Model-driven Mobile Expansion of Knowledge Flows in Educational Networks

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***Abstract**: The currently developing knowledge society needs high quality knowledge bases with wide-spreading knowledge sources. Because of the complexity of knowledge, it is organised as knowledge network characterised by model-driven architecture based on knowledge nodes as instigator for the intermediate knowledge flows. The theory of knowledge networks, knowledge nodes, and knowledge flows can be used for educational networks as a subset of general knowledge networks. In addition, the distribution of knowledge and skills will be structured and made more effective by using a knowledge model-driven architecture. The implementation is done by building up several competence clusters as transfer hubs in a multilayer architecture. The application of the existing theory and use of knowledge transfers in a mobile environment for instance for vocational training requires new kinds of special models based on the general architecture for knowledge networks and the more specific architecture of educational knowledge transfer by competence hubs. The mobile version of the knowledge transfer in vocational training programs proves to be an expansion of the model-driven approach for knowledge flows. The authors integrate the current multilevel knowledge from different kinds of research projects dealing with knowledge networks and knowledge transfer processes under the viewpoint of a model-driven approach leading to a expansion in a mobile environment for vocational training as example.*

***Key words:** Knowledge Flow; Vocational Training Network; Educational Network; Mobile Learning*

THE THEORY OF KNOWLEDGE FLOWS IN KNOWLEDGE NETWORKS

The systemic view of science leads for example to a subdivision in natural sciences, human sciences and structural sciences. Especially in the field of natural sciences like physics or chemistry there are formal descriptions to assess and calculate the value of these parameters, to describe their structure, and to identify their impact and influence on other objects. Analogous to the natural scientific (physical and chemical) processes a similarity exits to the knowledge processes, which belong to the human science and have primarily sociological and psychological origins. The basic assumption in this context is the idea of knowledge nodes (Figure 1). Knowledge nodes are individuals or smallest possible combinations of organizational units / individuals.

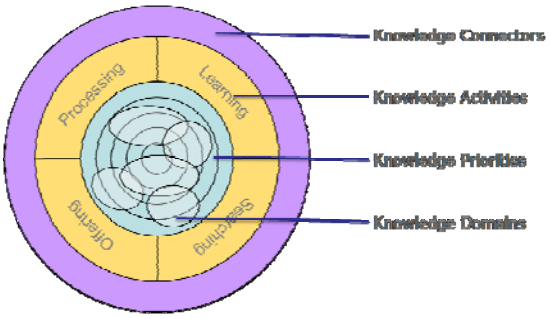

Fig.1. Model of knowledge node [1]

The nodes are turning into knowledge networks based on scientific or business-oriented motivations for cross-linking and increasing their knowledge power. The knowledge nodes consist of knowledge potentials of various knowledge domains. These knowledge potentials can be assessed by their size and by the priority or importance. The knowledge potential existing in the creation phase of the knowledge node will not keep its value along the timeline. There is a kind of half life of knowledge, and the

thesis, that knowledge potentials of knowledge nodes reduce or lose their level or value against other knowledge nodes if they do not develop and extend their knowledge. Therefore, every knowledge node tries to open and make accessible new knowledge sources. The development of knowledge takes place on the one hand by the exchange of knowledge within the knowledge node (as far as it consists of more than one individual) and the exploitation of explicit knowledge of external sources. On the other hand, there is the need for compensating and exchanging the knowledge potentials with other knowledge nodes (Figure 2).

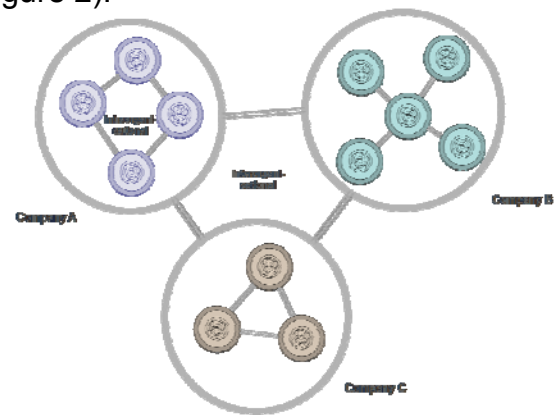

Fig.2. Cross-linked knowledge networks [1;2]

Thus, knowledge flows occur. This knowledge exchange is characterized by a structure, this means in the IT sense it is a protocol by which the exchange runs. The quantity and kind of exchanged knowledge will be determined by rules and regularities, including filters and restrictions. The structure of these knowledge flows, and the rules under which they run, are very difficult to measure (Figure 3). Thus, it is also not quit trivial to define them. Therefore, it is the aim of the research to develop an approach for defining the structure, rules and restrictions on knowledge flows between knowledge nodes.

