

Encouraging Students through Reflective Dialogues A Teaching Concept Based on DialogueMaps and its Evaluation

Marcel Morisse, Paul Drews, Detlef Rick, Arno Sagawe

Department of Informatics

Universität Hamburg

Vogt-Kölln-Str. 30, 22527 Hamburg, Germany

{morisse | drews | rick | sagawe}@informatik.uni-hamburg.de

Abstract—In computing and engineering courses, the students' personal experience in using technology can be embraced in order to encourage students and to enrich course contents. The own experience can be contrasted with theories, models and concepts from the course literature. In this paper, we describe the teaching concept of reflective dialogues. Reflective dialogues aim at fostering the students' involvement by using an interactive visualization and presentation tool called DialogueMaps. The concept has been applied in a master's program CSCW course. Steps for future development are derived from the results of the first multi-perspective and multi-method evaluations.

Keywords—reflective dialogue; teaching concept; DialogueMaps; reflection; individual experience; CSCW; CSCL

I. INTRODUCTION

In applied computing courses, there are numerous links to the students' practical experience and use of information and communication technology (ICT). With the advance of ICT, most students have already encountered a multitude of communication tools, social media, and all kinds of applications in school and everyday life. At university the use of ICT gets intensified and specialized. The students increasingly use ICT to coordinate their cooperation and communication with each other and with the faculty. Courses on topics in technology and society, human-computer interaction or computer-supported cooperative work (CSCW) give opportunities for including students' prior knowledge and practical experience in two different aspects. On the one hand technological innovations, such as interactive whiteboards, tablet computers, mobile devices, and innovative software concepts provide new possibilities for learning and teaching. On the other hand they are also related to course contents and can be evaluated in these courses.

In this article, we describe the teaching concept of 'reflective dialogues' with DialogueMaps [1]. The concept has been developed in order to integrate the students' prior knowledge into a CSCW course. The students should reflect their practical experience in the fields of 'congestion/interruption/multitasking,' 'social media' and 'dissolution of boundaries' considering the theoretical background from the literature on these topics. As a part of a seminar, 'reflective dialogues' are also considered as an alternative teaching concept to the traditional paper and presentation based seminar and thus to the students' selective examination of single topics. Furthermore DialogueMaps, an

interactive tool for supporting (face-to-face) dialogues which is being developed in our working group, should be used and evaluated during this seminar.

In the following, we first describe the three topics which are part of the course contents and which we have taken as a starting point for the reflective dialogues. Then we give a brief overview of the software DialogueMaps (DM) and its integration into the teaching concept. Subsequently, we present the teaching concept of reflective dialogues with DM. We include both the temporal structure and the use of the software. Then we describe the multi-perspective and multi-method evaluation approach and its results. After a discussion of the results, the paper concludes with a summary and an outlook.

II. TOPICS AS A STARTING POINT FOR REFLECTION

The teaching concept of reflective dialogues with DM has been developed for a master module called 'Computer-supported cooperation.' This module can be taken as a core elective in various master's programs like computer science and information systems. Main contents are fundamentals in the areas of computer-supported cooperative work (CSCW) and learning (CSCL) as well as its theoretical background and supporting ICT. In addition, the historical development of these topics and current research issues are discussed.

Three topics were selected as a starting point for the reflective dialogues, as we expected students to have first-hand experience in this field. These topics are closely related to the module's contents: first, the topics overload, interruption and multitasking as a coherent field; second, the use and impact of social media; and third, the dissolution of boundaries in space and time (e. g. between work and home, or between work and spare time). All three areas and their reflection are of great importance for the students' future working lives in organizations. Furthermore, they are being intensively discussed as social issues in the media. It is also assumed that there are linkages between the experiences of the teachers and those of the students. However, there are also differences that can be the subject of cultural encounter [2] between teachers and students in the reflective dialogues. In the following the three topics are briefly described.

