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Analysis of Knowledge Management and E-Learning Integration Models

Janis Judrups[a]*

[a]*Baltijas Datoru Akademija, Tallinas 4,Riga, LV-1001, Latvia*

Abstract

The development of knowledge management (KM) and e-learning (EL) naturally brings both disciplines closer and encourages integration. There are several models that offer possible ways of such integration. With the goal to develop practically applicable integration solution for specific organization, existing integration models are analysed in this paper. The main criterion for analysis is application of integration model in the enterprise. Model analysis shows several different theoretical approaches for integration that are tied to specific goals and needs of organization. The more general approach is to base integration on common ground, which is identified as learning.

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Keywords: Knowledge Management; E-learning; Integration models.

1. Introduction

Knowledge management and e-learning are developed as recognized, self-contained disciplines for years. By shifting focus on knowledge as the main resource of organization, these disciplines are gaining more and more interest. With further development, synergistic relationships should increase between KM and EL[1]. Some of these relationships are quite evident, because both disciplines: Deal with knowledge capture, sharing, application and generation; Have important technological components to enhance learning; Contribute to building a continuous learning culture; Can be decomposed into learning objects.

* Corresponding author.
E-mail address: janis.judrups@bda.lv

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Several conceptual, technological, organizational and content barriers are hindering close integration of KM and EL[2–8]. By overcoming them we may expect clear benefits for disciplines and increased quality, convenience, diversity and effectiveness within an organization[9–11].

There are several theoretical approaches for connecting both disciplines. They are described in literature as KM and EL integration models[6,7,10,12–15]. To develop practically applicable integration solution for specific organization it is necessary to understand these integration approaches. The main goal of this paper is to analyze existing integration models. The main criterion for analysis is application of integration model in the enterprise.

To describe connection of KM and EL domains, terms "integration" and "adoption" are used with very close meaning. In this paper term "integration" is used to describe situation when KM and EL are two equal, parallel operating disciplines. Their common, consistent implementation and usage is *integration* of knowledge management and e-learning. Term "adoption" will be used, when one discipline is the basis for another, approaches and tools from another discipline are tailored and used to increase its efficiency.

The structure of the paper is following. KM and EL integration models are analysed in Section 2. The results of model analysis are presented in Section 3. The conclusions contain a summary of the main ideas of the paper.

2. KM and EL integration models

KM and EL integration models found by author are presented in this section. Models are ranged by date of publication.

2.1. KM and EL technology integration model

Woelk's and Agarwal's model helps to understand the EL and KM technology integration capabilities with the aim to capture, organize, and deliver traditional courses and large bodies of knowledge [12]. Knowledge management can be analyzed for understanding the role of knowledge management life cycle and the knowledge flow in the organization. Model is based on Nonaka and Takenuchi SECI model of knowledge conversion with four phases - socialization, externalization, combination and internalization[16]. Two more phases are added to SECI model - cognition and feedback. For each of the knowledge management phase e-learning technologies are providing their own improvements. Knowledge management phases with e-Learning enhancements are shown in Figure 1. Knowledge Holder can create explicit knowledge and store it in a knowledge repository or transfer his tacit knowledge to Knowledge Seeker through socialization.

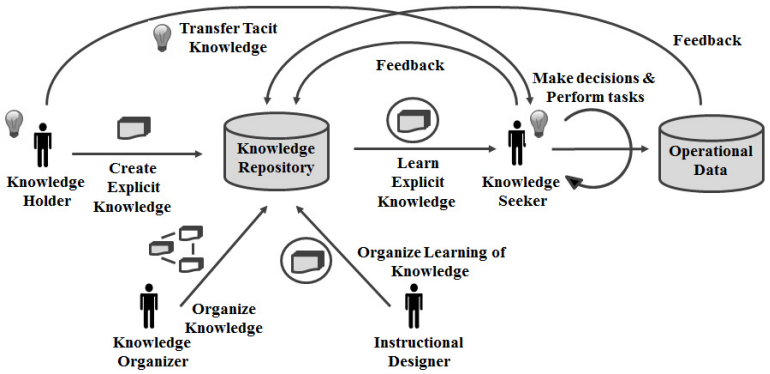

Fig. 1. Knowledge management phases with e-Learning enhancements[12].

