E-Collaborative Knowledge Construction:
Learning from Computer-Supported and Virtual Environments

Bernhard Ertl
Universität der Bundeswehr München, Germany

Information Science REFERENCE

INFORMATION SCIENCE REFERENCE

Hershey · New York

Director of Editorial Content: Kristin Klinger
Director of Book Publications: Julia Mosemann
Development Editor: Beth Ardner
Publishing Assistant: Kurt Smith
Typesetter: Callie Klinger
Quality control: Jamie Snavely
Cover Design: Lisa Tosheff
Printed at: Yurchak Printing Inc.

Published in the United States of America by
Information Science Reference (an imprint of IGI Global)
701 E. Chocolate Avenue
Hershey PA 17033
Tel: 717-533-8845
Fax: 717-533-8661
E-mail: cust@igi-global.com
Web site: http://www.igi-global.com/reference

Library of Congress Cataloging-in-Publication Data

E-collaborative knowledge construction : learning from computer-supported and virtual environments / Bernhard Ertl, editor.
p. cm.
Includes bibliographical references and index.
Summary: "This book presents best practice environments to implement e-collaborative knowledge construction, providing psychological and technical background information about issues present in such scenarios and presents methods to improve online learning environments"--Provided by publisher.
ISBN 978-1-61520-729-9 (hardcover) -- ISBN 978-1-61520-730-5 (ebook) 1. Education--Computer network resources. 2. Web-based instruction--Design. 3. Computer-assisted instruction I. Ertl, Bernhard, 1973-
LB1044.87.E1183 2010
371.33'44678--dc22
2009042991

British Cataloguing in Publication Data
A Cataloguing in Publication record for this book is available from the British Library.

Preface

The focus on knowledge has shifted during the last decades. Nowadays, lifelong learning and the ability to work with knowledge belong to the key skills of our society. This is reflected by authors using terms like *knowledge society* (e.g., Nonaka, 1994) or *knowledge age* (e.g., Bereiter, 2002). The quantity of information, which is generated and also accessible due to the new information and communication technologies, requires new strategies of information processing and exchange. It requires the individual as well as the society to keep their knowledge up to date, which results in a continuous process of knowledge generation (see Nonaka, 1994). In this way, it is not more enough to acquire knowledge and rely on it—learners find themselves in a permanent process of knowledge construction and rebuilding. Consequently, also learning scenarios have changed. Teaching cannot be seen anymore from the perspective of a teacher who is passing his or her knowledge to students and also learning cannot be seen any more as memorizing things presented by a teacher (see Ertl, Winkler & Mandl, 2007). Such kinds of learning would rather result in inert knowledge—knowledge which is reproducible for tests but not applicable by the learners (see Renkl, Mandl & Gruber, 1996).

COLLABORATIVE KNOWLEDGE CONSTRUCTION

According to constructivist approaches, learners have to construct their knowledge *actively* to create applicable knowledge. Thus, active knowledge construction in collaborative scenarios is provided by approaches like *cognitive apprenticeship* (Collins, Brown & Newman, 1989) or *situated learning* (Lave & Wenger, 1991). Fischer, Bruhn, Gräsel, and Mandl (2002) describe four important processes for collaborative knowledge construction: Learners' *externalization* and *elicitation* of knowledge, their *conflict-oriented negotiation* and their *consensus-oriented integration*. Externalization and elicitation relate to the exchange of knowledge in which the learning partners present their knowledge and query mutually for resolving deficits. These processes are complemented by conflict-oriented negotiation and consensus-oriented integration, which describe that learning partners have to negotiate about different viewpoints and integrate them to construct a shared knowledge base for collaboration. The development of this shared knowledge base can be a goal collaborative knowledge construction as well as the fundament for further collaborative activities, for example in learning communities. In sum, collaborative knowledge construction is attributed with many benefits for learners (see e.g., Ertl, Fischer & Mandl, 2006; Lou, Abrami & d'Apollonia, 2001; Roschelle & Teasley, 1995).

AFFORDANCES FOR E-COLLABORATIVE KNOWLEDGE CONSTRUCTION

Collaborative knowledge construction requires *collaboration* in a style in which collaboration partners interact frequently with *content-specific* activities and also commitment of the collaboration partners. It means that they work together at the same (virtual) place to construct one joint product or mental artifact (see Bereiter, 2002). Such collaboration does not necessarily have to happen synchronously—however, the collaboration partners' timing and their commitment have to be solid enough for the processes of collaborative knowledge construction to take place (see Ertl, 2008). The e-collaborative setting relies furthermore on the computer, which features collaboration partners' communication (e.g., by the provision of newsgroups, chats, Wikis, instant messaging tools or audio-visual communication). Communication (and collaboration) tools enable different scenarios for e-collaborative knowledge construction, for example virtual communities of practice, virtual learning communities, situated learning environments, cased-based learning, and virtual seminars. However, providing communication and collaboration facilities itself is not enough for e-collaborative knowledge construction (ECKC) to happen. Besides this, there is at least a shared motivation necessary and some aspects of instructional design (see Kirschner, Sweller & Clark, 2006). This can be introduced by the shared screen, which sets up the virtual collaboration space (e.g., the context and introducing pages of a learning environment or virtual community or by a shared application). In the last case, learners can see the moves of their collaboration partners simultaneously (see Dillenbourg & Traum, 2006; Ertl et al., 2006).

