

Cross-linking and Multivalent Use of Knowledge Modules for Special Target and User Groups

Janek Götze, *janek.goetze@fh-zwickau.de*

West Saxon University of Zwickau, Dr.-Friedrichs-Ring 2a, 08056 Zwickau,
Germany

Christian-Andreas Schumann, *christian.schumann@fh-zwickau.de*

West Saxon University of Zwickau

Claudia Tittmann, *claudia.tittmann@fh-zwickau.de*

West Saxon University of Zwickau

Thomas Kudraß, *kudrass@imn.htwk-leipzig.de*

Leipzig University of Applied Sciences, Karl-Liebknecht-Str. 132, 04277 Leipzig,
Germany

Thomas Wiedemann, *wiedem@informatik.htw-dresden.de*

Dresden University of Applied Sciences, Friedrich-List-Platz 1, 01069 Dresden,
Germany

Abstract

Modern education systems require that content tailored to the particular learning situation, the level of knowledge of the learner and the means of communication available and provided. A three-dimensional model for the content classification is the basis for a particular approach. The content is divided into modules, which are prepared with attributes for classification and stored. Therefore, a pilot solution is designed and implemented used to edit the modules. It supports the need-based and target-group-oriented content delivery for special subjects both the learners and the lecturers. The developed concepts and models facilitate the targeted access to complex content, because they are automatically generated in a prepared form. The approach makes the extraction, the handling, the management, the maintenance, and the usage of complex content significantly more efficient. The main ideas, the development of the general concept, the detailed models as well as the prototype by a R&D team from several universities in the framework of a public project is described in the paper. The sustainability of the project results will be guaranteed by a user network as well as national expert group accompanying the development and further application.

Keywords

cross-linking use of knowledge, multivalent use of knowledge, content for special target groups, content structuring, target-group-oriented learning

INTRODUCTION

The development in the education sector is characterised by continuously increasing individualization concerning target groups and demand-orientation, and

thus by the diversification of the offerings. At the first sight similar topics require different levels of education, sophisticated didactical, methodological and pedagogical concepts as well as technologically determined delivery channels, and specialized contents in various forms. A representation in three dimensions should allow the following statement: Which contents with which difficulty level (1st dimension) in a corresponding imparting methodology (2nd dimension) are to be provided by defined media and distribution channels (3rd dimension). This means that target-group and demand specific contents must be separated and provided as knowledge modules from a basic population of a body of knowledge of a specific subject. Thus, the electronic transfer of knowledge with the aid of digital contents and in the framework of educational portals will be possible and easier. Numerous digital and printed documents were developed by a variety of projects and development activities for creating content for education and training reflecting the knowledge of certain subjects and topics. Henceforth, a complex collection of knowledge for a specific subject could be arranged on the basis of existing documents having great relevance and scope in an interdisciplinary environment. It takes the form of a knowledge base built with a wiki as access interface and development functionality. After creating the knowledge base, exactly the part of the content should be separable by corresponding transformations and filtering living up to expectations the demand level of the target group, the intended final certification, and the available quantity of time.

Following, it is to be decided by reference to the didactical and methodological concept in what form the content is to be prepared in order to guarantee the highest possible learning experience and success. Derived from the methodological and didactic approach and the needs of the target group, it will be possible to define, which media channels and shapes are suitable and technically feasible. The presentation of the content must be adapted to the technical solution in the classical, electronic or mobile learning system. Special subjects with related contents, documents, and knowledge modules characterised by a high degree of reuse are to be favoured for the first approach in order to be able to provide a complex solution with a high efficiency. The results will be tested and evaluated in the framework of education and training programs. They will be transferable to various use cases and application scenarios. The knowledge modules will be combinable and useable for different target groups and learning situation due to the individual existing knowledge level and the learning resources. The access will be administrated and organised by special web portals.