The increasing availability of digital media among young people leads to an increased parallel use of media [3]. Besides the benefits this 'multitasking' can provide [4], many authors (e. g. [5]–[7]) also describe negative effects

(e. g. for filtering irrelevant stimuli and tasks [8]). The resulting disruption of activities (e. g. in cooperation-intensive projects) can lead to increased stress and congestion [9]. Working on this topic allows students to critically reflect multitasking, to detect congestion, and to develop strategies against problems which might arise from the parallel use of media.

Social media, such as wikis, social networks and microblogs, by now have established in both private and professional lives. For many young people, they are the primary pastime on the Internet [10]. Social media serve as communication platforms which can be used to easily create content and make it available to others. In addition to the potentials offered by social media, these also involve risks and dangers like unintended publication of data [11], [12]. Therefore the students should analyze and reflect their own use of social media and thus consciously realize potentials and risks.

The continuous development of ICT has led to more flexibility and consequently to the dissolution of boundaries. Fixed working hours and places are increasingly atypical; the affected people are in permanent readiness [13]. Students should reflect on the opportunities and threats posed by the dissolution of boundaries in their working live. They should develop their own stance to these phenomena.

III. DIALOGUEMAPS

The frequent use of Microsoft PowerPoint and other presentation software (PP) and the high proportion of teacher-centered lecturing in universities have been widely criticized. The students are forced into passivity by unilateral presentations and a lack of interaction. To overcome passivity and to encourage students, innovative teaching concepts supported by appropriate ICT are required. At the same time, smartphones, interactive whiteboards and new services like Google Maps or Prezi.com have radically changed user habits and expectations, and can be employed in learning and teaching contexts.

The web-based visualization and presentation tool DialogueMaps [1] which is being developed at the University of Hamburg, aims at supporting interactive (face-to-face) communication processes and student-centered instruction. Dialogue Maps (DM) is based on Flusser's theory of discourses and dialogues [14], Neurath's work on symbols and ISOTYPE [15], [16], the Mikropolis Model [17], [18], Knowledge Maps [19]–[21], Graphic Recording [22], [23], Issue Based Information System (IBIS) [24], [25] and DialogueMapping [26]. Moreover in the development of DM, concepts and findings from Computer-supported collaborative learning [27] were considered.

Following Neurath's ideas, DM allows for symbol-based visualization of complex issues. A moderating person can support a group during the collaboration and communication processes, while the ideas are captured in DM. In this way, participants and groups can interactively generate and present knowledge maps. Unlike in Graphic Recording, a professional illustrator is not required, because the appropriate visualizations can be selected from an extensive library

of symbols. The symbols are placed on a virtual canvas of any size. Like Google Maps the resulting knowledge maps can be panned and zoomed in and out. Each individual graphical object can store additional knowledge maps which can be accessed with a double click. Furthermore, the graphical icons can be augmented with additional information like links, videos or documents.

During the presentation, an overview of the whole knowledge map can be given as well as details of specific aspects. Moreover, contributions from the audience during presentation and discussion can interactively be added to the map.

DM is being developed in order to support interactive dialogues in three major contexts: teaching, consulting and interdisciplinary research. In all contexts, participants are interactively discussing different views on highly complex issues and need to record the results.

So far DM has essentially been used in university learning and teaching. We have already conducted two seminars supported by DM, and next semester it will be used in a lecture. During the seminars, the students have willingly tried new concepts of presentation and interaction while using DM. The presenters have spoken more freely, because they have had no chance to 'read slides.' Because of the non-linear presentation style and the possibility to include the participants' feedback directly into the presentation, the seminar has been more interactive. In the following, we describe the teaching concept of reflective dialogues with DialogueMaps.

IV. REFLECTIVE DIALOGUES WITH DIALOGUEMAPS

The teaching concept of reflective dialogues with DialogueMaps includes three core seminar sessions and the preparatory self-learning phases. Figure 1 gives an overview of the sequence of presence classes and self-learning phases. This concept is suitable for seminars in the last semesters of the bachelor's program or in the master's program, because students should have first experience in reading and interpreting scientific literature. As this concept requires three regular seminar sessions, other teaching methods can be used during the rest of the seminar.