The Knowledge Organizer and Instructional Designer are persons or software programs. The Knowledge Organizer is responsible for linking knowledge bodies or other improvements. The Instructional Designer is responsible for preparing knowledge for learning needs by adding assessments and assignments. The Knowledge Seeker gains the explicit knowledge by selecting them from knowledge repository. The Knowledge Seeker uses his

tacit knowledge to make decisions and perform business tasks. Work performance of the Knowledge Seeker can be measured and returned to the knowledge repository as feedback. This could help determine if learning goals are achieved and, if necessary, suggest additional e-Learning. In this model knowledge management is enhanced with e-learning technologies and represents EL adoption in KM. As theoretical model, it was applied to some real life scenarios to illustrate the benefits of integration. These scenarios also provide a roadmap for the evolution of new systems that will provide both the efficient capture of knowledge and the efficient delivery of knowledge. For practical implementation, technical specification and methodological support must be added to the model.

2.2. Knowledge management and e-Learning integration using context-aware corporate learning

Schmidt believes that both knowledge management and e-learning solves a fundamental problem - encourages learning in organization. However, for the solution of the problem two different paradigms are used that lead to two different types of system use. Reason of the isolation is explained by the lack of attention to the context of employees involved in learning[7]. For practical usage, the employee's context can be described by the personal (current competencies, objectives, desired interactivity), organization (department, role, business processes) and technical specifications (operating system, applications, bandwidth). Learning objects are bind with the user's context using competences from competency catalog (see Fig. 2). Competences and individual context are linked directly (as the existing competences and future planned) and indirectly (by linking the organization contextual elements with the competency requirements). Learning objects are described by their objectives (which are described as competencies that are acquired as a result of successful training) and prerequisites (which describe the competencies needed for successful learning).

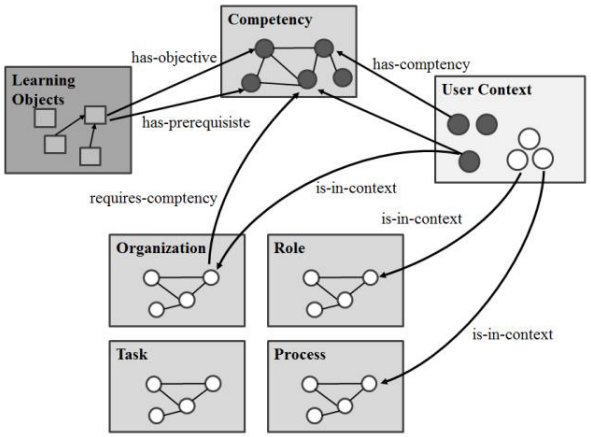

Fig. 2. Competencies as the semantic glue between the context and learning resources[7]

Learning system architecture with context-aware functionality is proposed for practical implementation. It is based on loosely coupled integration service creation. This allows the implementation of the model in existing IT infrastructure by adding the necessary systems. This model demonstrates KM and EL integration by using user/ learner context as connecting platform. Both KM and EL are seen as equally important disciplines. Model has been implemented in some prototype environments and shows relatively high user acceptance. Evaluation of this model shows that this blend of e-learning and knowledge management functionality can help to improve workplace learning. For practical implementation, organization must support general user context management services to deal with user context acquisition and management tasks. Especially challenging may be problems related to context change, imperfection of acquisition and reasoning techniques.

2.3. An integrated e-Learning system-design framework for knowledge dissemination

The main interest of Sivakumar research is the dissemination of knowledge in the organization and how this may be improved with specially adapted e-learning system. For different types of knowledge (tacit and explicit) dissemination it is necessary to choose the appropriate technology, the pedagogical method, the type of communication, interaction and learning styles[13]. E-learning environment development in organization must comply with the three aspects of the design - a technical solution, communication and interaction between the organization and design of training. For each of these aspects certain pedagogical approaches and learning styles need to be selected in accordance with organization's needs and knowledge types. In order to effectively meet the needs of geographically distributed employees, e-learning system providers should provide support for all four Nonaka and Takenuchi SECI model knowledge conversion phases. They also need to adjust the e-course content, teaching methods, architecture and training delivery methods used in their systems. In accordance of this model, integrated e-learning system design framework for knowledge dissemination in the organization must:

- Promote close interaction between staff, using synchronous and asynchronous communication;
- Incorporate pedagogical approaches that encourage active, collaborative, self-paced e-learning for explicit-tacit (explicit) knowledge conversion;
- Implement effective online mentoring forms for tacit-tacit (explicit) knowledge conversion;
- Integrate existing employee communication channels to organize practitioners, experts and mentors communications;
- Integrate secure delivery mechanisms in standard e-learning system architecture;
- Develop high-level measurements to monitor effectiveness of the e-learning process;
- Use modular, scalable architecture with reusability in geographically separate locations.