Environments for e-collaborative knowledge construction can be improved further by dedicated support for collaboration partners. Several methods offer such support, such as visualization aids (e.g., Mayer, 1994), structures for collaboration (e.g., Fischer, Kollar, Mandl & Haake, 2007) and tutoring (e.g., Pata, Sarapuu & Lehtinen, 2005). One challenge for designing support methods is to provide as much support as necessary for learners, but without overextending their capacity by too complex tools or inappropriate simplifications. Therefore, it is important to learn about the knowledge, skills, and needs of collaboration partners to provide appropriate support (see Dobson, 1999).

STRUCTURE OF THE BOOK

This book comprises four sections which take up important aspects of e-collaborative knowledge construction. It starts with environments that give an impression about scenarios of e-collaborative knowledge construction. The second section focuses typical approaches in the context of ECKC and discusses the issue of analysing and evaluating processes and outcomes of environments for ECKC. This is followed by the third section which deals with particular mechanisms to facilitate learners' processes and outcomes in ECKC. The book concludes with broader perspectives which set ECKC back in a school and an organizational context. In the following, the sections and chapters are described in more detail. Furthermore, the contents described can be complemented by technical perspectives and good practice examples, which appeared in Ertl (2010), *Technologies and Practices for Constructing Knowledge in Online Environments: Advancements in Learning*.

Environments for E-Collaborative Knowledge Construction

The book starts with a section about environments to illustrate scenarios in the context of e-collaborative knowledge construction. Chapters of this section give an impression of what is meant by e-collaborative

knowledge construction and show implementations. They focus on different goals ranging from empowering learners with 21st century skills to setting up a sustainable learning community. Thereby, authors give insights into issues that came up during planning, implementing and running these environments and provide lessons learned. The chapters discuss good practices for the design, the implementation and the application of environments for e-collaborative knowledge construction.

Clark, Sampson, Stegmann, Marttunen, Kollar, Janssen, Weinberger, Menekse, Erkens, and *Laurinen* show how working in e-collaborative environments can facilitate learners to develop *21st century skills*. By using this term, they refer to the concepts of adaptability, complex communication skills, non-routine problem-solving skills, self-management/self-development, and systems thinking. The chapter describes four different environments for e-collaborative knowledge construction, namely WISE Seeded Discussions, CASSIS, VCRI, and DREW and analyzes to which extent each environment supports the development of these skills.

Bettoni takes a community approach to e-collaborative knowledge construction. He describes how to apply the principle of communities of practice to the design and implementation of a community of research. His chapter gives insights into the design and implementation process of a community and into the activities which occurred within this community. By that, the author derives good practices and suggestions for the design, implementation and maintenance of communities.

Oehl and *Pfister* focus on applying chat for e-collaborative knowledge construction. Besides the pure chat communication, the authors also provide a shared application for enabling knowledge construction. They discuss shortcomings of chat-based scenarios and present the approach of learning protocols to facilitate it. These learning protocols provide collaboration partners means for referencing chat contributions and to classify them according to their intention. The chapter discusses which particular aspects can be facilitated by learning protocols and provides aspects which should be considered when setting up scenarios with chat communication.

Approaches in the Context of E-Collaborative Knowledge Construction

E-collaborative knowledge construction can be seen from different approaches, such as distributed cognitive processing, conceptual change, help-seeking, and expertise development. Each of them has a particular focus to build environments for the collaboration partners. All of them refer to cognitive processes and interactions that are taking place during e-collaborative knowledge construction and the assessment of its outcomes and they illustrate the process character of e-collaborative knowledge construction. This section will elaborate these approaches and their impact for e-collaborative knowledge construction.

The chapter by *Tscholl* and *Dowell* focuses on distributed cognitive processing and describes an approach for studying processes of e-collaborative knowledge construction. It illustrates this approach by examples from discourse analysis and presents evidence for a significant overlap between critical argumentation and knowledge construction. The authors provide a refined definition of co-construction that comprises of an interrelation between interaction and co-construction. The chapter concludes with implications on the analysis and evaluation of knowledge co-construction in different environments.