The goal of reflective dialogues is to discuss and reflect the students' own first-hand experience and practical knowledge on a chosen topic in the light of selected scientific literature. Therefore, the selected papers should include a critical perspective to the topic to encourage discussions among the students. By searching for theoretical and practical papers, students should gather more information on their topic and then combine and reflect the findings with their own experiences. The results of this process are transferable for later access and other courses and can be seen as a personal knowledge ePortfolio [28], [29].

A. Preparatory Meeting

Before the reflective dialogue classes begin, a preparatory meeting is held. During this first meeting, the selected topics are being presented. Students select one of the topics and form groups of about four to ten people. Each group receives

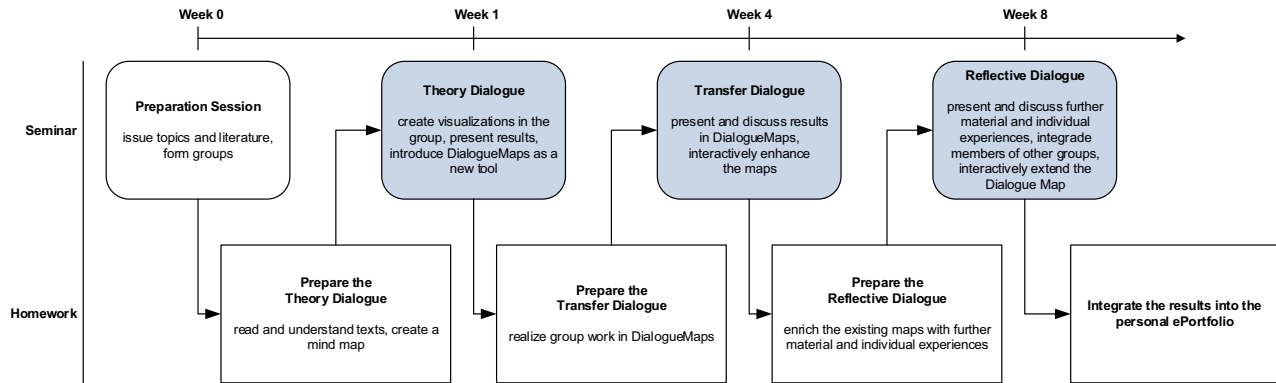


Figure 1. Phases in the teaching concept 'reflective dialogue'

one or two introductory papers specific on their topic to be read in preparation for the first seminar session. In order to structure the papers and link them to their topic, the students are urged to use mind maps [30]. This step is to ensure that the students understand the given literature and are able to compare different texts based on selective criteria. In addition to that, the mind maps support the students' ability to control and organize their self-study phase.

B. Theory Dialogue Session

At the first session, which we have called *theory dialogue*, students of each group come together, discuss concepts from the literature and the mind maps they have created, and visualize their topic collaboratively. Non-ICT tools such as paper cards, pens and metaplan are made available. After a first phase of 45 minutes, the groups are asked to give an overview of their work to the teachers and to prepare a short 5 minutes presentation for all seminar participants. At the end of the theory dialogue session, each group (at least two persons of each group) has to present the group's results. In this way, the teacher can ensure that the students understand the different topics and learn from each other. Specific requirements for structuring the topic during presentation are not made, due to the fact that the students have already structured their topics on the basis of their prepared mind maps. During the group work process, the students can reconsider their individual structure and find new forms of representation.

In the second phase of the theory dialogue session, DM is introduced by presenting a training video and a short demonstration. Then the students' assignment for the next weeks is presented: the pen-and-paper visualizations have to be transferred into DM. Furthermore, the literature basis of the chosen topic must be reevaluated and extended. Appropriate symbols and icons highlighting the topic have to be searched and selected. Also the possibilities of DM are to be used, starting from an overview map into several more detailed thematic sub maps.

While working on the assignment, each group has to organize their work process. The creation of the maps can

be done as a whole group, but a division of labor is also possible.

During the self-learning phases, the students can contact the teachers and ask for help with questions and problems. Since DM is in active development, the students are also invited to formulate wishes to the system and to report problems. The result of the second self-learning phase is a knowledge map in DM that can be presented in the following second session.