Proposed approach suggests developing of e-learning systems based on knowledge type conversion they will use. It demonstrates adaption of knowledge management approaches to e-learning. As practical framework it lists main factors to be considered for e-learning system design, but lacks importance and criticality assessments for them. Without guidelines for e-learning system design, it remains theoretical approach.

2.4. Knowledge maturing conceptual process model for integrating e-learning and knowledge management

Maier un Schmidt propose integration of EL and KM on the basis of a process that explicitly aims at designing the transitions of knowledge along varying degrees of maturity[6]. The authors indicated the following barriers to the successful integration of EL and KM:

- Different fundamental approaches. E-learning is rooted in psychology, didactic and pedagogy, emphasizing importance of structured and personal guidance. In turn, knowledge management focuses on the organization's memory or knowledge base, where individual's knowledge must be transferred and made explicit;
- Fragmented ICT environment. Organizations use a wide range of systems to improve the knowledge and learning processes. Employees are working in fragmented environment and each system provides only a certain part of the learning and knowledge processes;
- Fragmented organizational structure. Knowledge and learning processes are distributed among the organization's departments, such as human resources, e-learning, knowledge, innovation, and quality control departments. These organizational units typically use knowledge with distinct level of maturity.

E-learning and knowledge management goal is to promote learning and knowledge transfer. However, disciplines are using knowledge bodies with different levels of maturity. Maier and Schmidt offered the use of knowledge maturation process as a conceptual framework for organizations to undertake necessary integration processes. Knowledge maturation process is presented as a conceptual model to analyze and explain the disruptions in the organization-individual knowledge flow. These disruptions relate to the fragmented ICT environment and organizational structure that facilitates knowledge of different levels of maturity.

Knowledge maturation process may be divided into five phases:

- Emergence of ideas. Individuals generate new ideas in free and informal discussions. The used terminology is confusing and often determined by ideas;
- Distribution in Communities. With increasing maturity, common terminology is formed by members of the community, such as discussion groups;
- Formalization. Artifacts from previous phases are unstructured and isolated. In this phase, documents are with specific purpose and structured;
- Special training. Artifacts from previous phases are not appropriate for training needs. In this phase, materials are developed according to the pedagogical requirements to ensure a wider distribution;
- Formal Training. Individual learning objects are combined in broad material suitable for novice training.

Learning in organizations requires extending the individual knowledge maturing (described in previous model) by an organizational perspective. This is achieved using Model of organizational information processing[17]. Model describes 10 phases in organization knowledge processing. Comparison of two models shows that all processes in the model of knowledge maturing are also part of the model of information processing:

- Emergence of ideas – individual learning;
- Distribution in communities – sharing;
- Formalization – institutionalization;
- Add-hoc training – feedback;
- Formal training – refining and repackaging processes.

The knowledge maturing model sets the focus on a pragmatic chain of knowledge development tasks that can allow creation of formal, mature knowledge products. The following criteria may be used for practical knowledge maturity classification:

- Hardness. Characterize validity and reliability of information or knowledge. Measurement scale – from rumors to stock exchange data;
- Interconnectedness/ contextualization. By deepening understanding, relations to other topics become visible. In turn, the context of the role of knowledge in the process of maturation is increasingly diminishing. These two properties are mutually inverse;
- Commitment/legitimating. Knowledge can be structured by amount of support it gets. Support can be from a member of group, team, and community. It may take form of authorization to use the knowledge, legislation and standardization, i.e. different forms of legitimacy.
- Teachability. Immature knowledge is difficult to teach (even to expert), while formal training, by definition, is designed for wide usage.

The knowledge maturation process modeled real-life situations in organizations, their operations with the knowledge and development of related technical solutions. This model shows that the learning process has to depend on the maturity of knowledge that needs to be generated. Knowledge maturity level allows you to choose a suitable media format and assistive technology for training. This allows organizations to systematically develop ICT infrastructure and implement processes, roles and tools to help overcome the disruptions in the knowledge maturity process. This model demonstrates KM and EL integration by knowledge maturity process as connecting platform. Both KM and EL are seen as equally important disciplines. This is theoretical model, which needs further elaboration and validation.

2.5. InterCog sense-making model

Mason propose InterCog sense-making model (ISMM) for analysis and understanding common areas of e-learning and knowledge management[14]. The model can be used to create a strategic approach for planning, development, implementation and use of e-learning standards. This may be achieved by describing e-learning and knowledge management common "problem area" with very general and simple concepts. The main emphasis is placed on interrelationship of learning, knowledge and thinking. Context consists of "primitive" questions Who, What, When, Where, How, Why, and If[18]. This makes it possible to simplify and understand the situation while

maintaining a complex view[19]. ISMM model is theoretical KM and EL integration model, which suggests to add to integration the third dimension – knowing.