Harteis elaborates how e-collaborative knowledge construction is related with the development of professional expertise. He distinguishes different types of knowledge and shows how they develop individually and during collaboration. The chapter describes how information and communication technologies can facilitate these knowledge construction processes, including a discussion about challenges for e-collaborative knowledge construction.

Schworm and *Heckner* focus on the concept of help seeking that relates to an asymmetric knowledge distribution setting. Starting from the issue of interactions in academic help seeking they summarize general aspects of collaboration in settings with asymmetric expertise. They shift their attention to peculiarities of computer-based help seeking in human-human interactions as well as in human-computer scenarios. Thereby, they identify typical weaknesses of current help systems and show how far social Web can have an impact for the design of future help systems.

Liu and *Hmelo-Silver* elaborate scientific conceptual change during collaborative knowledge construction in their chapter. They present a model for collaborative scientific conceptual change (CSCC) and describe a study that was analyzed according to this model. Their analyses identified several processes of e-collaborative knowledge construction which are related to the outcomes of the collaborative setting. This enabled them to exemplify how conceptual change takes place during collaboration.

Sluijsmans and Stribos focus on the outcomes of e-collaborative knowledge construction, which is often some kind of group product that was created jointly by all members of the group. Research has shown that there are often differences in the individual contributions of each group member to the group outcome, which could result in inequalities and injustice for assessment. Sluijsmans and Strijbos focus on peer-assessment to overcome this issue. Peer-assessment facilitates instructors to evaluate the individuals' contributions to a group's outcome according to mutual estimations of the learning partners. The authors present different methods for peer-assessment and discuss their advantages and disadvantages.

Support Measures

The different settings and technologies are the key to understand how e-collaborative knowledge construction takes place and offers a starting point for the design of environments for e-collaborative knowledge construction as well as for the support of collaboration partners in these environments. Support approaches focus on instructional interventions which are applied during the process of e-collaborative knowledge construction. They help learners to work more effectively on their knowledge construction. Chapters in this section focus on particular mechanisms of the described support method (scripting, trainings, and tutoring) in the context of an environment for ECKC. They allow readers to transfer the presented support methods to other environments to provide further facilitation there.

Diziol and *Rummel* present a descriptive framework that provides dimensions for the support of collaborative e-learning. This framework allows classifying different types of support for e-collaborative knowledge construction by focussing important dimensions for support: the level of support, the domain, the mode, the timing, and the adaptivity. They exemplify their framework by the description of an adaptive domain-related assistance for a cognitive tutor algebra.

Häkkinen, Arvaja, Hämäläinen, and *Pöysa* focus on the particular support method of scripting in the context of a collaborative Web-based university course. They highlight the issue of different styles of script support, present a review of theoretical and empirical analyses and provide results of a design-based study which implemented three different styles of scripting. Based on this, they are able to present main applications for scripting and introduce the approach of flexible pedagogical scripts.

Pächter, Kreisler, and *Maier* raise the issue of how far processes and results of e-collaborative knowledge construction in videoconferencing settings may differ from face to face. They provide evidence by the presentation of an empirical study which shows that results do not differ significantly even if there are differences in the processes. Based on these results, the authors present a study about support by trainings for facilitating collaboration in videoconferencing which enable collaboration partners to reach better collaborative outcomes.

Kopp, Germ, and *Mandl* focus on the method of tutoring for providing support for e-collaborative knowledge construction. They elaborate the issue that tutors need more than just content-specific skills if they want to set beneficial conditions for learning. They further analyze which particular skills are necessary for a tutor to facilitate learning processes in e-collaborative scenarios. Their contribution is substantiated by the description of two virtual courses, one course which dealt with e-tutoring as subject matter and another course in which these tutoring strategies were applied.

Outlook

The outlook section puts e-collaborative knowledge construction in a broader context and discusses critically educational and organisational perspectives. Chapters in this section describe possible developments of e-collaborative knowledge construction in the future and driving and hindering forces.

Stevens provides in his chapter an educational perspective on the future development of e-collaborative knowledge construction. He focuses on the issue of rural education, which is characterized by small school sizes and often also by a decreasing number of students per school. Based on the exemplary situation of Newfoundland, he shows how e-collaborative knowledge construction can be applied in a school setting and how it can help schools, particularly in rural areas, to maintain their educational mission although to their small student numbers.

Moreland, Swanenburg, Flagg, and *Fetterman* take an organisational perspective on e-collaborative knowledge construction. They deal with the issue of transactive memory, which describes meta-knowledge about the skills of collaboration partners. They show prerequisites for the development of transactive memory and raise the issue, how far e-collaboration can support the development of transactive memory. Their conclusions show an ambivalent view on the role of technology for supporting e-collaborative knowledge construction.