C. Transfer Dialogue Session

In the second seminar session, the *transfer dialogue*, the students present the knowledge maps they have created using DM. For each presentation, more time than in the first session (approx. 15 to 20 minutes) is given allowing an overview as well as a profound insight into the given subject and a transfer of knowledge between the groups. This is a necessary prerequisite to get a common discussion basis for all participants. The transfer also involves the integration of the preselected and additional literature in DM.

In this context, DM is used as a presentation tool (preferably on an interactive whiteboard), which does not necessarily have to follow a linear sequence like PP presentations. Rather, based on the possibility creating sub-maps, different viewpoints can be included and easily illustrated. Likewise, questions from the audience can be answered by flexible jumps to other places on the map. There is also the possibility to add interactive content that is contributed by the audience even during the presentation. However, the presentation is still largely based on scientific literature. Thus it is desirable that the students begin to include their own experience to their topics. Contributions can be assessments, reports, audio or video files that are linked to the topic.

This task needs to be done in the third self-study phase. Texts and multimedia content are to be searched and included in DM to enrich the knowledge maps. The result is a 'theme garden' of the covered concepts. In addition, students also reflect in their groups, whether and how they are affected by the given topic and include their own experiences

into the map. By using the previously prepared knowledge maps, their own experiences can easily be linked to different theoretical concepts.

D. Reflective Dialogue Session

In the third and last seminar session, named *reflective dialogue*, each group presents their extensions to the knowledge map introduced in the previous session to illustrate their own experience. Because of time limitations, the presenters have to focus on specific subjects which are highly relevant for them. The presentation of their own experiences positioned on the knowledge maps is also intended to include other participants into the discussion. The continuous linkage of personal experience to scientific concepts leads to informed and structured reflection. The interactivity of DM should be used and tested by the students. The participants of the course can contribute by sending links or multimedia content via chat or mobile devices. The moderator leading the discussion of each session should be a member of the specific group, while another member acts as a DialogueMaps modeler and adds the information sent to the knowledge map.

The final result of the three phases is a substantial knowledge map in DM enriched with underlying texts and multimedia content. Students can include a copy of their group's knowledge map into their own e-portfolio and adjust it or edit it for their individual purposes.

V. EVALUATION METHOD

To analyze and improve the teaching concept of 'reflective dialogues' and the use of DM in practice, we planned and conducted a qualitative multi-perspective and multi-method [31] evaluation. The evaluation comprises three perspectives: First, the students attending the seminar have been asked about how they experienced the reflection dialogue and about suggestions for future improvement. Second, the teachers have been asked, whether the concept turned out to reach the goals and which plans for improvement were derived from the students' feedback and their own experience. Third, a neutral observer who attended the seminar to write down what they have noticed during the three seminar sessions. To gather the data on these three perspectives, we have used different methods: The students' experience has been gathered by a combination of a questionnaire to receive an overview and semi-structured interviews to attain detailed qualitative feedback [32], [33]. The teachers' viewpoint can also be captured by a semi-structured interview. Observation protocols are a suitable way to capture the impressions during the seminar sessions.

Formative and summative evaluation data have been collected during and after the reflective dialogue. Two neutral observers attended the two first sessions; the last session was documented by one person. Five observation protocols were written. Several interviews have been conducted: One interview with each teacher (in total three) and two with students. All interviews have been recorded. In addition to that, the main aspects of all interviews were documented in protocols during the interviews. The survey turned out to be

not very helpful, as it covered the whole seminar and not only the reflective dialogue (3 out of 14 sessions). Thus the feedback provided by the students was rather general and not very useful for providing insights in how the concept can be improved. However, the interviews with the students and teachers delivered valuable hints for improvement. The results from the interviews can also be used to develop a more adequate questionnaire for the evaluation of future courses.

VI. EVALUATION RESULTS

In this chapter, we present the results of the evaluation we conducted. Regarding most aspects, the teachers' and the students' perspective were congruent. Therefore, we present the results in a combined manner and structured in three categories: First, we analyze whether the students were activated and the intended interaction and reflection took place. Second, the experience in using the tool DialogueMaps as a substantial part of the teaching concept needs to be reflected. As a third aspect, we take a look at the overall organization and the time frame.