DISCUSSION

Issue and Approach

Educational offers and markets are characterised by an increasing diversification. The reason is the increasing demand for job-related training or individualized education, respectively. This tendency is reinforced by the exponentially growing volume and by the dynamics of the changes of the available knowledge. In the competition of the various educational providers to provide attractive and target-oriented offers in markets with a high demand, it is important to use the new resources multivalent and the already available resources even more efficiently. The growing complexity in the area of new kinds of education and training as well new forms of learning is to be controlled and to be used for new solutions. A constantly recurrent task is the provision of the knowledge basis as well as their transformation in terms of individual training needs. The development of content as explicitly available knowledge is still in the main focus. In recent decades, numerous projects for content development have been successfully completed. Basically, despite some problems with updating the content, it can be stated that there are quite successful business and process models that make it possible to adapt the existing content always to the current state of the art.

There is a large base of content for different scientific areas, which are designed for partially very different target groups, and which serve widely differing levels of education on this way. Knowledge, information and data pools or bases were created for storing and cataloguing the developed content in standardized manner, and to make it easy accessible. Thus, the potential re-user will be able to access on an orderly basic set of content, to compare the existing opportunities with its requirements, and to use appropriate digital contents for its purposes. This happens naturally as dictated by the source protection and by the compliance of the copyright and exploitation rights. Usually, this procedure involves no comparison of different digital documents in the analogous art on the same subject except the contents were collaborative or coordinated developed in a common project or cooperation networks. Meanwhile, there are procedures to conduct similarity investigations between documents of different origins. This is one opportunity to locate related content and perform optionally an integration of existing documents.

The second option is to conduct a comprehensive knowledge discovery for a specialist topic and to generate needs-based the required subset for a specific application situation as an extract of the documented knowledge. This approach was developed and tested in a prototype project with the help of a case study. A collection of documents as a knowledge base is compiled as a basis for investigations of existing contents of a specific subject supplemented and completed purposefully that the topic is substantially attributed in relation to highest achievable maximum degree or level of knowledge. The total population will be contentual and structural put into a pool of knowledge that could base on a semantic network. The demanded special knowledge can be provided for different applications in a suitable representation by a multidimensional transformation. This opens up the possibility to design a knowledge base, depending on the situation, and to generate knowledge in a suitable form provided digitally for different usage scenarios.

Objectives and Effects

The project is characterized by the following main objectives having significant economic and strategic implications for universities:

- Determining, composing and complementing of the existing knowledge base concerning the special subject, of the highest possible degree of graduation, of the applications and usage scenarios through participating partners from the universities and consultants;
- Model development, discussion and improvement of the network of experts in particular by defining the dimensions of the transformation as well as the derivation of the transformation steps, including the development of competitiveness clusters for the process of the participating organizations;
- Specification of selected applications, generating the necessary knowledge support in the form of digital media and experimental application of the method in selected lectures and courses;
- Development of a concept for the provision of additional uses and applications in the various institutions and cooperation in the network and the provision a prototype completed on a learning platform for multipliers.

In particular, the main objectives are diversified into sub goals. They contain detailed information for defining and describing the main objectives and form the basis for the succeeding design of the work packages.

The first objective is compiling and supplementing of the knowledge base for the selected subjects. The basis is created to provide the extracts from the knowledge base for specific applications and usage scenarios based on a diversified, demand-actuated, and acquired knowledge level. The expertise is acquired by the participating partners, and a Knowledge Map for the subject will be created. Then it is processed, stored and added in a well-structured knowledge pool. The processes for further maintenance, updating and expanding of the body of knowledge can be de-

defined and will be supported functional. The result is a semantic network which is a systematic configuration of the contents on which all parties involved as well as all those interested can access after finishing the development. An easy access is provided by use of a wiki.

The second objective as model development, discussion and improvement for transformation to the target audience generation of excerpts from the total body of knowledge for the special subject helps to create the prerequisites that only the knowledge is transferred to the application case required for the specific usage. A selection from the existing pool of knowledge will be realised due to the characteristics of defined dimensions.

