MOVING

Deliverable 2.1: Initial conceptual framework, curricula and technical prototypes for adaptive training support

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Work Package 2: Didactic and curricula development

TraininG towards a society of data-saVvy inforMation prOfessionals to enable open leadership INnovation

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Executive Summary

The goal of this deliverable is to report on WP 2's objectives and corresponding activities conducted within Y1 of MOVING. This includes the development of an initial conceptual framework to show the learning paths with all learning opportunities in order to overcome the gap between working and training (Section 2), development of a curriculum that defines the learning objectives for teaching information literacy on the platform (Section 3), development and enhancement of semantic profiling and recommender system to offer the users suggestions about scientific publications (Section 4), development of the Adaptive Training Support to provide learner guidance including the recommendation of relevant learning material (e.g. scientific publications), feedback on a learner's progress combined with prompts to reflect upon it and reflective questions to relate the learning and content to practical work experiences (Section 5). Finally, we summarise the main contribution for each task highlighting the achievements of Y1 and give an outlook for Y2.

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Abbreviations

Abbreviation	Explanation
ATS	Adaptive Training Support
BL	Bell Log Spreading Activation Function
CF-IDF	Concept Frequency - Inverse Document Frequency
cMOOC	Connectivist Massive Open Online Course
CoP	Community of Practice
HCF-IDF	Hierarchical Concept Frequency - Inverse Document Frequency
IAESB	International Accounting Education Standards Board
ICT	Information and Communication Technologies
IES	International Education Standards
ISA	International Standard on Auditing
nDCG	Normalised Discount Cumulative Gain
OER	Open Educational Resources
P_d	Document Profile
P_u	User Profile
PV	Paragraph Vectors model
TF-IDF	Term Frequency - Inverse Document Frequency
UCIVIT	User Activity Tracking System

Abbreviation	Explanation
WBL	Web-Based Learnings

1 Introduction

This section presents the history and the purpose of the document.

1.1 History of the document

Table 1 shows the history of the document.

Table 1: History of the document

Date	Version & status
31/01/2017	v0.1: initial ToC draft
06/02/2017	v0.11: telco-revised ToC draft
16/02/2017	v0.2: review-ready ToC draft
01/03/2017	v0.3: review-revised ToC draft
10/03/2017	v0.4: review-ready draft
23/03/2017	v0.5: review-revised draft
29/03/2017	v0.6: draft, main edits from partners implemented
30/03/2017	v0.7: draft after proofreading for final check
31/03/2017	v1.0: final

1.2 Purpose of the document

This deliverable describes the efforts of WP 2 to develop an empirically justified innovation training curriculum, the so-called Adaptive Training Support. To achieve this goal, the work conducted follows two major streams. The first stream follows a didactical approach by developing a conceptual framework for learning paths and the development of a curriculum for learning objectives. The second stream follows a technical, practical approach in order to implement a semantic profiling service and recommender system to suggest context-related content for the Adaptive Training Support. Figure 1 illustrates the structure of this report, showing how the didactical approach is combined with the technical approach.

The conceptual framework (see Section 2) provides an overview of all learning paths with their learning opportunities to train data-savvy information professionals. It includes a description of how curriculum (Section 3), recommender system (Section 4) and Adaptive Training Support (Section 5) interact in the MOVING platform.

The Adaptive Training Support (ATS) is a component of the MOVING platform which interacts with the users. The goal of the Adaptive Training Support (ATS) is to provide guidance to increase users' awareness of their training progress and facilitate the transfer of newly learned theoretical knowledge to work related situations. It supports the user's working and training process in two ways. First, the feature-based ATS provides guidance for training MOVING users on how to efficiently and effectively use the MOVING platform. Second, the content-based ATS recommends content tailored to the MOVING users' needs and the users' current learning and working context.

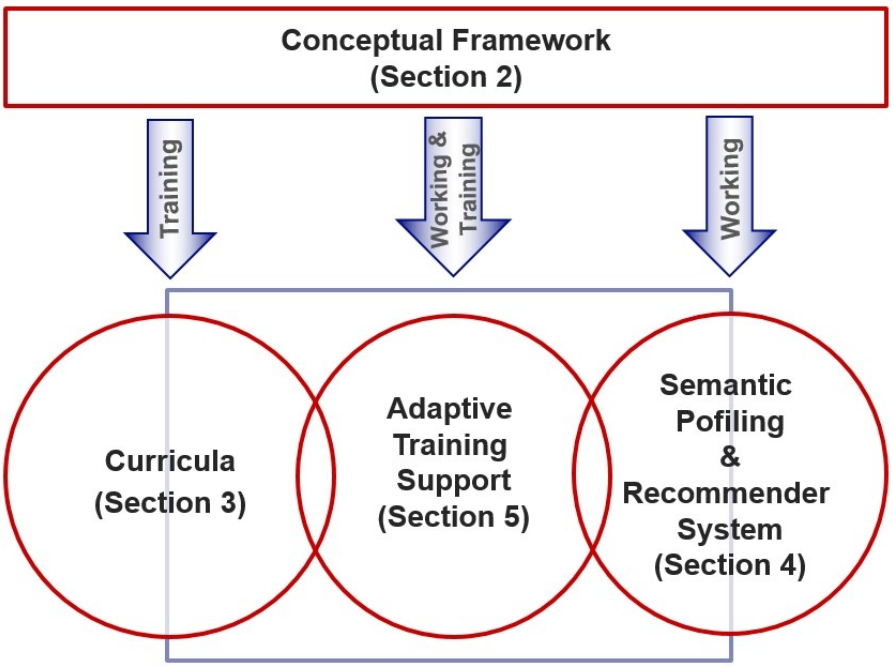

Figure 1: Structure of the Deliverable 2.1

The upcoming deliverables D2.2 (Updated curricula and prototypes for adaptive training support, M24) and D2.3 (Introductory MOVING MOOC for community building, M24) will further extend on this document to develop guidance components for each use case. This includes finding the best time and location to offer guidance for public administrators (use case: research on business information by public administrators) or young researchers (use case: managing and mining research information by PhD and Master students). To this end, we make use of the outcome of deliverable D1.1 (User requirements and specification of the use cases, M12).

2 Conceptual framework

To overcome the separation of practice and training, a framework, which connects working in a secured space and different training options, is necessary. This section includes the description of the learning paths (the different ways how to use the platform) and shows the connections of the learning options over the initial conceptual framework within the planned MOVING platform. Such learning options are, e. g. the Connectivist Massive Open Online Course (cMOOC) and the micro learning content within the Adaptive Training Support (ATS) widget as well as the production of user-generated content in an informal and formal learning environment. The initial conceptual framework involves the MOVING platform environment (working and training) and its social components (e.g. collaboration, sharing. and creation). Informal training options consist of a cMOOC, the ATS widget with micro content and the use of different motivational elements. Micro content – content of the partners, open educational resources (OER) and self-produced content – will be part of the different cMOOC-topics. In a cMOOC users create new content by mixing already existing content or by generating own content (Pscheida et al., 2014; Saadatmand & Kumpulainen, 2014). Such user-generated content can be provided on the platform and enriches the content-pool of the Community of Practice (CoP) by sharing (Pscheida et al., 2014; Saadatmand & Kumpulainen 2014). This is gained by the cMOOC focus of content creation and networking (Gamage, Fernando, & Perera, 2016). User-generated content with high quality can also be used for micro learning. A quality assessment will be necessary and just reviewed user-generated content will be provided as micro content. Formal training options are seminars for students at institutions of higher education. By attending a closed face-to-face seminar at an institution of higher education and the cMOOC – which is in general open – also allows to use the cMOOC as a blended massive open online courses (e. g. Mohsen 2016) or also called hybrid massive open online courses (e. g. Romero & Ventura, 2016). Furthermore, the digital content from the informal training options can be used in face-to-face events (e.g. seminars) to offer students blended learning options. Such a blended learning approach can be flexible for each individual with regard to pace, place, learning speed and type. With the use of badges, users might stay motivated and can finally be rewarded with a certification (Gibson et al. 2015). Creating or producing content as well as participating in some parts of the cMOOC can be a task within seminars. For such productions, students can get marks. Marks can motivate students to produce good content. High rated content guarantees a high quality. This content can be used on the MOVING platform. Furthermore, students make a first step into the CoP by providing and sharing their content. Figure 2 presents the initial conceptual framework with an overview of the learning paths.