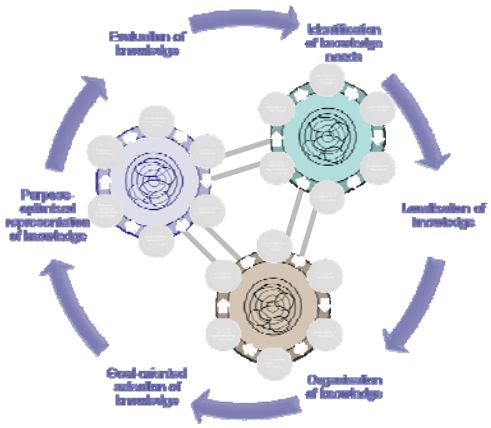

Fig.3. Knowledge flows between knowledge nodes in the framework of the KM lifecycle [3]

This model provides a fundamental concept for the further analysis of knowledge networks and the lifecycle of knowledge nodes. It forms an important basis for the understanding and hence for the assessability of knowledge flows and finally knowledge networks.

THE IMPLEMENTATION OF KNOWLEDGE FLOWS IN EDUCATIONAL NETWORKS

For implementing the described knowledge flows in networks it is necessary to manage the transformation of the classic monolithic learning systems to new forms of open and dynamic networking. Therefore, a meta modular-design model for educational offers with a dynamic structuring has to be built up. The information volumes of basic teaching, applied uses of economy and outcomes of research works will be centralized in knowledge blocs (Figure 4).

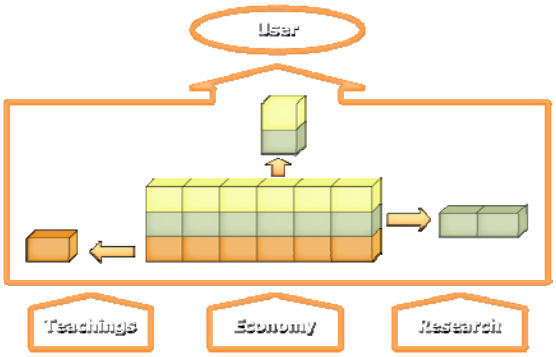

Fig.4. Meta modular-design model for educational offers [4]

Every knowledge bloc contains of several main topics which have to be clustered and selected by diverse subnodes. The next step in this systemic process is to form a content network and build main nodes of the clustered main topics (Figure 5). The map shows the importance of the equality of the nodes and the subnodes. Thereby, it is possible to connect the specific module network with a bigger knowledge network.

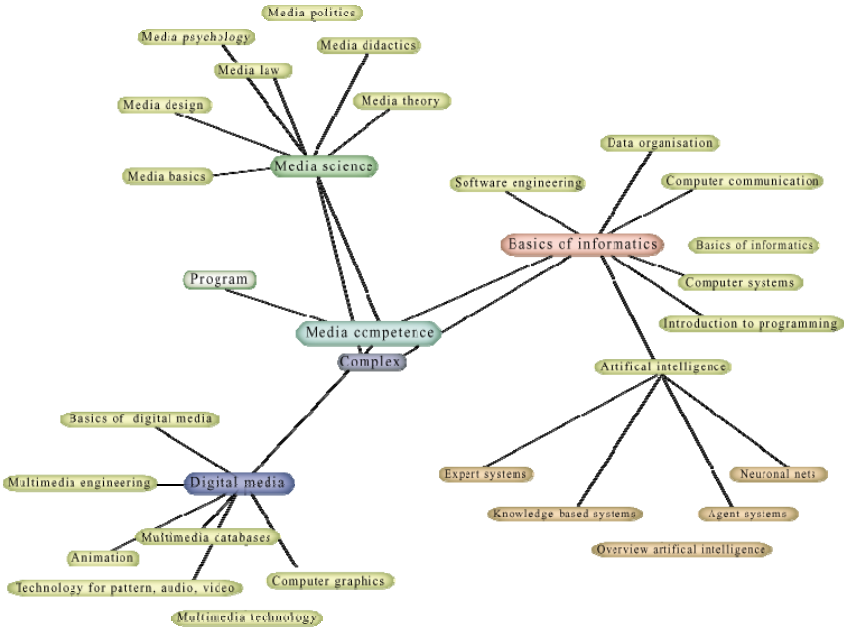

Fig.5. Content network and clustered main topics [5;6]

For being more innovative and intelligent, it is necessary to pinpoint the main groups of strongly associated key nodes of the networks as competence clusters [7]. The key nodes and the related clusters are sifted out by system analysis and documented for instance by mind and concept mapping (Figure 6).