- The first dimension involves the targeted selection of contents regarding the difference between the existing and to-reach level of knowledge with respect to the desired degree of graduation.
- The second dimension comprises the refining and processing of the now confined present knowledge regarding the amount of methodological and didactic concept, depending on the desired learning and teaching form.
- The third dimension is used to transform the selected and prepared content in one or more presentation styles to meet the particular requirements of the chosen delivery channels. The use of different technological-oriented delivery channels in stationary or mobile form as stationary PCs, notebooks, tablet PCs and smartphone is of central importance. (Fig. 1)

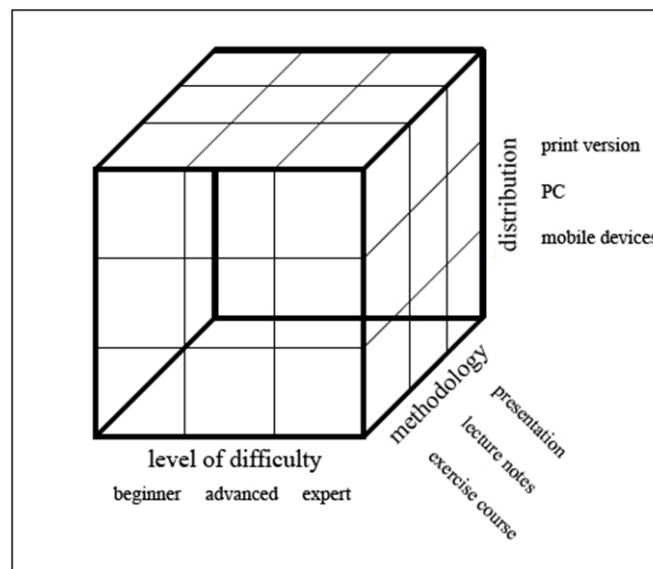


Figure 1: Cube-shaped model for the classification of the content

The third objective, selection of appropriate applications and experimental use of the edited content in defined lectures and training courses, the experiences are gained in the use of the model applied directly for the improvement of the model. An initial evaluation is concomitantly performed. This means that participants involved in the test will support the evaluation by short protocols of the processes of the content use and by answering specific questionnaires. Additional, an electronic assessment is carried out.

The fourth objective is the development of additional applications and use cases, and the dissemination of the knowledge gained through a learning platform. The reuse and sustainability of the project will be made possible. Interested partners and institutions can access via the platform to the project results as well as discuss and contribute their own experiences. The project results will be distributed by multiplayers using different kinds of channels. Thus, the methodology will be proved and developed. The process of improving the quality and quantity of the solution is docu-

mented on the platform. An open discussion in an expert network will give clues to solve the puzzle.

The development should have strategic and economic effects for the developers as well as the interested parties focussing the following aspects:

- Once recorded content is to be structured and stored. It will be provided as subject modules in many different ways for different applications and use cases in order to reduce the effort for knowledge acquisition.
- It is possible to react flexible and fast to different target groups and demand requirements by using the knowledge pool in order to increase the attractiveness and market conformity of appropriate educational offers.
- By multiple application of already acquired and stored knowledge, a more individual knowledge representation can be achieved, which is used to develop new applications, making efficient use of resources in order to be able to diversify the educational offers by the included institutions in a cost-efficient and resource-saving way and to offer the contents extended target groups.
- The stakeholder cooperation is promoted by the integration of existing knowledge to the subject in a pool of knowledge and the use of both individual institutions and in collaboration networks in order to support more sustainable and resource-efficient education and training in general.

The strategic and economic effects of the project will occur immediately upon the involved institutions. By using the multiplier function of the educational portals and platforms, other educational institutions will benefit.