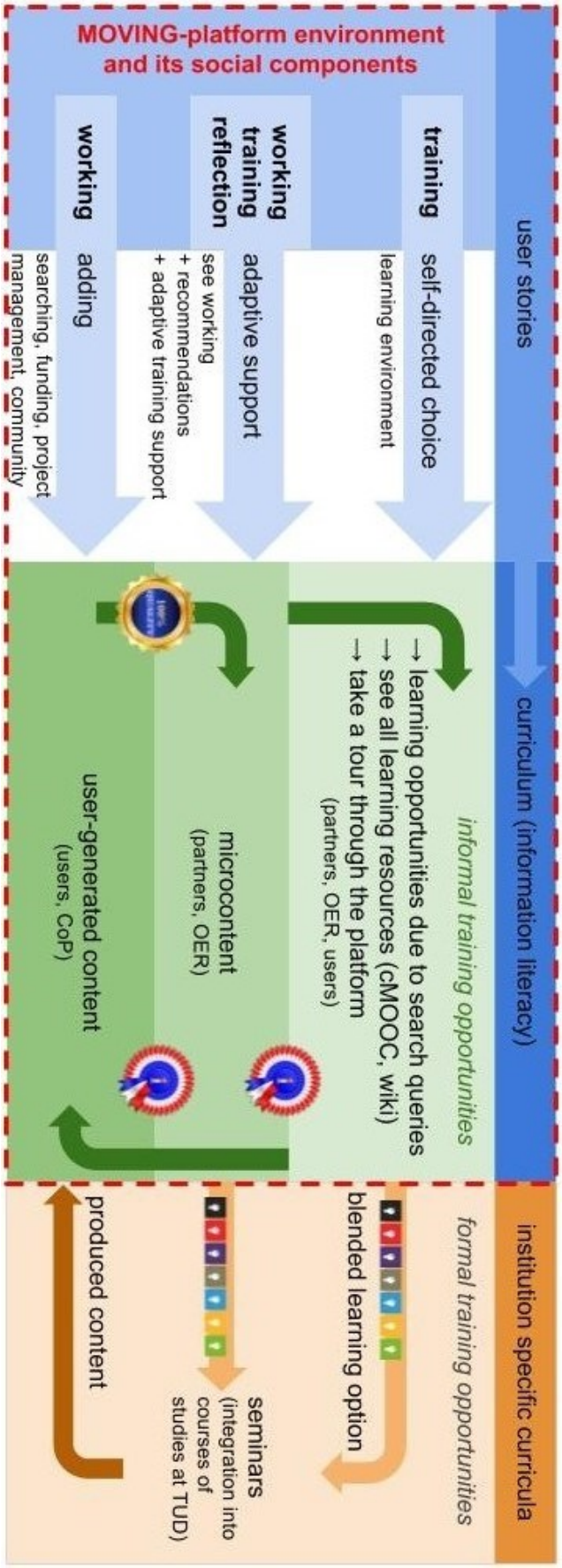

Figure 2: Initial conceptual framework

Table 2 gives explanations to every symbol of the initial conceptual framework shown in Figure 2. The learning paths will be explained afterwards.

Table 2: Legend of the initial conceptual framework

Symbol	Explanation
	Extending loop: micro content (content of the partners, OER, self-produced content, user-generated content) will be part of the different cMOOC-topics. In a cMOOC users mix and/or generate new content which can be extracted to the user-generated content and thus enrich the content-pool of the CoP. User-generated content with high quality can be also used for micro learning options. A quality assessment by the platform providers will be necessary and just reviewed user-generated content will be provided as micro content. Micro content can be also produced outside the cMOOC within the platform community or in connected seminars.
	The digital content can be used in face-to-face events (e.g. seminars) to offer students blended learning options. With the use of badges such options can be adapted to everyone's needs (e.g. pace, place, learning speed and type) and certified.
	Creating or producing content as well as participating in some parts of the cMOOC can be a task within seminars. Through giving marks for well-produced content, or part marks, a high quality can be guaranteed while the CoP is growing respectively students make a first step into it.
	Badges, as a way of assessment, can be achieved through informal learning opportunities (e.g. in the cMOOC, for produced content, for wiki entries)
	Quality assessment for user-generated content → see extending loop
(in brackets)	sources

The learning paths (training, working and the combined training and working) are shown in the framework (Figure 2). The connections of all learning paths to each other will be explained in the next three sections.

2.1 Learning path: training

The pure training intention is satisfied by the platform's learning environment with the following options:

- Search for some interesting learning materials such as:
  - A link to a well-done tutorial video, which explains you how to search more efficiently.
  - A link to a MOOC[1], which gives appropriate instructions on how to share sources you downloaded.
- Use the platform's learning materials:
  - The cMOOC gives a comprehensive learning environment about information literacy.
  - Wiki, which is growing as more users participate in training activities.
- Use the tutorial for the platform and its different features:
  - Tutorials, which give an overview about the platform's opportunities.
  - Tutorials, which explain how to efficiently use single features of the platform.

The learning path training comprises all knowledge units of information literacy. The focus is on searching, verifying and knowledge. The cMOOC comprises every unit of knowledge intensively. Search engine competence is a part of information literacy (Lewandowski, 2016). Search engine competence (within the knowledge unit searching) will be the platform's starting learning intention. Reaching the knowledge unit sharing is the final learning intention. The cMOOC[2] is a connective learning environment, where participants learn by making connections (Crosslin, 2016). This makes information literacy both topic and interaction. This cMOOC concept is a kind of pedagogical double decker (Geissler, 1985) and is facing new understandings of an information literate person within the knowledge society. Thus the cMOOC will not just create a learning environment for information

[1] Important international MOOC provider for the MOVING learning environment web crawl are the following: https://www.udacity.com, https://www.coursera.org, https://www.edx.org, https://www.open2study.com, last accessed: 30/03/2017

[2] cMOOC learning activities (Kop, 2011):

1) Aggregation: collection of a wide variety of resources.

2) Relation: reflection to prior knowledge and experiences.

3) Creation: blog post, social bookmarking site, entry in a LMS discussion, etc.

4) Sharing: with others and making connections.

literacy, but it will help the growth of a culture of open science alive for participants. The Connectivist Heutagogy's work aim, within a network, is to figure out how to become a learner of a specific topic (Crosslin, 2016). The instructor just offers an avenue for connections (Crosslin, 2016) and prepares students to work in a complex knowledge environment (Pankowska, 2017). The cMOOC will offer this. In a cMOOC the participants decide and contribute content and become already a community of practice (Gamage, Fernando, & Perera, 2016). Therefore, it is necessary to consider the environment of young researchers (Weilenmann, 2016), which is multimodal, interactive and social (Hartmann, 2016) and offer them participation opportunities on the learning environment (Mangold, 2016). Hartmann (2016) recommend that e-learning offers for information literacy should have a focus on the creative production of learning opportunities and should not aim at a perfect technical environment.

2.2 Learning path: working

Even pure working includes training. In a digital environment searching, finding, selecting and processing of information is the basis (Suehl-Strohmenger, 2016). But the production, creation and distribution of new knowledge within the process of scientific writing and publicising are getting more and more important (Suehl-Strohmenger, 2016). Strengthened scientific informational practice is applied to the principles of open science in a collaborative, open and transparent way (Suehl-Strohmenger, 2016). The learning-paths working means learning by producing, thus enriches the CoP with user-generated content and has a training focus on getting feedback to someone's own productions as well as the planned quality assurance for user-produced content. In modern science, for example, digital publications are including user-generated content (blog posts, wiki articles, video platform's and more), which offer the role of a prosumer to every user, but need skills within information literacy (Beutelspacher, 2014). Furthermore, information literacy and scientific writing are intermeshed (Suehl-Strohmenger, 2016) and publication competence is an important element of information literacy (Keller, 2016). The working learning path comprises all knowledge units of information literacy with focus on delineating and sharing (of the produced content) and is supported by Semantic Profiling and the Recommender Systems (Section 4).

2.3 Learning path: working and training

An intentioned mix of working and training will be offered by the use of the platform with help from the ATS (Section 5). The ATS offers reflections of the training and working progress by questions and micro learning recommendations for improving the progress.

The working and training learning path consists of all knowledge units of information literacy with focus on the units searching and verifying. An explanation on the units of knowledge within information literacy will be given in the context curricula development in the following section.

This framework is the common basis of the learning paths and places all learning opportunities, which will be available on the MOVING platform. Therefore the curriculum delivers the learning objectives.

3 Curricula

Following the MOVING project's vision of developing a training environment that supports people to improve their information literacy, a common understanding and the consideration of all aspects of information literacy is necessary. Hence the description of curricula contains learning objectives in the context of information literacy. Section 3.1 presents the general (digital) information literacy curriculum as a basis for the platform's training environment while Sections 3.2 and 3.3 show use case specific requirements for the training environment.

3.1 General (digital) information literacy curriculum

The general (digital) information literacy curriculum (Section 3.1.2) bases on a framework of information literacy. The following section presents the results of the literature review and explains which framework was chosen.

3.1.1 Literature review

The following variety of modern international frameworks (standards are on a higher level and will be shown later) for teaching information literacy relevant within the area of higher education was mentioned:

- The six information literacy standards by the United Nations Educational, Scientific and Cultural Organisation (Catts & Lau, 2008): definition and articulation of information need, location and access of information, assessment of information, organisation of information, use of information, communication and ethical use of information.
- The six-staged Big6 process model of how people of all ages solve an information problem, each with two sub-stages (Eisenberg, 2008): task definition (define the problem, identify the information needed), information seeking strategies (determine all possible sources, select the best sources), location and access (locate sources, find information within sources), use of information (engage by, for example, read, hear, view, extract relevant information), synthesis (organise information from multiple sources, present information), evaluation (judge the result – effectiveness, judge the process – efficiency).
- The seven pillars of information literacy core model for higher education (Society of College, National and University Libraries Working Group on Information Literacy, 2011): identify (identifying a personal need for information), scope (assessing current knowledge and identifying gaps), plan (constructing strategies for locating information and data), gather (locating and accessing the information and data they need), evaluate (reviewing the research process and comparing, as well as evaluating information and data), manage (organising information professionally and ethically), present (applying the knowledge

gained, that is presenting the results of their research, synthesising new and old information and data to create new knowledge and disseminating it in various ways).

- The so called ten strands of the new curriculum for information literacy (Coonan et al., 2012): transition to higher education, becoming an independent learner, academic literacies, mapping and evaluating the information landscape, resource discovery in your discipline, managing information, ethical dimension of information, presenting and communicating, synthesis and knowledge creation, social dimension of information.
- The digital and information literacy framework consists of five competence areas (Reedy & Goodfellow, 2012): understand and engage in digital practices, find information, critically evaluate information, online interactions and online tools, manage and communicate information, collaborate and share digital content. Each competence area has five levels each: access (level 0), foundation digital practice stage (level 1), interactive and co-operative digital practice stage (level 2), personalised and collaborative digital practice stage (level 3) and professional and digital identity stage (masters).
- The six-staged I-LEARN model for information literacy (Neuman, 2013): identify (activate, scan, formulate), locate (focus, find, extract), evaluate (authority, relevance, timeliness), apply (generate, organise, communicate), reflect (analyse, revise, refine), know (internalise, personalise, activate).
- The framework for information literacy for higher education with its six frames (Association of College and Research Libraries, 2016): authority is constructed and contextual, information creation as a process, information has value, research as inquiry, scholarship as conversation, searching as strategic exploration.