A. Results: Activation, Interaction and Self-reflection

A major goal of the teaching concept of reflective dialogues was to increase the students' active participation. In comparison to a 'classical' seminar with talks on individual topics, this goal has been reached. The consecutive phases have been valued as helpful for structuring and reflecting the given topics. However, the topic of 'social media' has led to a markedly higher involvement of the students. In this area, the students seem to be more experienced. The other topics (multitasking, dissolution of boundaries) also lead to active discussions. But as most of the students have no or only little working experience, these problem areas are not as intensively linked to their own experience.

Overall, the integration of additional literature and material did not match the teachers' expectations. Students and teachers agreed that more time is needed to find appropriate material and adopt it to the maps. In addition to that, the students seemed to be unsure, how to search and categorize scientific and practical literature in a systematic approach.

The students were open to talk about and reflect on their own experiences regarding the topics discussed. However, it turned out to be difficult to integrate the experiences of other groups' members into the knowledge maps.

B. Results: Tool Support with DialogueMaps

The students reported that they perceived the opportunity to use DialogueMaps on the interactive whiteboard as an interesting alternative to traditional projector presentations. DM allowed them to express themselves more freely. The ability to zoom into the maps was understood as an innovative idea. The possibility to visualize and discuss complex issues at different levels was intensively used. Students indicate that the group's dialogue has been fostered by using DM.

Another advantage mentioned by students is the time- and location-independent access to DM. This enables working

collaboratively on knowledge maps independent from specific time frames.

However, the students regarded DM as immature. The user experience does not adequately support standard functions like copy and paste, grouping of map elements, and undo. They also missed tools to navigate in DM without interruption, similar to the presentation path in prezi.com. Furthermore, some functions are not yet stable. A significant technical problem occurred during the preparation of the theory dialogue. The integration of a single faulty SVG graphic into a map prevented DM from saving the complete map. After invoking the save process, the whole map was lost. This problem occurred in one of three groups. To conduct their presentation during the seminar, this group used PowerPoint in a way similar to the idea of DM. Instead of zooming and using sub-maps, this group created a graphical representation of their topic. The drill-down to a submap was simulated by switching to the next slide. This group also used a central starting graphic as a structure for their talk.

So far, export functionality in DM is not fully given. The integration of knowledge maps into an individual ePortfolio is also limited at the moment. The knowledge generated during the groups' work process is only accessible via the DM servers.

In order to use the tool, an explicit technical support for the students should be guaranteed.

C. Results: Organization and Time

Though the concept of reflective dialogues was perceived as an improvement compared to traditional seminar talks, a major area for improvement, mentioned by both teachers and students, is the total amount of time reserved for the reflective dialogue. The three sessions and the time in between were too short.

Several obstacles have been mentioned during the evaluation. First, the introduction and learning phase for DM was too short, so that students had difficulties to understand the concepts and features completely. Second, the students and teachers wished more time for searching and integrating additional literature and third, the individual group presentations took too long. Therefore, the integration of other groups to share their members' personal experience had to be shorter than intended.

VII. DISCUSSION AND FUTURE IMPROVEMENTS

The evaluation of the seminars shows that the concept of reflective dialogues in combination with DialogueMaps is a suitable way to foster interactivity and reflection of students' individual life in the light of concepts from the literature. In this section, we discuss the evaluation results and describe future improvements for the teaching concept as well as DM. A new version of DM is currently under development. The evaluated course will be repeated next semester with the new version of DM.

A. Discussion: Activation, Interaction and Self-reflection

The proposed concept of reflective dialogues has been developed as a structured approach to reflect on students' experiences in using IT. So far, this goal has been reached. As described, subjects with higher personal experience (like social media) were better accepted than other. Therefore, students should be asked in advance, which topics of relevance they want to reflect during the reflective dialogue.