Concept and Realisation

The first approach is realised within a framework project of three developing partners from the universities of applied sciences from Dresden, Leipzig and Zwickau accompanied by the professional support of specialists of the University for Telecommunication Leipzig as well as an German advisory body of renowned personalities. It was focused on the development of the general concept and of a first rough prototype for evaluating the theoretical and planned design. The project was structured as multiphase approach including four work packages:

- *Collection and completion of a defined knowledge base* (Compilation and analysis of existing knowledge, especially in digital form to the specialist subject; Supplementation of the existing knowledge in the sense of completion related to a maximum aspired knowledge level; Preparing, structuring and storing of knowledge in a specific knowledge base, including the creation of a Wiki)
- *Development of the model for the knowledge transformation* (Development of the model and in particular of the necessary transformation steps based on defined dimensions for the target group-specific provision of knowledge in line with demand; Discussion of the model and in particular on scientific soundness, feasibility and application capability; Improvement of the model by following the hints of the advisory board as well as by initial evaluation with potential users)
- *Selection of prototypical application fields and pilot use* (Application of the model in the context of selected elementary and advanced courses offered by HEIs; Accompanying evaluation of the application with the involvement of all stakeholders; Analysis of the evaluation and accompanying fine-tuning of the model)
- *Opening up of further areas of application and dissemination of results* (Setting up a multiplication platform; Implementation of a multiplier workshops and preparation for further training opportunities for interested parties; Transfer of the advisory body in a subsequent re-use group).

The development partners discussed and adapted the working packages in the framework of the project progression. Especially, the issue of the development by using existing software systems was characterised by problems in particular with the automated document transfer within an integrated system landscape, the knowledge representation of individual elements of a knowledge base in a semantic network, and the limitation of the output opportunities of the content especially in the case of mobile devices such as smartphones. The decision was to develop an own prototype fulfilling all requirements of an complex and integrated solution for cross-linking and multivalent use of knowledge modules for special target and application groups. The result was a modified model of the project progression. (Figure 2)

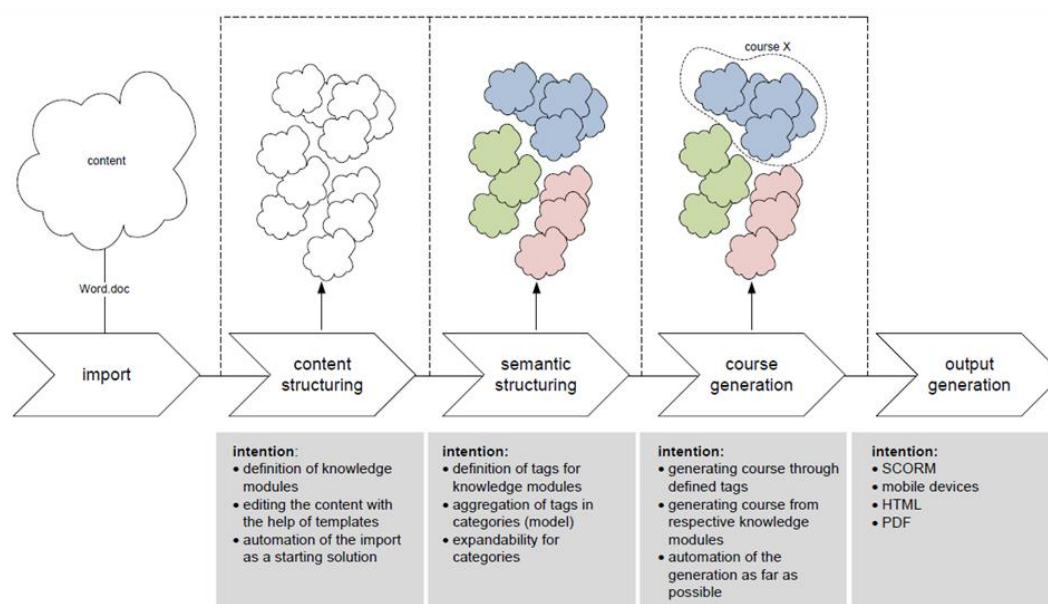


Figure 2: Modified project schedule, content, and work packages

At first a target-group-specific model for generating extracts from the total knowledge base was created. Based on the three stages of transformation a cube-shaped model has been developed which will illustrate the definition of the three dimensions: degree of knowledge, kind of methodology, and form of presentation. The knowledge inventory of a defined subject was edited and completed by semantic categorisation of the level of difficulty. The content was decomposed into sets of knowledge elements and stored in a SQL data base using the opportunity to fractionise the content into separate objects. The next step was to test the alternative solution by applying the XML-format for describing the content in a structured manner. The knowledge components provided by the facilities of MySQL knowledge base and based on the transformation levels have been structured in the next step in order to create the basis for a diversified, demand-oriented provision of extracts from the knowledge base for specific applications and usage scenarios. (Figure 3).