Various frameworks for information literacy were examined in order to create an appropriate curriculum for the MOVING platform. The focus was put on (updated) frameworks of the last years. The most important reason for this selection is the rapid change of digitalisation within the knowledge society. Older concepts of information literacy (ten years and older) are not facing all aspects of a today's (ongoing) digitised world (Beutelspacher, 2014). Older concepts have mostly a focus on librarian specific information literacy. Furthermore, information literacy is a dynamic concept and a subject to ongoing change, which also reached the stage of higher education and scientific research (Suehl-Strohmenger, 2016). Information literacy is very important to everyone in a digitalised world. Avoiding to be information literate can make people illiterate and lead to professional and personal problems and extend the gap between information literate and illiterate people (Tokić & Tokić, 2015). MOVING's vision to shrink and prevent this gap bases on a clear understanding of information literacy for supporting open innovations to improve the development of the European society. Information literacy is the ability, which enables to determine, select, procure, process, convert and create information efficiently and with appropriate media types as well as to communicate them over appropriate channels (Stoecklin, 2012).

The German library association (Deutscher Bibliotheksverband) defined five standards of information literacy for students (Dienstleistungskommission, 2010). The librarian's focus on information literacy is not contemporary, because information literacy cannot be explained on printed information. Information literacy also needs to include the understanding and interpreting of pictures and videos (as a kind of reading within information literacy), the creation/production of them (as a kind of writing within information literacy), as well as orientation on the internet (Stoecklin, 2012). The increased standards of Stoecklin (2012) modifies the librarian specific standards of information literacy for students within the context of the knowledge society, characterised by big data and based on a culture of information and communication technologies (ICT), which MOVING is aiming as well.

The modified five standards of information literacy for students are (Stoecklin, 2012):

1. Information literate students recognise their steady as well as situational need for information and determine the nature and extent of the information needed (searching, to search).
2. Information literate students gain efficient access to information, assess them and select appropriate information for their needs (verifying, to verify).
3. Information literate students recognise their steady and situational need for transmission as well as appropriate channels and determine the nature and extent of the information to be transmitted (knowledge, to know).
4. Information literate students use information practically or process them efficiently and effectively in an appropriate nature and an appropriate extent and transmit them (delineating, to delineate).
5. Information literate students appreciate the responsibility concerning the use and transmission of information towards both, others and themselves (sharing, to share).

These five standards of information literacy for students are still similar to the, probably best known (Beutelspacher, 2014), Information Literacy Competency Standards for Higher Education (American Library Association 2000). In general, there are many overlaps between different models and standards of information literacy (Beutelspacher, 2014). The modified five standards of information literacy for students by Stoecklin (2012) shown above is an appropriate basis for the MOVING vision and threefold. Firstly, it is based on and including the most international standards for information literacy as shown before. Secondly, it is facing the ICT culture in a digitalised world full of big data. Finally, it allows a symbiosis of all learning opportunities within the MOVING platform (see the framework in Section 2), especially because of the close alignment between information literacy standards and cMOOC activity patterns (Bond, 2015). This appropriate concept of information literacy allows the development of the curriculum, which is described next.

3.1.2 Development

Standards of information literacy are currently in a state of reformulation and realignment – national and international, while in Germany the focus lays on a common framework of reference for information literacy for all educational sectors (Franke, 2016). Therefore, the German framework of reference for information literacy for all educational sectors (Klingenberg, 2016b) is the basis of the further development. It consists of units of knowledge, which are according to the five partial-competences of information literacy (as shown in the end of Section 3.1.1), as defined within the German framework of reference for information literacy (Klingenberg, 2016a). This units of knowledge where already used as first level keywords to categorise the interview outcomes concerning the MOVING user stories (WP1, see Section 3 in D1.1). The level description is based on the general accepted references (Franke, 2016) of the Common European Framework of Reference for Languages (Council of Europe, 2009) following Klingenberg's idea to use them for this purpose (Klingenberg, 2016a). This makes comparisons between prior knowledge stages and learning objectives as well as requirements more easily. Furthermore, it is concerned, that independent descriptors are necessary to formulate learning objectives (Council of Europe, 2009). The descriptions are changed into the active form to reach a learner adequate formulation. Moreover, they are written in the context of the knowledge society characterised by digitalisation. The active "I can" wording for self-assessing is influenced by the European Unions (2015) self-assessment grid for digital competences, which is part of information literacy, especially in the field of processing information. The following overview shows the units of knowledge and explains them in general with work steps by questions or criteria (Klingenberg, 2016a):

- Search
    - What do I want to know?
    - Where could I find it?
    - Where is it written?
    - What is written there?
- Verify
    - Does it fit to the topic?
    - Is it true?
    - Is it written right?
    - Is it all?
- Know
    - Express in your own words.
    - Compare with other information.
    - Integrate into a context.
    - Connecting several information in a meaningful way.
- Delineate
    - Simple.

    - Varied.
    - Organised.
    - Surprising.
- Share
    - How I am allowed to use it?
    - Who wrote it?
    - Where it is from?
    - Who might be interested in?

The intensity of the main learning objectives within the knowledge subunits depends on the target group and ranges from primary education until lifelong learning. The levels A1 (breakthrough), A2 (waystage), B1 (threshold) and B2 (vantage) can be declared as requirements for the MOVING target groups through school socialisation. This puts the levels C1 (effective operational proficiency) within higher education for study and job as well as the level C2 (mastery) within further education essential for the MOVING training aims, which can be summarised as proficient information literacy. The following knowledge subunits are the main learning objectives and the basis for the use case specific contents influenced by D1.1. The MOVING general (digital) information literacy curriculum in active wording (for learner purpose) consists of five knowledge units with four knowledge subunits each, explained in the following tables.

The units of knowledge within the general (digital) information literacy curriculum are enriched with badges. These badges are emerging to (Gibson et al., 2015):

- Incentivise learners to engage in positive learning behaviours.
- Identify progress in learning, content trajectories.
- Signify and credential engagement, learning and achievement.

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[3] https://creativecommons.org/share-your-work/public-domain/cc0, last accessed: 30/03/2017

[4] https://pixabay.com, last accessed: 30/03/2017

[5] https://creativecommons.org/publicdomain/zero/1.0/legalcode, last accessed: 30/03/2017

Table 3 shows the subunits within the knowledge unit search.

Table 3: Knowledge unit search

			
Subunit	**Badge**	**Effective operational proficiency**	**Mastery**
Recognise and express the need for information/ knowledge		Extract search terms out of a scientific text.	Formulate suitable search terms to a scientific text.
Find resources (identify different information resources)		Find media independently also with unknown information tools on the internet.	Determine meaningful information tools independently and also search purposefully in unknown research systems.
Choose resources (the use of different information resources)		Find media independently also with unknown information tools on the internet.	Determine meaningful information tools independently and also search purposefully in unknown research systems.
Segregate information (identify and document information)		Document the search process and recognise given intentions of published information.	Document the search process and question the intentions of published information by yourself.

Table 4 shows the subunits within the knowledge unit verify.

Table 4: Knowledge unit verify

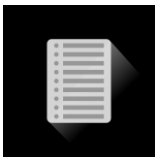
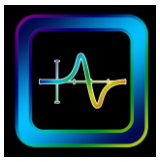
			
Subunit	**Badge**	**Effective operational proficiency**	**Mastery**
Verify the relevance of a topic		Identify a search topic within a manageable text with several thematic focuses.	Identify a search topic within a longer and complex text with several thematic focuses.
Verify the factual accuracy		Compare contradictions and wrong information within a text with other sources.	Scrutinise possible contradictions and wrong information within a text independently and compare them with other sources.
Verify the formal accuracy		Identify structural errors and deficiencies.	Identify and correct structural errors and deficiencies.
Verify the completeness		Decide, by which criteria the satisfaction of the need for information is determined.	Select systematically comprehensive different media for the satisfaction of the need for information by meaningful criteria.

Table 5 shows the subunits within the knowledge unit know.

Table 5: Knowledge unit know

			
Subunit	**Badge**	**Effective operational proficiency**	**Mastery**
Formulate/process an information		Formulate a simple thematically relevant information in a new technical terminology.	Formulate a complex thematically relevant information in a new technical terminology.
Compare information		Put new and familiar information in a bigger context due to further sources.	Develop an own attitude by new information of different sources and prior knowledge.
Integrate information		Rethink your own opinion because of new information.	Develop an own opinion to an unknown topic because of new information.
Organise information		Sequence new information from different sources in an own, meaningful way.	Give a weight to new information from different sources by your own.

Table 6 shows the subunits within the knowledge unit delineate.

Table 6: Knowledge unit delineate

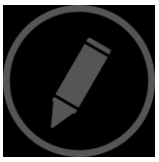
			
Subunit	**Badge**	**Effective operational proficiency**	**Mastery**
Linguistic simplicity		Present a complex topic clearly in comprehensive presentations.	Present a complex topic appropriate to the target group vividly.
Semantic redundancy		Transfer a topic to other contexts creatively.	Recognise a topic basic statements and present it in meaningful contexts.
Cognitive structuring (structure a topic well)		Structure a topic clearly and present each partial aspect by meaningful tools.	Structure a complex topic appropriate to the target group by meaningful tools.
Cognitive conflict (arouse interest on the topic)		Let the audience recognise a selected thematic aspect.	To let the audience choose the thematic aspect.