Furthermore, the search and integration of additional material and literature have to be improved. Two improvements should be made. On the one hand, the search process has to be supported by the teachers (e. g. by presenting the process of a systematic literature review or illustrating the access to digital libraries) and on the other hand, more time for search and integration should be available.

Another extension of the concept presented here could address the transfer of the discussion back into the students' life. After reflecting the topics on an individual and group level, the students should be encouraged to develop strategies to handle problems that were identified. For example, the students can discuss strategies to limit the problems with multitasking and share ideas on how to create time slots which can be used to focus on a single issue.

B. Discussion: Tool Support with Dialogue Maps

This concept is facilitated by the interactive dialogue tool DialogueMaps. While reflective dialogues without ICT support is possible, the options of linking additional materials (especially multimedia content) with the knowledge map would be significantly limited. Especially, the inclusion of video and audio files would be lacking. In addition to that, DM supports the visualization of complex information by providing ready-made digital icons and symbols and the possibility of uploading tailor-made graphics easily. In contrast, in a paper-based group work, the development of appropriate symbols is limited by visualization skills.

As an alternative to DM, tools like prezi.com could also be used. Compared to prezi.com, the advantages of DM are its open source basis and the possibility to customize the tool to specific needs (e. g. by including new symbols and icons). Moreover, the creation of sub-maps is possible allowing a better structuring of the maps' content. On the other hand DM is currently under development and has not reached a comparable functionality and stability as prezi.com. However, DM is not designed primarily as a presentation tool and is capable of easy adjustments of maps during presentations, as there is no need to switch between presentation and modification mode. Thus DM has the potential to support interactive teaching approaches better than prezi.com.

Due to the availability of the source code¹, restrictions and problems occurring during the practical use of DM can be resolved by improving the tool. This offers potential for additional courses or theses, which focus on the development of the tool. Based on the evaluation results and students' recommendation, we have started the next iteration of development in the context of a project course, which will be

¹A development version of DM can be downloaded from sourceforge.net.

completed in January 2013. The new version of the tool will support easier collaboration, a more stable saving function as well as features like copy and paste, and rotating of elements. In addition to that, technical support for DM will be offered by the teachers during the courses.

C. Discussion: Organization and Time

The structure of the teaching concept includes both presence classes and self-learning phases along the theory dialogue, the transfer dialogue and the reflective dialogue. This structure turned out to address important stages of reflection. However, it could be improved in consideration of reflection taxonomies from literature [34], [35]. Moreover, according to the evaluation, the phases should be conducted within a greater time frame.

More time is needed to get used to DM. Ideally, an entire seminar session should be reserved for learning the tool. Good examples of maps should be demonstrated by the teachers. Furthermore, the introduction of the tool should also address the intended change in the way the presentations are given. Students need to learn, how to activate other students to share their knowledge and experience within a group.

The time for searching and integrating additional literature was also too short. During the preparation of the theory dialogue, the students need to learn how to use the new tool, and to gather further content for enriching their map. These two tasks should be separated or the time between both seminar sessions should be extended to more than a week.

The last session was intended to present the group members' personal experience, but also to foster the integration of experience from the other participants. While some personal experiences were shared, the time was too short for a significant cross-group discussion. Each group should have a single session to present their personal experience and to integrate and reflect on the individual experience of other students.

VIII. CONCLUSION AND OUTLOOK

In this paper, we have presented a teaching concept to promote students' reflection on their use of IT. In three consecutive dialogues sessions, the students develop a knowledge map containing principles and concepts based on scientific literature. The students enrich their maps with additional practical and personal content and experiences. In a third step, the maps are presented and further experiences from other groups can be included. From our point of view, this teaching concept can be used in a multitude of courses, in which students have to present a specific topic or reflect their actions in relation to the subject of the course. In our specific example, we have used and evaluated the concept in a master module for CSCW. Other subjects like computer science in society or human-computer interaction are also conceivable. In these areas, the students can use their individual knowledge and suitable scientific literature to support the reflective dialogue.