CONCLUSION

E-collaborative knowledge construction describes an interactive process of collaborative knowledge work for the collaboration partners. The approaches and environments described in this book are therefore not restricted to the pure exchange of knowledge—learners also have the opportunity to negotiate on a collaborative knowledge base. Even if environments are very different with respect to their aims and contents, all of them facilitated these intense collaboration processes by their instructional design which was added to or included in the technical features. Technical development can promote chances for e-collaborative knowledge construction (see therefore the already mentioned book of Ertl, 2010: *Technologies and Practices for Constructing Knowledge in Online Environments: Advancements in Learning*). The increasing use of Web 2.0 technologies will be a motor for enabling intense collaboration due to their interactivity and support smooth processes of ECKC. Yet, the most interactive technology doesn't implicate processes of e-collaborative knowledge construction per se—there is always the need to contextualize the technology for example, by group rules for virtual communities or by the instructional design for learning environments (see Kirschner, Sweller & Clark, 2006).

E-collaborative knowledge construction may have links to face to face collaboration but may also be completely virtually. Currently there is just little research about interpersonal knowledge in virtual settings, which can provide motivation and prerequisite for successful processes and outcomes. There-

fore, future research should also analyze the influence and contribution of social networking systems like facebook to e-collaborative knowledge construction.

Bernhard Ertl
Universität der Bundeswehr München, Germany

REFERENCES

Bereiter, C. (2002). *Education and mind in the knowledge age*. Mahwah, NJ: Erlbaum.

Collins, A., Brown, J.S., & Newman, S. (1989). Cognitive apprenticeship: Teaching the crafts of reading, writing, and mathematics. In L. B. Resnick (Ed.), *Knowing, learning, and instruction: Essays in honor of Robert Glaser.* Hillsdale, NJ: Erlbaum.

Dillenbourg, P., & Traum, D. (2006). Sharing solutions: persistence and grounding in multimodal collaborative problem solving. *Journal of the Learning Sciences, 15*(1), 121-151.

Dobson, M. (1999). Information enforcement and learning with interactive graphical systems. *Learning and Instruction, 9*(4), 365-390.

Ertl, B. (2008). E-collaborative knowledge construction. In N. Kock (Ed.), *Encyclopedia of E-Collaboration* (pp. 233-239). Hershey, PA: Information Science Reference.

Ertl, B. (Ed.). (2010). *Technologies and Practices for Constructing Knowledge in Online Environments: Advancements in Learning.* Hershey, PA: Information Science Reference.

Ertl, B., Fischer, F., & Mandl, H. (2006) Conceptual and socio-cognitive support for collaborative learning in videoconferencing environments. *Computers & Education, 47*(3)**,** 298-315.

Ertl, B., Winkler, K., & Mandl, H. (2007). E-learning - Trends and future development. In F. M. M. Neto & F. V. Brasileiro (Eds.), *Advances in Computer-Supported Learning* (pp. 122-144). Hershey, PA: Information Science Publishing.

Fischer, F., Bruhn, J., Gräsel, C., & Mandl, H. (2002). Fostering collaborative knowledge construction with visualization tools. *Learning and Instruction, 12*, 213-232.

Fischer, F., Kollar, I., Mandl, H., & Haake, J. M. (Eds.). (2007). *Scripting computer-supported communication of knowledge - Cognitive, computational, and educational perspectives*. Berlin, Germany: Springer.

Kirschner, P. A., Sweller, J., & Clark, R. E. (2006). Why minimal guidance during instruction does not work: an analysis of the failure of constructivist, discovery, problem-based, experiential, and inquiry-based teaching. *Educational Psychologist, 41*(2), 75-86.

Lave, J., & Wenger, E. (1991). *Situated learning: Legitimate peripheral participation*. New York: Cambridge University Press.

Lou, Y., Abrami, P. C., & d'Apollonia, S. (2001). Small group and individual learning with technology: A meta-analysis. *Review of Educational Research, 71*(3), 449-521.

Mayer, R. E. (1994). Visual Aids to Knowledge Construction: Building mental representations from pictures and words. In W. K. Schnotz & R.W. Kulhavy (Eds.), *Comprehension of Graphics* (pp. 125-138). Amsterdam: North Holland.

Nonaka, I. (1994). A Dynamic Theory of Organizational Knowledge Creation. *Organization Science, 5*(1), 14-37.

Pata, K., Sarapuu, T., & Lehtinen, E. (2005) Tutor scaffolding styles of dilemma solving in network-based role-play. *Learning and Instruction, 15***,** 571-587.

Renkl, A., Mandl, H., & Gruber, H. (1996). Inert knowledge: Analyses and remedies. *Educational Psychologist, 31*(2), 115-121.

Roschelle, J., & Teasley, S. D. (1995). The construction of shared knowledge in collaborative problem solving. In C. O'Malley (Ed.), *Computer Supported Collaborative Learning* (pp. 69-97). Berlin, Germany: Springer.