “conquers” the subject field during the work process. In this lies also the possibility to discover connections across subjects and to develop a meta perspective on their own learning and knowledge (Dysthe, 2001).

Portfolio assessment is a method fit to present the process that leads to the finished product. It is in this process the constructions of knowledge develop. If it is possible to get pupils/students to reflect on connections during the work process, it will lead to a more conscious learning process. To see that you have produced something can be satisfying in itself. The portfolio assessment shows steps in the work process, and especially for pupils/students that need to see “quick results” the method can be strongly motivating. To many pupils/students who experienced defeats in school, the method can be an alternative of less risk of “loosing” because the process involves steps of trying and failing before the final result. Corrections can be made during the process, and the responses from teachers and co-workers assure the quality of the work. This reduces uncertainty and opens for new initiatives in the learning process.

Portfolio assessment are based upon the learners previous constructions of knowledge, and will always be possible to use for adapted and customized education which is a strong principle in all education in Norway. In the process of collecting products for the final assessment or exam, valuable reflections take place concerning curricular questions, what’s important to show, how to present an overall picture of the portfolio, a.s.o. This represent an important part of the scientific reflections and give room for reflections on one’s learning strategies and ways of socializing into a working cooperative (Dysthe, 2001). In educational processes there are close connections between working methods and systems of assessment. This concerns both students/pupils and teachers. The teachers need to see the choice of objectives, methods and sources of knowledge in connection with the question of assessment. The pupil/student will also look to the final assessment during the work
process and make choices according to that. If the grades depend on the ability to remember the textbook, the learner will probably work on remembering text. In the portfolio assessment method the learning process will be attached great importance as a part of the final assessment. This will make the students/pupils more conscious on their own learning strategies. (Limstrand and Rønningsbakk, 2003).

**Digital portfolios.**

There are many expectations related to working with digital portfolios. Even if it is the same methodology as physical portfolios, the digital format will have several benefits. The portfolios can content different file formats that make it possible to document the learning processes and final products in presentations of various expressions. We have a strong tradition of using the text media as the common expression in school, but are more and more aware that some learners express themselves better in other formats than written text and that school therefore should open for more use of other medias. (Pictures, films, animations, multi-media presentations)

Another and just as important aspect to digital portfolios is that they easily can be distributed. The traditional form of assessment usually takes place in one-to-one relations between teacher and student with limited insight from others. This gives room for dialogues and reflections, but only within a certain frame. The digital media makes it possible to share thoughts and understandings with anyone, and can give room for learning processes supported by many different dialogues and evaluations. It might be this aspect about ICT-supported learning that will show to be the most interesting in the future.

The communicative side of learning is important in the portfolio pedagogy. Through communication we have access to other people’s thoughts and ideas that “nourishes” our own understandings. The expression of learning consists of elements from the culture and the working community that during time appropriate in the individual (Säljö, 2001). Using ICT, the acquiring of knowledge gets a new dimension. We earlier had a limited access to information, but with the internet this access is enormous. Through available applications pupils and students get new tools that can compensate problems with handwriting, orthography, gramatics o.a, and the ICT offers great possibilities to use other presentation forms than text.

**BBL and digital portfolios.**

The BBL already has structures that can be used as digital portfolios. The principle of constructing knowledge as topic maps in BBL makes the pupil/student able to present reflected associations all from the beginning. This reflection about associations, which is an important part of the learning process, will be focused especially, and not just expected to appear during the process more or less coincidental. This aspect makes BBL a very promising tool. When pupils/students work with concepts and associations in the BBL, we can say that they also create “digital portfolios” in forms of advanced knowledge indexes. The different concepts can be linked to various sources of documentation of the knowledge and the learning process.

Every concept is connected in a structure of concepts that through associations and together with the resources can form a work portfolio related to a topic or a subject. The structure of the BBL makes it possible to define any concept as center of a concept map, which, including the connected structures can be presented as a digital portfolio. It will be possible to present portfolios for various subjects and topics, and also focus on the relations between subjects and topics.

The comment field is important in the BBL. It opens for the dialogue between student and teacher that the portfolio pedagogy is based upon. In the BBL the dialogue goes on about the topics and tasks during the work process. The dialogues will be stored in the BBL and can document the learning process. The teacher can also introduce a set of basic concepts related to a specific subject to all the students to assure that they get introduced to everyone. All in all, BBL offers a set of functions that generally give good support in the learning work and are fit for portfolio assessment. As the data stores in the open standard of Topic Map, the application secures a defensible storage of the individual's constructions of knowledge and an access to further usage of data in other situations of study or work.

The BBL ver 2 is promising but could improve as in a portfolio assessment perspective. In general the application need to be more user friendly to structure the associations between the conceptions, also in a more hierarchical structure. Further on one can imagine another complex presentation of a
problem with the BBL: The students that have collected larger amounts of data in their BrainBank ask for a filtering mechanism to reduce the complexity in the presentation of a topic map, to bring out the context in focus at the moment. As a long-term question one can wish interactivity between the visualization of the topic map and the conceptions list. The BBL should also develop functionality for cooperation between students/pupils. Concretely it could be very interesting to make the BBL support the collaboration in contracting common topic maps. The most pressing is anyway to develop functionality to pick out resources and pieces of work in a topic map structure for a specific presentation or assessment portfolio.

**BBL 3.0. – Topic Maps evaluation and positioning in the learning process**

BrainBank Learning 3.0 was released in August 2005 as an answered to some of the requests mentioned above. In this chapter we will present a selection of relevant improvement and addition of features and functionality.

**Topic types:** The users (teachers and pupils) are able to create and use topic types. This is to improve the possibilities of structuring the topic map.

**Perspective:** With perspectives the user can model the context for which association and resources are valid for a given topic. The example below shows that the topic Pythagoras has been put up with two different perspectives, philosophy and geometry. The context (perspective) will work as a filter for the associations and resources connected to Pythagoras.

Access control: With the next release of BBL, it will be possible for the users to control what a supervisor should have access to the look at in a users BrainBank.

**Conclusion**

BrainBank Learning is today an innovative and exciting pedagogical tool, supporting constructivist learning strategies through the learners building of personal knowledge maps, in the form of TM. The tool shows a great degree of use in learning situations in classes, and it has been developed in close cooperation with research institutions and practical testing.

The tool also supports digital portfolio (e-portfolio) through the possibility to link the external and internal learning resources to the learner’s knowledge index. The application is therefore also well
adapted to modern evaluation methods, as e.g. evaluation of the learners' e-portfolio. With the improvements in version 3, the learning tool BBL appears to be a modern e-portfolio tool with an international potential.

References

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