Table 7 shows the subunits within the knowledge unit share.

Table 7: Knowledge unit share

[redacted]			
Subunit	**Badge**	**Effective operational proficiency**	**Mastery**
Clarify terms of use		Understand and apply the copyright law and determine fundamental terms of use for foreign publications.	Monitor the discussion of copyright issues and determine terms of use for your own publication.
Mark citations		Avoid plagiarism by your own and other persons.	Support the avoidance of plagiarism.
Name resources		Use discipline-specific rules of citation.	Use rules of citation from other disciplines.
Use networks		Exchange new findings with others within your own scientific field.	Exchange new findings with others interdisciplinary.

Table 8 and 9 give an overview about the general (digital) information literacy curriculum.

Table 8: General curriculum overview (Part 1)

MOVING general (digital) information literacy curriculum in active wording					Missions: learning objectives and outcomes	
Prior knowledge assessment					By self-directed choice: Do you want to be able to ...?/I can ...	
Reference					Proficient information literacy	
Level					C1 (study, job): effective operational proficiency	C2 (further education): mastery
Knowledge		Badges		Work steps/criteria		
Unit	Subunit	C1	C2			
Search	Recognize and express the need for information/knowledge			What do I want to know?	Extract search terms out of a scientific text.	Formulate suitable search terms to a scientific text.
	Find resources (identify different information resources)			Where could I find it?	Find media independently also with unknown information tools on the internet.	Determine meaningful information tools independently and also search purposefully in unknown research systems.
	Choose resources (the use of different information resources)			Where is it written?	Find media independently also with unknown information tools on the internet.	Determine meaningful information tools independently and also search purposefully in unknown research systems.
	Segregate information (identify and document information)			What is written there?	Document the search process and recognize given intentions of published information	Document the search process and question the intentions of published information by yourself.
Verify	Verify the relevance of a topic			Does it fit to the topic?	Identify a search topic within a manageable text with several thematic focuses.	Identify a search topic within a longer and complex text with several thematic focuses.
	Verify the factual accuracy			Is it true?	Compare contradictions and wrong information within a text with other sources.	Scrutinize possible contradictions and wrong information within a text independently and compare them with other sources.
	Verify the formal accuracy			Is it written right?	Identify structural errors and deficiencies.	Identify and correct structural errors and deficiencies.
	Verify the completeness			Is it all?	Decide, by which criteria the satisfaction of the need for information is determined.	Select systematically comprehensive different media for the satisfaction of the need for information by meaningful criteria.

Table 9: General curriculum overview (Part 2)

MOVING general (digital) information literacy curriculum in active wording					Missions: learning objectives and outcomes	
Prior knowledge assessment					By self-directed choice: Do you want to be able to …?/I can …	
Reference					Proficient information literacy	
Level					C1 (study, job): effective operational proficiency	C2 (further education): mastery
Knowledge		Badges		Work steps/criteria		
Unit	Subunit	C1	C2			
Know	Formulate/process an information			Express in your own words.	Formulate a simple thematically relevant information in a new technical terminology.	Formulate a complex thematically relevant information in a new technical terminology.
	Compare information			Compare with other information.	Put new and familiar information in a bigger context due to further sources.	Develop an own attitude by new information of different sources and prior knowledge.
	Integrate information			Integrate into a context.	Rethink your own opinion because of new information.	Develop an own opinion to an unknown topic because of new information.
	Organize information			Connecting several information in a meaningful way.	Sequence new information from different sources in an own, meaningful way.	Give a weight to new information from different sources by your own.
Delineate	Linguistic simplicity			Simple	Present a complex topic clearly in comprehensive presentations.	Present a complex topic appropriate to the target group vividly.
	Semantic redundancy			Varied	Transfer a topic to other contexts creatively.	Recognize a topic basic statements and present it in meaningful contexts.
	Cognitive structuring (structure a topic well)			Organized	Structure a topic clearly and present each partial aspect by meaningful tools.	Structure a complex topic appropriate to the target group by meaningful tools.
	Cognitive conflict (arouse interest on the topic)			Surprising	Let the audience recognize a selected thematic aspect.	To let the audience choose the thematic aspect.
Share	Clarify terms of use			How I am allowed to use it?	Understand and apply the copyright law and determine fundamental terms of use for foreign publications.	Monitor the discussion of copyright issues and determine terms of use for your own publication.
	Mark citations			Who wrote it?	Avoid plagiarism by your own and other persons.	Support the avoidance of plagiarism.
	Name resources			Where it is from?	Use discipline-specific rules of citation.	Use rules of citation from other disciplines.
	Use networks			Who might be interested in?	Exchange new findings with others within your own scientific field.	Exchange new findings with others interdisciplinary.

This curriculum delivers the learning objective and is the basis for the use case specific developments. First requirements of the use cases include first results of the use case analysis by WP1 and are presented in the following two Sections 3.2 and 3.3.

3.2 Use case 1: training public administrators

The first use case (research on business information by public administrators) has the following two scenarios:

- Scenario 1: Research on compliance to European laws and regulations.
- Scenario 2: Innovation in advisory services.

The following sections contain the requirements for the first use case, which aims the target group compliance officers.

3.2.1 Requirements for professional education in accounting and auditing

Continuous professional education and training in accounting and auditing are accompanied by a dynamic market environment and a constantly changing rate of applicable accounting and auditing standards. Simultaneously, the market's expectation to the audit profession in regard to audit quality is steadily increasing. The International Accounting Education Standards Board (IAESB) reacts to those developments by issuing and revising International Education Standards (IES) that define the minimum requirements for the education and training of professional accountants.

IES 7, Continuing professional development, requires all professional accountants (including the audit assistants at EY) to develop and maintain professional competence relevant and appropriate to their work and professional responsibilities (IAESB, 2016a). IES 8, Professional competence for Engagement Partners responsible for audits of financial statements (revised), applies this IES 7 requirement to the role of an engagement partner and to professional accountants performing an equivalent role. Professional competence is progressive in nature and goes beyond knowledge of principles, standards, concepts, facts and procedures (IAESB, 2016b). It is the integration and application of (i) technical competence, (ii) professional skills and (iii) professional values, ethics and attitudes and is demonstrated by the achievement of learning outcomes (IAESB, 2016b; para. A2). Effective since 1st of July 2016, the IAESB implemented an exclusively output oriented approach for the assessment of learning activities according to IES 8. With this revision of IES 8, audit firms are required to adapt its learning approaches for the affected professionals to an output oriented assessment of learning activities (Fuessel, 2016).

In the context of MOVING, significant learning outcomes of IES 8 include the ability to (IAESB, 2016b):

- Analyse relevant industry, regulatory and other external factors including market, competition, product technology and environmental requirements.
- Understand the nature of the business, the operating environment and assess the entity's ability to continue as a going concern.

- Evaluate corporate governance structures and risk assessment processes.
- Evaluate the compliance with applicable accounting standards and relevant laws and regulations.
- Evaluate accounting judgments and estimates made by management.
- Apply a sceptical mind-set and professional judgment.

Those learning outcomes are closely related to the requirements of the International Standard on Auditing (ISA), especially ISA 315, Identifying and assessing the risks of material misstatement through understanding the entity and its environment and therefore the EY user scenarios developed in WP 1, Task 1.1. Professional scepticism and professional judgment are relevant for all audits (thus they are defined in the Glossary of terms to the ISA) and can be interpreted as a side condition for the learning approach. A sceptical mind-set is an attitude that includes a questioning mind, being alerted to conditions, which may indicate possible misstatement and a critical assessment of audit evidence. Professional judgment includes the application of relevant training, knowledge and experience in making informed decisions about the courses of action that are appropriate in the circumstances of the audit engagement. The MOVING platform is designed to support the professional accountants in fulfilling the abovementioned requirements and making informed analyses, evaluations and decisions.

3.2.2 Learning organisation

EY, as a learning organisation, will be supported by the MOVING platform. The following sections will give a first insight into learning at EY, learning inside and outside the MOVING application.

3.2.2.1 Learning at EY

High class learning is a fundamental and central element of the EY culture and a strategy to advance the personal potential of each and every employee. Learning at EY is organised in pre-defined learning roadmaps per service line and rank within the firm, containing core (mandatory), elective and role-related learning modules.

The learning development plans include multiple learning delivery methods:

- *Web-Based Learnings (WBLs)* are e-learning[6] environments delivered via the corporate intranet to the professionals. They often close with an assessment about the accounting and auditing knowledge covered in the WBL. The assessment has to be passed in order to complete the course.
- *Classroom courses* are face-to-face-courses taking place at the main office locations on specific dates during the year.

[6] https://www.virtual-college.co.uk/help/what-is-e-learning, last accessed: 30/03/2017

- *Self-study manuals* and *quick reference cards* are delivered via an intranet library and accessed on-demand. They mainly cover specific audit tools and their application in compliance with EY's audit methodology.
- *Videos* are currently most often integrated into WBLs. However, EY's innovation management for Germany, Switzerland and Austria has an ongoing initiative dealing with the provision of a video platform for knowledge-sharing and on-demand learning of specific topics. Those videos are also intended to facilitate the transfer of theoretical knowledge on work-related situations.
- *Learning-on-the-job* describes the training curve immanent to the audit profession that every employee passes through by gaining audit experience, working on a client engagement within the audit team and thus collaborating with more experienced colleagues.

Considering costs and benefits (Fiehl, Diaz, & Solom, 2013), videos and learning-on-the-job (in this case: "learning-within-the-application") have been identified as most suitable learning delivery methods for the MOVING platform at EY. These methods can be separated into learning inside and outside the MOVING application.