2.6. Knowledge management and e-learning adoption model

In accordance with Personalized learning model proposed by Irfan & Shaikh e-learning can take place via either explicit or tacit knowledge[20]. Islam & Kunifuji offers to increase efficiency of e-learning systems by supplementing Personalized learning model with knowledge management knowledge conversion methods to convert tacit knowledge to explicit[10]. This approach is described as a theoretical model for knowledge management adoption for e-learning system. Term "adoption" here is understood as the application of certain techniques, i.e. conversion tacit knowledge into explicit knowledge. In the KM an EL adoption model knowledge creation, acquisition, evaluation and feedback are displayed as tacit knowledge with corresponding conversion to explicit knowledge. On the other part, knowledge organization, storage, dissemination and retrieval is shown as explicit knowledge, which can be converted to tacit knowledge. KM an EL adaptation model includes the following four steps: Knowledge creation and acquisition; Knowledge organization and storage; Knowledge dissemination and retrieval; Evaluation and feedback.

2.6.1. Knowledge creation and acquisition

Tacit knowledge is created in either direct (Human-Human) or online (Human-Machine) interaction. This can happen as training or job related communication between the training participants/ employees. Moving on to the second step, this knowledge will be converted to explicit knowledge and saved in KM and EL systems. Tacit and explicit knowledge acquisition takes place with a variety of activities and uses all available online and offline sources.

2.6.2. Knowledge organization and storage

Knowledge organization for use and reuse in a modern organization is a complex challenge and affect the whole knowledge management cycle. E-learning system organizes its knowledge resources in convenient form to be easily accessed and used by the teachers and students. So the model propose to supplement the e-learning with KM knowledge organization and storage techniques and thus to improve the learning process. Knowledge retrieval process is highly dependent on the proper storage of knowledge in KM and EL systems. Therefore, systematized and well organized knowledge resources are stored in digital repositories of knowledge or web sites where they can be used for both KM and EL needs.

2.6.3. Knowledge dissemination and retrieval

Several KM techniques (browse, search, data mining, knowledge mapping) may be used in e-learning for structuring and retrieving digital content. This will contribute to accessibility and retrieval of knowledge resources. Dissemination of knowledge is important not only for the employees of the organization, but also between its clients and partners. KM and EL may use e-mail, chat, discussion forums, video conferencing and social networking tools to share, distribute, and deliver knowledge.

2.6.4. Evaluation and feedback

Comments and evaluation from learners and teachers can contribute to e-learning troubleshooting and system development. Model offers to complement knowledge management with these essential elements of e-learning. Users' feedback enables the further development of KM and EL systems and adapts them to the needs of the organization.

Application of model may bring following benefits:

- Tacit knowledge conversion. By converting tacit knowledge into explicit, EL systems and trainers can easily deliver knowledge resources, while employees and learners can gain knowledge in more convenient way;
- Promotion of knowledge organization and retrieval. EL can use several KM knowledge organization and retrieval techniques to improve EL systems and efficiency of learning process. For example, e-learning participants can access knowledge bank from EL system;

- Improvement of knowledge sharing and management. KM approach adoption in EL systems allows promotion of innovation and open knowledge sharing culture in organization.

In fact, learning is a process of interaction between students, teachers and curriculum. Its effectiveness depends on the close interaction between the elements. The proposed KM and EL adoption model is designed to improve the performance of e-learning, properly aligning these elements. The authors believe that the conversion tacit knowledge, proper organization and retrieval of knowledge, improvement of knowledge sharing and management should be organically linked to and benefit from KM and EL adaptation. The KM and EL adoption model suggests adopting specific KM approaches to e-learning to enhance EL performance. This is theoretical model, which needs to be verified and tested.

2.7. Dynamic learnings system model

Ungaretti and Tillberg-Webb suppose that knowledge management and e-learning are important components of learning allowing integration of both disciplines. Learning may be common ground where KM and EL distinct teorethical approaches can be combined and complement each other. For this goal Dynamic learning system (DLS) model is proposed by combining three components – knowledge management, e-learning and assurance of learning (AoL)[15]. Assurance of learning is described as systemic, intentional process that identifies desired learning and provides a process to measure its achievement and the improvement of both the learning and the process to attain it. AoL is also known as learning outcomes assessment, assessment, the outcomes assessment movement, assessing student learning, assurance of learning. Assurance relates to systemic and multidimensional nature of process – it is not limited to assessment of learning results. Dynamic learning system model is composed from common elements of knowledge management, e-learning and assurance of learning value chains, divided into four groups/ phases:

- Institutional-level analysis and goal setting;
- Individual/ group-level needs analysis;
- Knowledge/ learning design and distribution;
- Knowledge/ learning increase measurements and analysis.