We have evaluated our proposed teaching concept of reflective dialogues using interviews and observations. The results indicate that students appreciate their active involvement during teaching sessions and emphasize the potential of DM. Due to the nonlinear structuring of information in knowledge maps, students may have to change their PP-based presentation style. A few students switched back to more familiar tools (like PP), but tried to rebuild the intended way of using DM in their presentations. Additionally, students missed lacking standard features familiar from other tools as well as a support for the orientation on maps.

We use the evaluation results to derive consequences for the teaching concept and the developed tool. These consequences will inform future development iterations for both reflective dialogues and DialogueMaps.

REFERENCES

- [1] P. Drews, A. Sagawe, E. Kaya, and A. Rolf, "Dialoguemaps: A web-based tool for supporting interactive dialogues in education, research, and consulting," in *15th International Conference on Interactive Collaborative Learning (ICL '12)*. IEEE, 2012.
- [2] Y. Ben-David Kolikant, "Fertile zones of cultural encounter in computer science education," *Journal of the Learning Sciences*, vol. 17, no. 1, pp. 1–32, 2008.
- [3] U. G. Foehr, "Media multitasking among american youth: Prevalence, predictors and pairings," The Henry J. Kaiser Family Foundation, Menlo Park, CA, USA, report #7592, Dec. 2006.
- [4] J. M. Hudson, J. Christensen, W. A. Kellogg, and T. Erickson, "'I'd be overwhelmed, but it's just one more thing to do': Availability and interruption in research management," in *Proceedings of the SIGCHI Conference on Human Factors in Computing Systems (CHI '02)*. New York, NY, USA: ACM, 2002, pp. 97–104.
- [5] D. C. McFarlane, "Interruption of people in human-computer interaction: A general unifying definition of human interruption and taxonomy," Naval Research Laboratory, Washington, DC, USA, formal report NRL/FR/5510–97-9870, 1997.
- [6] —. (1998) Interruption of people in human-computer interaction. Dissertation. George Washington University, School of Engineering and Applied Science. Washington, DC, USA. Last accessed 27/01/2013. [Online]. Available: <http://interruptions.net/literature/McFarlane-Dissertation-98.pdf>
- [7] H. Yuzawa and G. Mark, "The japanese garden: task awareness for collaborative multitasking," in *Proceedings of the 16th ACM international conference on Supporting group work (GROUP '10)*. New York, NY, USA: ACM, 2010, pp. 253–262.
- [8] E. Ophir, C. Nass, and A. D. Wagner, "Cognitive control in media multitaskers," *Proceedings of the National Academy of Sciences of the United States of America (PNAS)*, vol. 106, no. 37, pp. 15 583–15 587, 2009.
- [9] G. Mark, D. Gudith, and U. Klocke, "The cost of interrupted work: more speed and stress," in *Proceedings of the SIGCHI Conference on Human Factors in Computing Systems (CHI '08)*. New York, NY, USA: ACM, 2008, pp. 107–110.
- [10] The Nielsen Company. (2010, Jun.) Social networks/blogs now account for one in every four and a half minutes online. Blog entry on Nielsenwire. Last accessed 27/01/2013. [Online]. Available: <http://blog.nielsen.com/nielsenwire/global/social-media-accounts-for-22-percent-of-time-online/>
- [11] P. A. Kirschner and A. C. Karpinski, "Facebook® and academic performance," *Computers in Human Behavior*, vol. 26, no. 6, pp. 1237–1245, 2010.