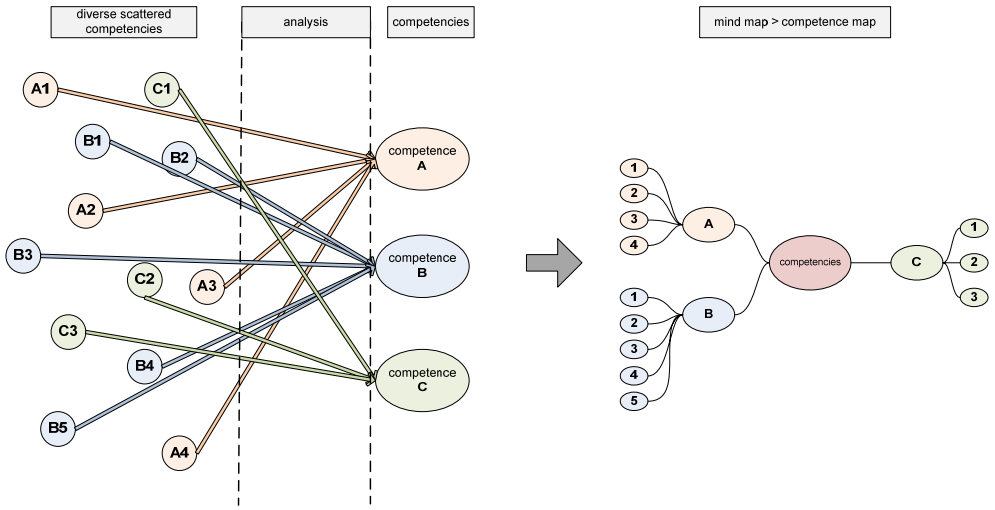

Fig.6. Description of the process from diverse competencies to a competence (mind) map [4]

The competence clusters are used to configure one or several related networks of competence based on the back bone system of competence clusters. The method and information literacy approach based on competence clusters as transfer hubs will be realised by using a multi-consortium project dealing with a multilevel network for last-mile-solutions supported by e-education competence clusters.

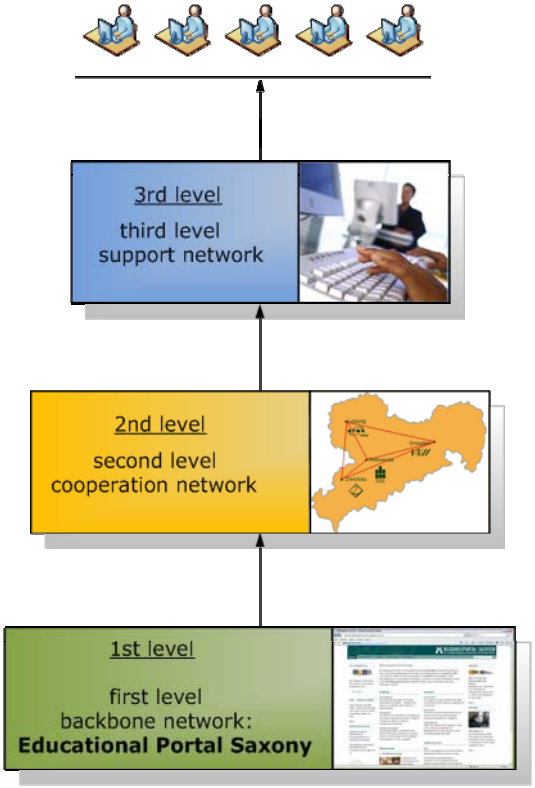

Fig.7. Special architecture of educational knowledge transfer [4]

The first level is composed by the e-platforms, CBT and WBT systems, etc. as first-level-backbone network from the users view. It is the organisational-technical system view for e-education. The second-level-cooperation network is formed by the e-education specialists pushing the development and application of e-learning in the framework of competence clusters. It is the world of special knowledge, skills, abilities, and competencies integrated in clusters and networks for developing particular aspects such as methodology, didactics, ergonomics, architectures, etc. The third level is characterised by last mile solutions as user's support network including the personal

services for the end users and for improving the individual knowledge and competence transfer.

These main levels form a special three level architecture for imaging an educational knowledge transfer (Figure 7).

The specific architecture of educational knowledge transfer can be the next level for an application in a learning mobile environment.

THE EXPANSION FOR MOBILE LEARNING IN VOCATIONAL TRAINING NETWORKS

Mobility and local independence are one part of mobile learning (m-learning) in the complexity of e-learning. Fast accesses as well as current interruptions of learning flows are thereby further challenges a mobile learning environment has to be adjusted to. These aspects require for methodical, didactical and multimedia processing of learning contents.

Apart from these requirements there is as well a high technological dependence in the field of hardware. Wireless broadband connections and the use of mobile terminals may prevent a successful conception of a mobile learning environment. However these special technologies may improve the knowledge of using e-learning since the spatial expansion of a mobile learning environment is enormously increased in contrast to a purely stationary environment.