Each of these three disciplines has their primary goals. KM is focused on organization-level knowledge formed by individuals. EL main aspect is individual learners while considering impact on whole organization. Assurance of learning is focused on achieving certain business goals aligning this with data management, externalization of tacit knowledge, individual learning with explicit knowledge, etc. Together they allow the organization to develop a systemic approach to knowledge and learning. Important part of DLS is evaluation that measures impact to organization produced by KM and EL. In this phase, learning outcomes are analyzed in the level of learning program or organization. Results may suggest improvements for learning system. In that way closed organization's development circle is formed. Main targets of KM systems are on what tacit and explicit knowledge is and how it will be managed: created, organized, shared, preserved, gathered, captured, etc.

The result is compelling, robust, dynamic learning systems model that combine the unique elements of KM, EL and AoL. Model ensures the development of organization by addressing needs in individual, group and institution level. Multilevel analysis of learning provides insight to necessary changes and improvements in every organizational level. Model may be appropriate for both educational and business organizations; however, AoL approach is widely accepted in academic learning environment. For business organizations, it will be necessary to develop appropriate AoL approaches and processes. This model demonstrates KM and EL integration by adding third element – assurance of learning. This theoretical model needs further elaboration and validation.

3. Results and discussions

Author has identified seven models for KM and EL integration in the analysed literature (see Table 1). Only Schmidt's model (2) was implemented practically in prototype environment with relatively good user acceptance. However, it requires implementing support for general user context management functionality that may be challenging task and requires further research. Other models are theoretical and need further elaboration and

validation. Some authors are not intended to do further research to validate and test their models. In cases when upcoming model validation and implementation may be expected no more information was found in literature and practical usability of models is under the question.

Table 1. Summary of KM and EL integration models.

Nr.	Author	Integration model	Practically applied	Description
1.	Woelk, Agarwal	KM and EL technology integration model	Partly	Theoretical model; KM enhanced with EL technologies; Applied to some real world scenarios; Lack applicability support.
2.	Schmidt	KM and EL integration using context-aware corporate learning	Yes	Practical model; KM and EL integration based on user context; Implemented in prototype environment; Need applicability support for generic user context management functionality.
3.	Sivakumar	An integrated EL system-design framework for knowledge dissemination	No	Theoretical model; EL system development based on knowledge type conversion; Lack importance and criticality assessments for system design factors. Need further elaboration and validation.
4.	Maier, Schmidt	Knowledge maturing conceptual process model for integrating EL and KM	No	Theoretical model; KM and EL integration based on knowledge maturity process; Need further applicability support, elaboration and validation.
5.	Mason	InterCog sense-making model	No	Theoretical model; KM and EL integration by adding dimension of knowing; Need applicability support.
6.	Islam, Kunifuji	KM and EL adoption model	No	Theoretical model; Adopt KM approaches to EL to enhance EL performance; Need applicability support, verification and testing.
7.	Ungaretti, Tillberg-Webb	Dynamic learnings system model	No	Theoretical model; KM and EL integration by adding assurance of learning; Need applicability support, elaboration and validation.

Analysis of these models showed usage of both approaches – integration (both disciplines are seen as equal) and adoption (approaches and techniques when one discipline is used to enhance other). Adoption approach was used in both directions – EL techniques may be applied in KM and KM approaches may be used to enhance e-learning.

Integration approach is looking for common ground of knowledge management and e-learning. Several authors identified learning as a common ground, however they proposed to use additional component (like context, knowledge maturity level and assurance of learning) for integration of KM and EL. Dynamic learnings system model (7) is best example to base integration on learning as common ground. However, assurance of learning is approach specific to academic environment and it may be problematic to implement it in business environment.

Diversity of integration models clearly shows, that there is no one generally accepted best way – it must be selected and prepared based on organization's needs. The selection of linkage approach (integration or adoption) and the base discipline for improvement will depend on specific business need and environment – which of two disciplines must be primarily enhanced and developed. "Clean" integration with similar priorities of disciplines may be based on common ground – learning.

4. Conclusion

The development of knowledge management (KM) and e-learning (EL) naturally brings both disciplines closer and encourages integration. There are several models that offer possible ways of such integration. Model analysis shows several integration ways and approaches, however, these models are not implemented in production environment and lack necessary technical specification and application support. As result of specific organizational goals and needs models employ different adaption and integration approaches. The more general approach is to base integration on common ground, which was identified as learning.

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