- [12] E. Christofides, A. Muise, and S. Desmarais, "Risky disclosures on facebook : The effect of having a bad experience on online behavior," *Journal of Adolescent Research*, vol. 27, no. 6, pp. 714–731, 2012.
- [13] K. A. Geißler, *Alles. Gleichzeitig. Und zwar sofort. Unsere Suche nach dem pausenlosen Glück*, 3rd ed. Freiburg i. B., Germany: Herder, 2005, in German.
- [14] V. Flusser, *Kommunikologie*. Frankfurt a. M., Germany: Fischer, 1998, in German.
- [15] O. Neurath, *International Picture Language : The First Rules of ISOTYPE*. London: Kegan Paul, 1936.
- [16] E. Lupton, "Reading Isotype," *Design Issues*, vol. 3, no. 2, pp. 47–58, 1986.
- [17] A. Rolf, *Mikropolis 2010 : Menschen, Computer, Internet in der globalen Gesellschaft*. Marburg: Metropolis-Verlag, 2008, in German.
- [18] J.-H. Wahoff, J. Porto de Albuquerque, and A. Rolf, "The mikropolis model: A framework for transdisciplinary research of information systems in society," in *Information Systems Theory*, Y. K. Dwivedi, M. R. Wade, and S. L. Schneberger, Eds. New York: Springer, 2012, pp. 367–386.
- [19] M. J. Eppler, "Making knowledge visible through intranet knowledge maps: concepts, elements, cases," in *Proceedings of the 34th Annual Hawaii International Conference on System Sciences (HICSS 2001)*. IEEE, 2001.
- [20] J. Armani, L. Botturi, and A. Rocci, "Maps as learning tools: the Swissling solution," in *Proceedings of the 4th International Conference on New Educational Environments (ICNEE 02)*. Bern, Switzerland: net4net, 2002.
- [21] J. Maisch, *Wissensmanagement am Gymnasium : Anforderungen der Wissensgesellschaft*. Wiesbaden, Germany: VS Verlag für Sozialwissenschaften, 2006, in German.
- [22] H. E. Hoff and L. A. Geddes, "The beginnings of graphic recording," *Isis*, vol. 53, no. 3, pp. 287–324, Sep. 1962.
- [23] H. Scholz and M. Haussmann, "Lernlandkarte Nr. 4 – visual facilitating," *Folded map*. Rotkreuz, Switzerland: Neuland, 2008.
- [24] J. Conklin and M. L. Begeman, "gIBIS: A tool for all reasons," *Journal of the American Society for Information Science*, vol. 40, no. 3, pp. 200–213, May 1989.
- [25] V. A. Brown, J. A. Harris, and J. Y. Russel, Eds., *Tackling wicked problems through the transdisciplinary imagination*. London: Earthscan, 2010.
- [26] J. Conklin, *Dialogue Mapping: Building Shared Understanding of Wicked Problems*. Chichester: Wiley, 2006.
- [27] T. Koschmann, Ed., *CSCL: Theory and Practice of an Emerging Paradigm*. Mahwah, NJ, USA: Lawrence Erlbaum, 1996.
- [28] C. McCowan, W. Harper, and K. Hauville, "Student e-portfolio: The successful implementation of an e-portfolio across a major australian university," *Australian Journal of Career Development*, vol. 14, no. 2, pp. 40–51, 2005.
- [29] D. Challis, "Towards the mature eportfolio: Some implications for higher education," *Canadian Journal of Learning and Technology*, vol. 31, no. 3, 2005. [Online]. Available: <http://cjlt.csj.ualberta.ca/index.php/cjlt/article/view/93/87>
- [30] M. J. Eppler, "A comparison between concept maps, mind maps, conceptual diagrams, and visual metaphors as complementary tools for knowledge construction and sharing," *Information Visualization*, vol. 5, no. 3, pp. 202–210, 2006.
- [31] D. Snape and L. Spencer, "The foundations of qualitative research," in *Qualitative Research Practice: A Guide for Social Science Students and Researchers*, J. Ritchie and J. Lewis, Eds. London: Sage, 2003, pp. 1–23.
- [32] N. King and C. Horrocks, *Interviews in Qualitative Research*. London: Sage, 2010.
- [33] J. Saldaña, *Fundamentals of Qualitative Research*. New York: Oxford, 2011.
- [34] N. Hatton and D. Smith, "Reflection in teacher education: Towards definition and implementation," *Teaching and Teacher Education*, vol. 11, no. 1, pp. 33–49, 1995.
- [35] R. McDermott, M. Daniels, Å. Cajander, T. Clear, and C. Laxer, "Student reflections on collaborative technology in a globally distributed student project," in *42nd ASEE/IEEE Frontiers in Education Conference (FIE'12)*, 2012, pp. 365–370, last accessed 28/01/2013. [Online]. Available: <http://www.fie2012.org/>