3.2.2.2 Learning inside the MOVING application

A benefit in the daily business at EY could be the adaptive (and digital) training support inside the MOVING application. User profiling and the assessment of prior knowledge combined with recommendations and real-time feedback could enable learning progress measurement and strengthen the awareness of the learning progress. The "learning-on-the-job" element can be supported by sharing insights to others, adding favourites and providing alternatives to current search profiles.

3.2.2.3 Learning outside the MOVING application

At EY, learning outside the MOVING application could be implemented by guided tours through different aspects of the application and short videos about best practices, recommendations and interpretations of specific outputs.

3.3 Use case 2: training young researchers

The second use case (managing and mining research information) has the following four scenarios, which will be expanded in this section:

- Scenario 1: State-of-the-art on a research topic.
- Scenario 2: Finding suitable partners for research projects that are active in the respective research fields.
- Scenario 3: Strategic decisions for deciding to go for which research funding for my topics.
- Scenario 4: Accompanying training materials, courses and tutorials.

The following sections contain the requirements for the second use case, which aims the target groups PhD and Master's students.

3.3.1 Requirements for professional education in higher education

This section includes relevant results of the requirement analysis of WP1 (see Section 3 in D1.1) about young researchers. In general, it can be declared, that PhD students as a target group are difficult to specify, are very heterogenic and have different subject cultures (Exner, 2014, Pilerot, & Limberg, 2015).

The following reasons to use or not to use a specific learning format are connected with the target group as the interview results show:

- Costs of courses or learning content are often not visible and the price/performance ratio seems not transparent.
    - Videos (e.g. YouTube).
    - Game-based-Learning.
    - MOOCs.
    - Webinar.
    - Self-study modules.
    - E-Portfolios.
- Courses are for free.
    - Face-to-face teaching (e.g. in-class courses of the graduate academy).
- It is possible to exchange with other participants.
    - Face-to-face teaching.
    - Other (a network between online courses and formats, where the person has the opportunity to talk, reflect and discuss the contents).
- The logistical effort is very low.
    - MOOCs.
    - Webinar.
- It is possible to get a certification for the attendance.
    - Face-to-face teaching.
    - Blended learning.
- It is possible to have access to learning content from all around the world.
    - Videos (e.g. YouTube) (Video lectures).
    - MOOCs.

3.3.2 Learning formats

These sections describe the working experiences in general based on the WP1 analysis and the experiences and wishes for informal learning (inside MOVING) and implication into institutional curricula (outside MOVING). For methodological aspects see Section 3 in D1.1.

3.3.2.1 Learning by young researchers

Table 10 presents the scenario specific scientific working experiences of PhD and Master's students within the first use case and implement this experiences into the subunits of the general curriculum. It is the WP2-relevant part of the comprehensive studies done in WP1 and described in D1.1 Section 3. The colours in the table show the relevance for the different scenarios according to the header of the table. Numbers in brackets show the second or third appearing due to relevance for different subunits of knowledge.

Table 10: Interview results within the curriculum (Colours show the relevance for different scenarios, numbers in brackets show the second or third appearing due to relevance for more subunits)

Knowledge subunit	**Scenario 1: State-of-the-art on a research topic.** **Scenario 2: Finding suitable partners for research projects that are active in the respective research fields.** **Scenario 3: Strategic decisions for deciding to go for which research funding for my topics.** **Scenario 4: Accompanying training materials, courses and tutorials.**
Express the need for information	- Use the Wikipedia find information about a new research subject and to find literature. - What is really needed for the own research?
Find resources	- Use search engines, alternative resources like ArXive.org, Social Networks find information about a new research subject/literature. - Which possibilities exist to find information at the library but also outside of it. - How and where to find project partners? - Find scientists who are important to a field of research through the quality or quantity of the essays of these scientists. - Find research partners through publications (i.e. authors of publications). - How to find project partners from other countries? - Which Websites are useful to find funding opportunities? - Who can help me (e.g. at my university) with information on funding opportunities? - Which data bases are relevant to find funding opportunities?
Choose resources	- Use search engines, alternative resources like ArXive.org, Social Networks find information about a new research subject/literature. - Which possibilities exist to find information at the library but also outside of it (2). - How to find what is searched for and how to research relevant information because of the large selection of sources? - Filter Search results. - How and where to find project partners? (2). - Find scientists who are important to a field of research through the quality or quantity of the essays of these scientists (2). - Find research partners through publications (i.e. authors of publications) (2). - Which Websites are useful to find project partners? - How to find project partners from other countries? (2) - Which Websites are useful to find funding opportunities? (2) - Which data bases are relevant to find funding opportunities? (2)

Knowledge subunit	**Scenario 1: State-of-the-art on a research topic.** **Scenario 2: Finding suitable partners for research projects that are active in the respective research fields.** **Scenario 3: Strategic decisions for deciding to go for which research funding for my topics.** **Scenario 4: Accompanying training materials, courses and tutorials.**
Segregate information	- Use keywords in databases to read the frequency of their usage. - At what point have I to end up my search for literature? - Use keywords and their frequency in documents in order to open up large amounts of text material.
Verify the relevance of a topic	- Use Search engines to verify the social relevance of a topic. - Use keywords in databases to read the frequency of their usage (2). - Decide on the relevance of a topic for the scientific research of a user (of the platform). - Use the function of displaying the temporal course of a public discourse on a specific topic e.g. from the online archive of Frankfurter Allgemeine Zeitung. - Visualise Search results. - Which Websites are useful to find project partners? (2) - Which Conferences etc. can be useful to find project partners? - What kind of funding (e.g. project funding from EU or national funding, foundations, companies, etc.) fits my research project?
Verify the factual accuracy	- Compare information from Wikipedia articles with relevant subject literature to verify the seriousness of Wikipedia content - Understand how algorithms (e.g. search engines) work -Handling with information from the internet (e.g. Social Media, the Wikipedia, Websites, Community-Websites) - Asses the reliability of sources esp. With unstructured information from the internet
Verify the formal accuracy	- Data Security.
Verify the completeness	- Understand how algorithms (e.g. of search engines) work (2) - Distinguish between important and not important information due to the large amount of it. - Criteria for decisions on the relevance of search results (e.g. impact factor of a journal article).
Process an information	N/A
Compare information	N/A
Integrate information	N/A

Knowledge subunit	**Scenario 1: State-of-the-art on a research topic.** **Scenario 2: Finding suitable partners for research projects that are active in the respective research fields.** **Scenario 3: Strategic decisions for deciding to go for which research funding for my topics.** **Scenario 4: Accompanying training materials, courses and tutorials.**
Organize information	- Mind Maps (to set personal focus, especially when considering large amounts of data and their selection) - Use and store meta data from publications. - Strategies/methods to organise (save and store) search results (e.g. with reference managers). - Tag search results with keywords. - Use of specific tools for literature research (e.g. reference managers like ZOTERO[7] or Mendeley[8]). - Decide on tags for search results and literature together in a research group
Linguistic simplicity	- How do I write a proposal that fits to the call for funding?
Semantic redundancy	- How do I write a proposal that fits to the call for funding? (2)
Cognitive structuring	- How do I write a proposal that fits to the call for funding? (3)
Cognitive conflict	N/A
Clarify terms of use	- Information on the Copyright/Terms of use of images, publishing content (texts, images) of still living persons of the time, right on one's own image. -Handling with information from the internet (e.g.: Social Media, the Wikipedia, Websites, Community-Websites) (2). - Decide on the publication format (e.g. Open Access or not). - Data Security (2).
Mark citations	- Citation regulations (e.g. APA guidelines).
Name resources	N/A
Use networks	- Citation regulations (e.g. APA guidelines). - Data Security (3). - use Social Networks (when it is meaningful? Which Social Networks e.g. research gate or XING? - Build up personal networks.

[7] https://www.zotero.org, last accessed: 30/03/2017

[8] https://www.mendeley.com, last accessed: 30/03/2017

Knowledge subunit	**Scenario 1: State-of-the-art on a research topic.** **Scenario 2: Finding suitable partners for research projects that are active in the respective research fields.** **Scenario 3: Strategic decisions for deciding to go for which research funding for my topics.** **Scenario 4: Accompanying training materials, courses and tutorials.**
(Almost) Overall	- How to conduct a structured literature research (structured literature review)? - Documentation of search terms and search process, combination of search terms - use of Asterisks and Boolean Operators, etc.).
Less relevant	- Network analysis. - Data security: searches for programs that enable safe work (search what other universities offer in their programs and consider how to use them in his own work process).

3.3.2.2 Learning inside the MOVING application

Informal learning experiences/wishes due to the interview results (methodological aspects see Section 3 in D1.1) are categorised into the following categories: videos (e.g. on YouTube), game-based-learning, face-to-face teaching, MOOCs, flipped classroom, webinar, blended learning, self-study modules, certification, E-Portfolios, books, journal papers, manuals, guidelines, exchange within the community (i.e. ask friends, colleagues, etc.) and other.

Self-regulated learnings, i.e. informal learning processes within the research process (e.g. within the process of searching for literature) are the following:

- Get information about software or (online) tools and how to use them that are important to solve specific problems or tasks within the research process.
    - Videos (e.g. YouTube) (tutorials).
    - Books, Journal Papers, Manuals, Guidelines.
- Get first information on a subject/topic that is new or where the researcher just started to work in.
    - Videos (e.g. YouTube).
    - MOOCs.
- Get an overview over a subject/topic.
- Get an insight in or an overview over a topic the researcher is not necessarily working in but is interested in.
    - Videos (e.g. YouTube) (TED-Talks).
    - Face-to-face teaching (e.g. summer schools).
    - Other (Social Media such as Blogs; popular scientific websites such as “brand eins”).
- Get information about methods (research methods) that are important or necessary to solve a specific research question or to conduct a specific task (e.g. literature research) within the research process.
    - Books, Journal Papers, Manuals, Guidelines.