Subsequently, demand-actuated subsets of the knowledge base can be presented in the desired output format using a configurator, filtering out exactly the desired sub-cubes from the model of the transformation level. For this purpose, a website has been created, which allows selecting the requested category defined by the three dimensions. On the basis of this selection, the corresponding proportion of the knowledge base will be presented in the desired form. The output capability of the knowledge s part of the development of this prototype has been implemented as a web page both for stationary and mobile devices as well as different output formats.

Due to the division of responsibility, the HEI developer group have been practised a differentiation of labour within the context of achieving the objectives and results of the R&D task in particular concerning the prearrangement and the development of

the prototype. The rapid prototype was created in order to be able to model and illustrate all required main functions of the future solution. The individual tasks solved by the partners were:

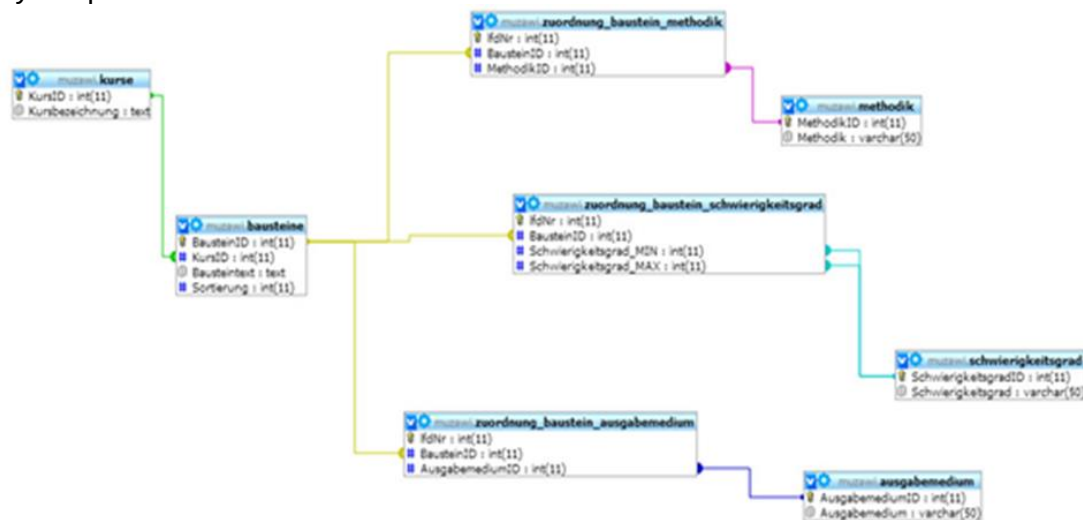


Figure 3: Architecture model for the data base

- Development of a model for structuring and characterising the content modules
- Realisation of a prototype for the fractionation of a given learning content (lecture notes) into small content modules on the basis of a document by the applied web editor
- Storage of content objects in a related SQL database
- Producing a course consisting of a schedule of arranged content objects on the basis of metadata description of the content modules
- Development of a document transfer with regard to selected document formats
- Input and preparation of content due to the dimensions including the processing of the content modules and tagging of the metadata for the objects as part of the prototype
- Presentation of the course as web content for the learners providing different levels of difficulties, methodological approaches, and output streams.

The main parts of the prototype were developed, tested and evaluated. The practicality and feasibility of the developed concepts and solution models has been demonstrated in principle in a case study.