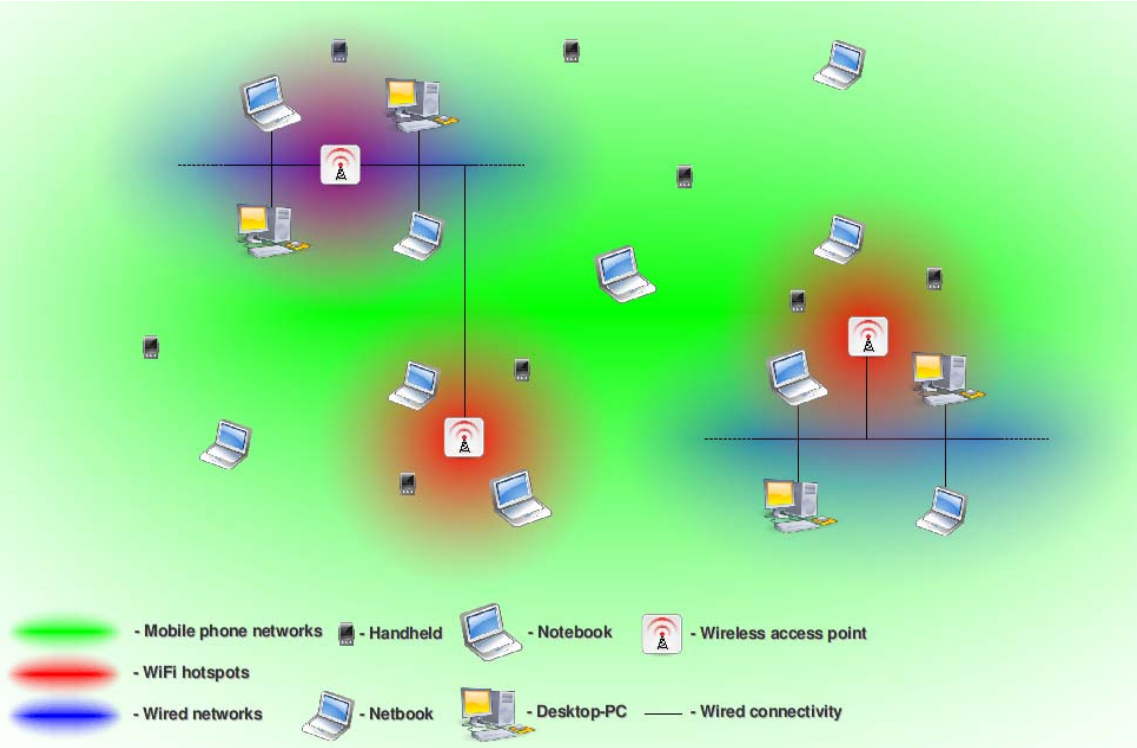

Fig.8. Spatial expansion of e-learning environments by using radio networks to mobile learning environments

Because of these special characteristics of mobile learning environments, there are in contrast to the stationary e-Learning, only limited possibilities to realize learning scenarios. These learning scenarios are usually extremely problem-(job-oriented), demand- and target group oriented in the field of m-learning. Therefore, they possess in most cases clearly defined learning offers with a small range of other topics. A major role plays thereby the supply of specialized and learning process accompanying knowledge. Apart from these restrictions however also new operational areas for e-learning are opened. Thus, excursions and similar learning scenario with a large extent on mobility and flexibility can be supported and accomplished [8][9].

In the surroundings of a professional training the m-learning can be used for the support by vocational training processes. In this case above all, the spontaneous, individual use plays still another basic role, whereby the study content/course is usually retrieved to close knowledge gaps. Newer investigations and concepts in the field of a professional training try to support working and networking of study groups in virtual classrooms with the help of m-learning [10][11]. In this process above all, the cooperative and self-organized learning as well as the connection of learning and knowledge management should be strengthened. Here the inclusion of the Web 2.0 - technologies and social software, which show high potential in other fields of cooperative and organized communication and information retrieval, appears particularly important.

The solution of these complex challenges for an optimal conversion in the professional training is, like in other subject areas also difficult, and usually lengthily. M-learning thereby can only be seen as completion to other teaching methods and -scenarios. But already the possibilities, which a mobile learning environment provides, should be exhausted, to raise/increase the motivation of the trainee/apprentice as well as the quality within the apprenticeship.

CONCLUSIONS AND FUTURE WORK

This paper shows the diverse levels of specialisation of knowledge flows. The first level contains the knowledge model with knowledge nodes and knowledge flows. This model is essential for the organizational learning level, because knowledge is the e-learning content. The organizational learning will be extended in the next specialization level by the technical and methodic-didactic aspect, the mobile learning, for reaching more flexibility.

Therefore, the goal for the further development of these different specialized models is the better integration and the optimization of the processes in education, vocational training, and further training for becoming time- and place-independent.

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