- Exchange within the community (i.e. ask friends, colleagues etc.).
- Other (textmarks and bookmarks on Google)

This also gives a hint on how to reach the target group and is verifying the literature's advices like teaching information literacy by videos is one important way to face the needs of the target groups, communication on an equal footing is highly recommended as well the abandonment of pedagogisation to speak the language of the potential users and reach them in their environment (Seyder, 2016).

3.3.2.3 Learning outside the MOVING application

The curricular implementation can be of different nature and single learning elements can be used in single subjects or study areas (Wannemacher et al., 2016). More formal learning experiences/wishes due to the interview results (methodological aspects see Section 3 in D1.1), within self-contained courses on specific topics, are the following:

- Get information/learn about comprehensive topics, such as methods of scientific research, information literacy, general usage of online tools.
  - Face-to-face teaching (e.g. academic writing support).
- Get information/learn about comprehensive topics, such as methods of scientific research, information literacy, general usage of online tools in formal learning during the university studies.
  - Face-to-face teaching (e.g.: introductory courses).
  - Blended learning.
  - Certification.
- Attend courses on specific topics (e.g. Latin, Higher Education Didactics, Economic education, copyright issues, media design (media design for people with disabilities) and media work, for programming and programming languages, German as Foreign Language, online tools and how to use them).
  - Videos (e.g. YouTube).
  - Face-to-face teaching (e.g.: further education courses from the university library, conference sections).
  - Blended learning.
  - Self-study modules.
  - Certification (e.g. didactic certificate of the Saxon Centre for Higher Education).
  - E-portfolios.

The curriculum presents the learning objectives of teaching information literacy within the MOVING platform. It is the basis for the use case specific developments and the cMOOC. A first insight into the feature needs for the cMOOC is presented in Table 11.

Table 11: First insight into the cMOOC technical feature needs to WP4 by M24

ID	Who	What	Where	Platform	Origin
#001a	Admin	I write a blog post.	Blog	Within	Feature of MOVING
#001t	Tutor	I write a blog post.	Blog	Within	Feature of MOVING
#001u	User	I write a blog post.	Blog	Within	Feature of MOVING
#002a	Admin	I comment a blog post.	Blog	Within	Feature of MOVING
#002t	Tutor	I comment a blog post.	Blog	Within	Feature of MOVING
#002u	User	I comment a blog post.	Blog	Within	Feature of MOVING
#003a	Admin	I comment a blog commentary.	Blog	Within	Feature of MOVING
#003t	Tutor	I comment a blog commentary.	Blog	Within	Feature of MOVING
#003u	User	I comment a blog commentary.	Blog	Within	Feature of MOVING
#004a	Admin	I close the commentary option of a blog post.	Blog	Within	Feature of MOVING
#004t	Tutor	I close the commentary option of a blog post.	Blog	Within	Feature of MOVING
#005t	Tutor	I iframe a YouTube video in a blog post.	Blog	Within	Feature of YouTube
#005u	User	I iframe a YouTube video in a blog post.	Blog	Within	Feature of YouTube
#006t	Tutor	I iframe a YouTube video in a blog comment.	Blog	Within	Feature of YouTube
#006u	User	I iframe a YouTube video in a blog comment.	Blog	Within	Feature of YouTube

The curriculum provides the learning objectives for the ATS (see Section 5). In addition, for the technical implementation of the ATS, the ATS takes the recommendations provided by the semantic profiling and recommender system into account (see Section 4).

4 Semantic profiling and recommender system

There is enormous volume of scientific publications published every year and the readers cannot read them all. We address the problem of offering the users of the MOVING platform suggestions about scientific publications which they might like to read. Recommending scientific papers in the context of the ATS of MOVING is based on the users' utterances on the platform such as social media postings. The recommender system provides generic profiling methods that support the ATS for learning content (Section 5.3.1). The recommender system is developed on top of ZBW's previous developed recommender system (Nishioka & Scherp, 2016). In our MOVING recommender system, we trained a deep learning, called paragraph vectors, for re-ranking the best results of the HCF-IDF and CF-IDF algorithms (see Section 4 for details on the model). In the following sections we will present the problem statement (in Section 4.2), method description (in Section 4.3), the evaluation metrics and the results (in Section 4.4).

4.1 Literature review

Capturing the user interests from a set of text updates (e.g. tweets, social media status) have been studied in different works. Chen et al. (2010) presented a recommender system that could recommend URLs to the users based on their Twitter profiles and follower-followee relationships. The authors implemented twelve strategies and concluded that profiling based on the users' tweets performed better than based on the tweets of their followees. Goosen et al. (2012) proposed a recommender system for news articles based on a novel CF-IDF profiling method. CF-IDF is an extension of TF-IDF where the terms are replaced by the concepts which are extracted from WordNet[9], a large lexical dataset. The authors performed an experiment where 100 news articles have been displayed to 19 users to indicate whether it is relevant or not. The results show that CF-IDF outperformed TF-IDF. Lu et al. (2012) presented an approach for capturing users interests based on his or her tweets for the purpose of re-ranking. The authors represented the user interest profile as a set of Wikipedia concepts. Inspired by the previous work, we have developed a novel method, called HCF-IDF, as a hierarchical variant of CF-IDF (Nishioka & Scherp, 2016). We have built a recommender system based on twelve user profiling strategies, each of which generated five recommendations to 123 participants in an online experiment. Half of the strategies were applied on full texts and the other on titles of scientific publications. The participants assessed whether the recommendations are of their interest or not. The results showed that the best recommendations were achieved by CF-IDF and HCF-IDF on full text, with a sliding window as decay function. However,

the novel HCF-IDF profiling method achieves similar results with just using the titles of the publications.

Following the successful application of HCF-IDF, we have investigated the possibility building a deep learning model that capture a syntactic and semantic word relationships in the users' social media profiles in order to provide better recommendations. To this end, we investigated recent word embedding techniques. Mikolov et al. (2013) introduced the skip-gram model, an efficient method for learning high quality vector representations of words from large amounts of unstructured text data. The word vectors generated the skip-gram model, which showed a high performance for explicitly encoding different linguistic regularities and patterns. The results inspired Quoc Le et al. (2014) for developing an unsupervised learning technique, called Paragraph Vectors, that takes advantage of the skip-gram model's words representation to learn fixed-length feature representations from variable-length pieces of texts (e.g. documents, users' social media profiles). The results showed that the paragraph vector model outperformed the bag-of-word models.

4.2 Problem statement

Providing recommendations of scientific papers based on the users' profiles is a challenge. For addressing this problem, we defined a recommender system that is composed of the following four main components (Nishioka & Scherp, 2016):

(1) User profiling from social media items:

Consider that the user of the MOVING platform u has an active social media profile which contains a set of textual updates I_u. The user profile P_u will be generated using different functions Φ and is defined as:

$$P_u = \Phi(I_u, C) \coloneqq \{(c, w(c, I_u)) \mid \forall\, c \in C\}$$

Where w computes the importance of a concept $c \in C$ in the user's social media stream I_u. The profiling methods Φ are described in Section 4.3.1.

(2) Profiling scientific publications:

For profiling scientific publications, we applied the same profiling methods as in the user profiling. This allows determining a similarity score between a user profile and publication profile. Consider the scientific publication $d \in D$. The document profile P_d will be generated using different profiling functions Φ and could be defined as:

$$P_d = \Phi(d, C) \coloneqq \{(c, w(c, d)) \mid \forall\, c \in C\}$$

Where w computes the importance of a concept in document d.

(3) Ranking of scientific publications:

After generating the user profile P_u and the scientific publication profile P_d, we apply a similarity function σ for computing the similarity between them. This could be defined as:

$$\sigma(\mathrm{P_u}, \mathrm{P_d}) \rightarrow [0,1].$$

The similarity scores over all $\mathrm{d} \in \mathrm{D}$ are used for ranking the documents and retrieving the most relevant five documents.

(4) Deep learning re-ranking:

For re-ranking the five relevant documents which have been generated by the previously mentioned methods, we have used a documents embedding method, called paragraph vectors (PV). We use PV as profiling method over the top five documents. Let the PV profile of document d be denoted as $\mathrm{P_d}$. The re-ranking method will represent the document d by its words' vectors. PV is mapping the word vectors into a vector space such that semantically similar words have similar vector representations (e.g. "strong" is close to "powerful"). PV is also representing variable length texts as fixed length vector (Le & Mikolov, 2014).

The top five relevant documents $\mathrm{r}(\mathrm{P_u}, \mathrm{P_D})$ to a user profile $\mathrm{P_u}$ are re-ranked by finding those documents that are close to the user's social media text in terms of cosine distance σ :

$$r(P_u, P_D) = (d_1, \dots, d_n), \sigma(P_u, P_{d_u}) \leq \cdots \leq \sigma(P_u, P_{d_n})$$

It should be noted that the dimensionality of the paragraph vectors' profile of a document $\dim(\overrightarrow{\mathrm{P_d}})$ has a high impact on the recommendation results. The re-ranking method is described in Section 4.3.3.

4.3 Method description

We start by discussing methods for profiling documents and computing user profiles on the MOVING platform (Section 4.3.1). Subsequently, we description of how to use using the results of these methods as an input for a cosine similarity function in order to provide an initiation ranking of top-k relevant documents (Section 4.3.2). Finally, we present an approach of re-ranking the top k relevant documents using the deep learning paragraph vectors model, which has been pre-trained with the user's profiles.