Application and Sustainability

The project is designed for an extensive use of existing knowledge in the form of available content and reuse of the project results. It aims to improve the use and dissemination of knowledge of existing competencies in various application scenarios such as classroom instruction, blended learning, self-studies, e-learning and m-learning potentially on learning platforms and portals. The approach will significantly contribute to the development of the platforms for the purpose of widespread application. All results are presented in a way that they can be adopted by potential re-users and developed by them. This innovation is based on the development of synergies in the transfer of knowledge through networking, integration and individualization of educational processes using the platforms of the HEIs. The results of each work package promote the sustainability of the project and can be re-used separately. The analysis, decision-making, and implementation processes were documented and updated during the project period. Their analysis points to new ways of creating competence cells for multivalent use of existing knowledge through a variety of distribution channels in the context of e-learning and m-learning in higher education

and can be used as means for strategic and tactical decisions in the further development of e-education and e-learning.

The participants will benefit directly from the knowledge acquisition, the existing knowledge pool for the subject including demand and target group-oriented transformation and opportunities for networking. The knowledge transfer is promoted sustainable because the new competence cells and the experts group help to dismantle information barriers, make processes more transparent, and improve the access to existing knowledge and skills. The new network is open to the entry of new users. They form the nucleus for further networking between specialists on the one hand as well as the professionals and the students on the other hand. The clear definition and naming of competence cells in universities ease the development of the existing potentials and its targeted expansion. The project results will be tutoring and coaching made directly accessible to the stakeholders and the interested individuals.

In the future, the sustainability in the application is ensured not only by storing the knowledge on a semantic network in well-structured knowledge base, but also by a Wiki supporting the permanent updating and expanding of the content of the knowledge base. The transformation opportunities in the dimensions of the substantial level of education, the didactic methods of adaptation and technologically related modification based on the selected distribution channels are being developed as a methodology, documented and made available for use. The re-users will be able to apply the various edited content and use them as needed event specific for target groups. A complex set of knowledge on special subjects can be resource-conserving and efficiently adapted to highly individualised applications and used wisely in different kinds of excerpts.

CONCLUSION

Cross-linking and multivalent use of knowledge modules for special target and user groups were developed as a model-based concept. The practicability and the feasibility of the model-driven approach are demonstrated by developing and using a first rapid prototype. The functionality of the prototype should be developed and integrated into existing software systems for enabling the developers to structure and manage different user requirements on the basis of a common knowledge base of selected subjects with regard to particular learning situations and arrangements. At the end, the learners will be able to get the right extracts of knowledge and adapted information sets individually due to several dimensions characterised by the level of knowledge, the methodology, and the kind of learning.

REFERENCES

- Rutsch, A., Schumann, C.-A., Tittmann, C. (2010). *The Epistemological-based Change in Educational Theory and Practice*. In: The 1st International Theorising Education Conference. The laboratory for educational theory at The Stirling Institute of Education. University of Stirling, Paper No. 039. 6 pp. CD-Proceedings.
- Rühling, S., Schumann, Chr.-A., Simon, M., Tittmann, S., Weißflog, S. (2010). *Typology and Illustration of Generic Competencies in a Hybrid Learning Environment*. EDEN 2010 Annual Conference. Valencia. European Distance and E-Learning Network. Budapest. 7. (ISBN 978-963-06-9429-2)
- Schumann, Chr.-A., Nöske, C., Tittmann, C., Weber, J., (2006). *Methodology and Technology - Knowledge Based Approach for E-Learning in the Future Networks of Distance Education*. Proceedings of the GUIDE 2006. Università Telematica Guglielmo Marconi. Rom.
http://www.guideassociation.org/about/web_Guide.htm.
- Schumann, Chr.-A., Tittmann, C., Weber, J., Nöske, C., (2006). *Effectiveness of Individual Competence Development by Using Networks of Granulated Con-*