4.3.1 Profiling methods

We present the two main methods for profiling, which provided the best recommendations in a previous work, namely HCF-IDF and CF-IDF (Nishioka & Scherp, 2016).

CF-IDF

CF-IDF is an extension of TF-IDF that counts concepts instead of terms. CF represents the frequency of occurrence of a concept, while the IDF factor of a term is inversely proportional to the number of documents in which the concept appears. This means, the lower the concept appears in the corpus, the higher the IDF factor and vice versa. CF-IDF is the product of these quantities and is computed using the following equation:

$$\text{score}_{\text{cf-idf}}(c, d) = \text{freq}(c, d) \,.\, \log \frac{|D|}{|d \in D : c \in d|}$$

Where $|D|$ denotes the number of documents in our dataset and $|d \in D: c \in d|$ are the number of documents d in D containing c.

HCF-IDF

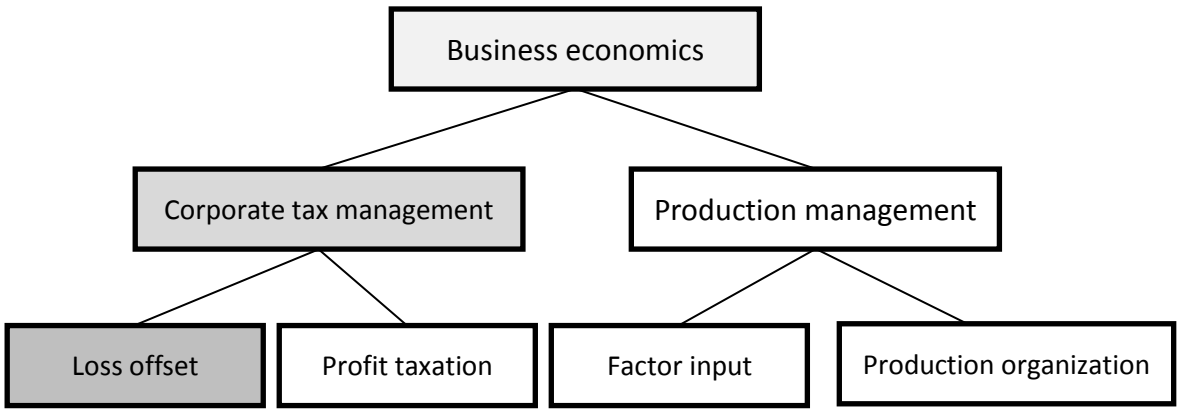


Figure 3: An example of HCF-IDF

HCF-IDF is an extension of CF-IDF that takes into account the hierarchical structure of concepts by applying a spreading activation function. Figure 3 shows an example where a user social media profile includes the concept "loss offset". Because of the hierarchical structure of the thesaurus of economics, also called STW thesaurus (more details in Section 4.4.1), HCF-IDF will also activate the parent concepts "Corporate tax management" and "Business economics". The algorithm will automatically give less weight to the general concepts, like "Business economics", by using the bell log spreading activation which has been presented by Kapanipathi et al. (2014).

HCF-IDF is a product of the following two quantities and is computed using the following equation:

$$\text{score}_{\text{hcf-idf}}(c, i) = \text{BL}(c, i) \,.\, \log \frac{|I_u| + |I_r|}{|\{i \in I_u \cup I_r : c \in i\}|}$$

Where $|I_u|$ denotes the user's social media stream, $|I_r|$ is the number of random social media items and $\text{BL}(c, i)$ is the bell log spreading activation function.

4.3.2 Ranking based on similarity scores

For computing the similarity between the social media profile of the MOVING user P_u and the documents profiles in our MOVING database, which have been generated using the previously mentioned methods (in Section 4.3.1), we employ the cosine similarity using the following equation:

$$\sigma(P_u, P_d) = \frac{\vec{P_u} . \overrightarrow{P_d}}{\left|\left| \vec{P_u} \right|\right| \; \left|\left| \overrightarrow{P_d} \right|\right|}$$

Based on the similarity scores $\sigma(P_u, P_d)$, the top five documents are chosen and passed to a pre-trained paragraph vectors model for re-ranking the documents based on their semantics. More details are covered below.

4.3.3 Profiling and re-ranking with paragraphs vector

The approach aims to map the detected concepts into a vector space in such a way that similar concepts are located close to each other. The underlying assumption is highly inspired by the skip-gram word embedding models, presented by Mikolov et al. (2013). Due to the fact that similar concepts appear in similar contexts. A corpus 'documents' of paragraph vectors are trained simultaneously with the word embedding. The training optimises the paragraph representation such that it encodes the probability of a sequence of words to occur in a paragraph. The profiling method of paragraphs vectors will then compute the vector representation of a document and the user's social media profile and compute the cosine similarity between both of them. Two paragraph vectors will be similar (in terms of cosine similarity), if the entities are similar. This is utilised to improve the recommendation results of the CF-IDF and HCF-IDF profiling methods.

The word embedding model of the PV is mapping the word vectors into a vector space such that semantically similar words have similar vector representations. Formally, assume that you have a set of words $w_1, w_2, \ldots, w_{t-1}, w_T$ in your document. The objective is to maximise the log likelihood of a word based on the $Log\ P(w_t|w_{t-k})$.

For performing the prediction task, we used softmax loss function:

$$P(w_t|w_{t-k}, .. w_{t+k}) = \frac{e^{y_{w_t}}}{\sum_i e^{y_i}}$$

Each y_i is un-normalised log-probability for each output word i, computed as

$$y = b + Uh(w_{t-k}, \ldots, w_{t+k}\ ;\ W)$$

Where U, b are the softmax parameters, h is constructed by a concatenation or average of word vectors extracted from W.

4.4 Experimental evaluation and comparison

In this section, we will present more information about our evaluation methodology (Section 4.4.2), the datasets which have been used (Section 4.4.1) and the results in correspondence with the nDCG evaluation metric (Section 4.4.3).

4.4.1 Datasets

Economics thesaurus (STW) The economics thesaurus[10] provides a vocabulary of more than 6,000 economics subjects. This thesaurus is developed and maintained by an editorial board of domain experts at ZBW -- Leibniz information centre for economics.

EconBizRecSys evaluation dataset The EconBizRecSys evaluation dataset[11] contains the evaluation results from a previously built recommender system based on the assessments of n = 123 participants after analysing their Twitter profiles (Nishioka & Scherp, 2016). The evaluation results have been generated for twelve different strategies, each of which contains five scientific publication recommendations and its corresponding user assessment. The recommended scientific publications are a subset of the ZBW Economics dataset (see D6.2: Data Management Plan).

4.4.2 Evaluation procedures

In order to evaluate the performance of our MOVING recommender system, we have used two datasets (Section 4.4.1). The first one, STW, has been used for building the documents and the user's profiles. The second dataset has been used to re-evaluate the recommendation results of the HCF-IDF and CF-IDF profiling methods and evaluate the re-ranking recommendation results of the paragraph vectors model comparable to the users' assessment as a gold standard. The paragraph vectors model was trained on the EconBizRecSys evaluation dataset in order to capture the semantics of the participant's utterances and to avoid the problem of "out of vocabulary words", this problem occurs when the embedding models are trained on a small dataset (in terms of the number of words) from different domains. For evaluating the results we have used the nDCG metric (see below).

4.4.3 Evaluation metric

For evaluating the usefulness, often called gain, of the recommended document based on its position in the recommendations list, we apply the normalised discounted cumulative gain (nDCG) metric. The metric compares the re-ranked recommendation results from the paragraph vector method (DCG) with the user assessments of the recommendation results which have been generated by the CF-IDF and HCF-IDF profiling methods (IDCG) as a gold standard.

In more details, let D be the set of documents, rel(d) is a function that returns one if the document is relevant and zero for the non-relevant comparable to the user. Thus, the normalised discounted cumulative gain nDCG could be computed as:

[10] http://zbw.eu/stw/version/latest/about, last accessed: 30/03/2017

[11] https://datorium.gesis.org/xmlui/handle/10.7802/1224, last accessed: 30/03/2017

$$nDCG_k = \frac{DCG_k}{IDCG_k} \text{ where } DCG_k = \text{rel}(1) \quad + \sum_{i=2}^{k} \frac{\text{rel(i)}}{Log(i)}$$

In Table 12, the final results of the re-ranking recommendation results are presented.

Table 12: Normalised discount cumulative gain (nDCG) of the CF-IDF and HCF-IDF plain recommendation results vs. the re-ranked results of the paragraph vectors model (PV**).**

	Strategy	**Re-ranking Strategy**	**NDCG@5**
Full text	CF-IDF	PV	0.822 (0.267)
		-	0.796 (0.274)
	HCF-IDF	PV	0.740 (0.325)
		-	0.773 (0.327)
Titles	CF-IDF	PV	0.671 (0.345)
		-	0.654 (0.335)
	HCF-IDF	PV	0.762 (0.332)
		-	0.734 (0.327)

The semantic profiling and the recommender system is one technical part of the ATS, which is presented in the following Section 5.

5 Adaptive Training Support

In this section, we will give an overview of the Task 2.1 Adaptive Training Support (ATS) and the corresponding activities conducted in Y1 of MOVING. These activities focus on the development of the Adaptive Training Support for guiding the training and working on the MOVING platform including the elaboration of a theoretical concept, mock-ups and its technical implementation.

Most of the described activities have been carried out together with other work packages (mainly WP1 and WP4) and between multiple project partners as depicted in Figure 4 (i.e. EY, TUD, ZBW and UMAN and will therefore be referred to where applicable.