- tents. In: Szücs, A., Bo, I., *E-Competences for Life, Employment and Innovation*. Proceedings of the EDEN 2006 Annual Conference. Wien. 63-69.
- Schumann, Chr.-A., Tittmann, C., Weber, J., Didszun, M., (2006). *User-related Content Preparation for Different Kinds of Content Distribution and Application*. In: Grabe, D., Zimmermann, L., Proceedings of the Multimedia Applications in Education Conference. Mapec 2006. Graz. 193-200.
- Schumann, Chr.-A., Tittmann, C., (2007). *Impact of Information Literacy on Academic Knowledge Transfer: Information Literacy and its Role in Learning Process*. International Seminar. University of Jyväskylä. 6.-7. February, 2007.
- Schumann, Chr.-A., Tittmann, C., Weber, J., (2007). *Multi-level Modelling for Faculty Educational Program Development in Global Networks*. Association for Global Universities in Distance Education: Online Proceedings of the Thematic Workshop European Area. Tischner European University. Krakow.
<http://www.guideassociation.org/about/customContent.aspx?param=AbstractEuropa2007>.
- Schumann, Chr.-A., Tittmann, C., Weber, J., (2007). *Challenges of the Market-Driven Modelling by Content Engineering in the Content Lifecycle*. In: Szücs, A., Bo, I., New Learning 2.0 - Strategy, Foresight and Policy in ICTs and Learning Systems. Proceedings of the EDEN 2007 Annual Conference. Naples. 21.
- Schumann, Chr.-A., Tittmann, C., (2007). *Multilevel Cross-Linking and Offering of Organisational Knowledge*. In: Martins, B., Remenyi, D.: Proceedings of the 8th European Conference on Knowledge Management (Volume Two). Barcelona. Reading: Academic Conferences. 878-883. (ISBN: 978-905305-52-0)
- Schumann, Chr.-A., Tittmann, C., Weber, J., (2007). *An Approach for Embedding Developing and Learning Processes in the Virtual (3D) World*. In: Abbott, C., Lustigová, Z.: Information Technologies for Education and Training. ITET 2007 Proceedings of the IFIP Joint Working Conference. Prague: ETIC Prague. 140-153. (ISBN 978-80-254-0391-4)
- Schumann, Chr.-A., Tittmann, C., Tittmann, S., Weber, J.: *Multilevel Approach for Last-Mile-Solutions supported by e-Education Competence Cluster*. 1st International Conference on Technology Supported Learning & Training. ONLINE EDUCATION MOSCOW. 2007.
- Schumann, Chr.-A. Tittmann, S., (2008). *Last-Mile-Lösung durch e-Education-Kompetenzcluster für den sächsischen Wissenstransfer und Bildungsexport*. In: Helmstädter, H.G. und Umbach, W.-R. (2008). Tagungsband: Wirtschaftsnah Qualifizierung durch Fernstudium und Weiterbildung. Schriftenreihe zu Fernstudium und Weiterbildung. Band 3. Service-Agentur des HDL. Brandenburg. 45-57.
- Schumann, Chr.-A. Tittmann, C., (2008). *Agile and Intelligent Networks for Information Literacy by Knowledge Sharing*. In: Harorimana, D. Watkins, D. Proceedings of the 9th European Conference on Knowledge Management. Academic Publishing. Reading. 797-806. (ISBN 978-1-906638-10-8)
- Schumann, Chr.-A., Tittmann, C., Tittmann, S.N., (2008). *Merger of Knowledge Network and Users Support for Lifelong Learning Services*. In: Learning to Live in the Knowledge Society. Proceedings of the 20th World Computer Congress. Milano.
- Schumann, Chr.-A., Tittmann, S., Granow, R., (2009). *Knowledge Transfer in the Field of New Teaching and Studying Forms under Reference of Research Activities at Zwickau University*. In: Tait, A., Szücs, A, Innovation in Learning Communities. EDEN 2009 Annual Conference Gdansk. Book of Abstracts and Electronic Proceedings. European Distance and E-Learning Network Budapest. 39. (ISBN 978-963-87914-2-9)
- Schmucker, D., Schumann, Chr.-A., Tittmann, C., Tittmann, S. (2009). *Model-driven Mobile Expansion of Knowledge Flows in Educational Networks*. In: Lifelong Learning Programme. European Thematic Network: Teaching, Research, and

- Innovation in Computing Education. International Conference on e-Learning and the Knowledge Society. e-Learning'09. Berlin. 175-181.
- Schumann, C.-A. and Tittmann, C. (2009). *Structures and regularities of knowledge flows*. In: Bolisani, E. Scarso E., Proceedings of the 10th European Conference on Knowledge Management Padua. Academic Publishing Limited. Reading. 765-775. (ISBN 978-1-906638-39-9)
- Schumann, Chr.-A., Tittmann, S., Rühling, S., Weißflog, S. (2011). *Sustainability and Efficiency in Creating Educational Services and Additional Programs*. In: Paulsen, M.F., Szücs, A. Learning and Sustainability. *The New Ecosystem of Innovation and Knowledge*. EDEN 2011 Annual Conference Dublin. European Distance and E-Learning Network. Budapest. 68. (ISBN 978-963-87914-5-0)
- Schumann, Chr.-A., Gerischer, H., Feng, X., Zhu, Y. (2012). *Multiwave Rollout Approach for Continuing Education in Business and Engineering Studies*. In: Continuing Engineering Education: solutions for competitiveness, innovation and grand challenges. New ideas for tired programs, new missions and services. IACEE 2012 World Conference on Continuing Engineering Education Valencia. Universitat Politècnica de València. 20 pp. (ISBN 978-84-8363-858-3)
- Schumann, Chr.-A., Marr, R., Weber, J., Tittmann, C., Lerant, K. (2012). *Cross-Generational Approach for the Integration of Formal, Non-Formal and Academic Education*. In: Paulsen, M.F., Szücs, A. Open Learning Generations. Closing the Gap from Generation „Y“ to the Mature Lifelong Learners. EDEN 2012 Annual Conference. Porto. European Distance Education and E-Learning Network. Budapest. 6 pp. (ISBN 978-963-89559-0-6 (CD-Proceedings))
- Schumann, Chr.-A., Tittmann, C. (2012). *Multilayer Structure of Knowledge Nodes*. In: Cegarra, J.G. Proceedings of the 13th European Conference on Knowledge Management. Cartagena. Volume Two. Book version. Reading. 1079-1085. (ISBN 978-1-9088272-63-8)
- Schumann, Chr.-A., Kassel, St., Tittmann, C., Weber, J., Schumann, M.-A., Haubold, M. (2012). *Holistic Approach of Knowledge Transfer for Project Management in Global Cooperation*. In: Pantouvakis, J.P. Integrating Project Management Standards. Proceedings of the 26th IPMA World Congress. Greece. CD version. 109. (ISBN 978-618-80311-0-4)
- Tittmann, Claudia; Schumann, C.-A. (2010). *Evolution analysis of knowledge potentials by pattern matrices*. In: Tomé, E. ECKM2010 - European Conference on Knowledge Management. Famalicao, Portugal. Proceedings of the 11th European Conference on Knowledge Management Volume Two. Academic Publishing. Reading. 892-900. (ISBN 978-1-906638-71-9 (CD-Proceedings))

Biography



Professor Christian-Andreas Schumann. 1982 MSc Industrial Management, 1984 & 1987 PhD, Habilitation 1990. 1988 Associated Professor, Chemnitz University. 1994 Professor for Business Informatics, Zwickau University. 2003-2009 Dean of faculty economic sciences. 2009- Vice Dean. In addition: Director of the Institute of Management and Information, Head of Scientific Centre for New Education, Member of the VDI Scientific Advisory Council and VDI Financial Advisory Committee. Research: Logistic Management, PLM, Knowledge and Information Management.

Copyright

This work is licensed under a Creative Commons Attribution-NonCommercial-NoDerivs 3.0 Unported License. To view a copy of this licence, visit <http://creativecommons.org/licenses/by-nc-nd/3.0/>