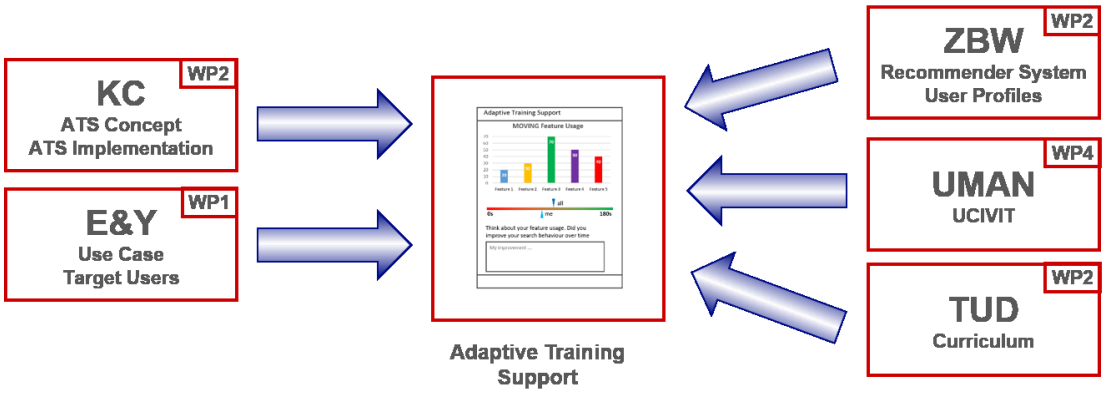


Figure 4: MOVING partners contributing to the Adaptive Training Support

5.1 Activity overview

For the development of the Adaptive Training Support the following major activities were taken:

- Development of a theoretical adaptive training and learning support concept based on a literature review (see Section 5.2) and requirement analysis (see Section 5.3).
- Development of a clickable mock-up of the Adaptive Training Support including its integration in the MOVING platform (see Section 5.4 and WP1 Deliverable D1.1).
- Organisation of an online focus group with EY for evaluating the Adaptive Training Support concept and mock-up and checking its relevance for the use cases provided by EY (see Section 5.6).
- Starting the technical development of the adaptive training support tool for the Adaptive Training Support (see Section 5.4).

In more detail, Figure 5 depicts a summary of the activity streams for the development of the Adaptive Training Support on a timeline.

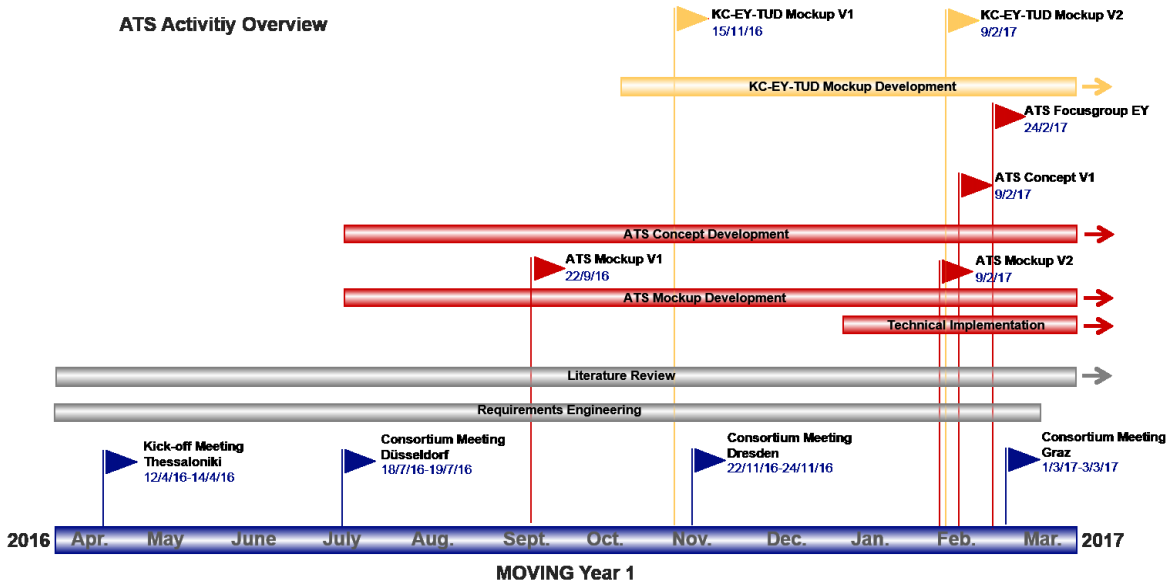


Figure 5: ATS Activities conducted in year 1 of MOVING along a timeline

For the development of the Adaptive Training Support concept and the implemented clickable mock-ups, we conducted requirements engineering during the first year. The requirement engineering for both started with discussions during the first two MOVING consortium meetings in April and July 2016. Thus, we discussed on the one hand with colleagues from EY and TUD, how the ATS might look like and which features it should have. In addition, we discussed with the colleagues from UMAN, which information their activity tracking tool (UCIVIT) collects and how this information can be accessed and used for the development and implementation of the ATS. In September 2016, the first stand-alone ATS mock-up was presented and discussed together with the MOVING consortium. We presented a set of slides with mock-ups of the ATS to give the whole MOVING consortium a first impression on how the ATS will look like and which functionalities it has. During these discussions it became clear that the ATS needs not only to support the training on the platform itself but also to provide opportunities for learning content on the platform. Afterwards, the collaboration together with EY and TUD became closer in order to combine the requirements provided by EY and TUD with the ATS of Know-Center into one combined mock-up representing the MOVING platform. As a result, a first mock-up for the whole MOVING platform was created covering most of the search functionalities and visualisations the platform should have including the integrated ATS. These mock-ups were presented and discussed at the Dresden Consortium meeting and afterwards, the mock-ups were further refined in order to meet the use case requirements of EY and TUD. This also included of how the ATS can be better related to the user stories of EY and how to relate the Curriculum developed by the TUD to the ATS. Finally, a first clickable mock-up was developed in cooperation with all three partners and presented to all partners at the beginning of February 2017. During this iteration cycle, the second ATS mock-up emerged and covered not only on how to provide support for learning on using the platform, but also how to present content recommendations on learning content within the platform. To provide these recommendations tailored to the MOVING user's

need, discussions with ZBW started in order to find out, which information can be provided by the ZBW's recommender with the goal to be presented within the ATS. In parallel to the development of the mock-ups, the ATS concept was continuously pushed forward including a continuous literature review. The requirement analysis was closed with an online focus group conducted with target-users of EY on the 24th of February 2017 followed by intensive discussions on the Consortium Meeting taking place in Graz from the 1st-3rd of March 2017. The goal of the focus group was to evaluate the developed concept and ATS mock-ups and finally adapt it to needs of EY user stories (see Section 5.6). The discussions at the consortium meeting shed light on how to improve the functionality of the ATS as well as how to relate the Curriculum of TUD to the ATS. At the beginning of 2017, the technical implementation of the first prototype of the ATS started. In the integration camp, on the third day of the MOVING Consortium meeting in Graz, intensive discussions took place between KC, UMAN and TUD on how to technically implement and integrate the ATS in the MOVING platform.

5.2 Literature review

For the development of the Adaptive Training Support, related work of different research areas need to be taken into account. Therefore, this section will give a short overview of the related literature with regard to reflective learning and guidance, adaptive hypermedia systems, as well as social comparison and motivation.

5.2.1 Reflective learning and guidance

Reflective learning is the conscious re-evaluation of past experiences with the goal to learn from them to guide new behaviour (Boud et al., 1985). In literature, there are different types of technologies like prompts, diaries or visuals (Fessl et al., 2017) that aim to actively guide reflective learning not only in conventional learning environments but also in work-related settings.

By reflection prompts, we understand interventions (or triggers) such as small text messages or questions that try to motivate a user to reflect (Davis, 2003). In the area of self-regulated learning, prompts are used very often to organise, retrieve, monitor or evaluate knowledge as well as to reflect on own learning progress (King, 1992; Xung & Land, 2004; Bannert, 2012; Ifenthaler, 2012). Following Fessl et al. (2015), we consider two types of prompts: reflection amplifiers and reflection interventions. We understand reflection amplifiers as prompts that do some sort of content or behaviour analysis and adapt to the results of this analysis. As they relate to actual statements made by or activities carried out by the user, they are ideally more on target (in the sense of personalisation) than interventions. In contrast, reflection interventions are prompts that ask users for action, in this setting to use a new feature on the MOVING platform to improve learning and training productivity. Core challenges for both types of good prompts are right timing in the sense of not interrupting a user where (s)he should not be interrupted and context-awareness in the sense of adapting context where possible (Thillman et al., 2009).

Diaries are personal notes not meant to be shared; hence most studies focus on the effect of diary writing on learning (Tang, 2000). In contrast, the term "journal" is mostly used to describe diaries that are intended for sharing and are often used in training settings, e.g. athletes (Walker, 2006) and also in work-related settings especially in medical education of nurses (Thorpe, 2004; Chirema, 2007; Harris, 2008). The joint goal of diaries and journals is to support describing experiences by providing a technology for content creation (e.g. allowing text) and provide easy accessibility and sophisticated visualisations to engage learners in re-visiting these experiences. However, creating diaries or journals is very time consuming, thus it needs to be carefully considered if and how such tool can be instantiated in work-related settings.

Fessl et al. (2015) describe a general applicable reflection guidance concept that conceptualises diaries as "reflection-on-action" components and prompts as "reflection-in-action" components. The terms "reflection-on-action" and "reflection-in-action" lead back to Schoen (1984) emphasising the different timing of prompts and diaries with regard to the activity into which reflective learning is embedded in. This distinction with regard to the timing as well as the insights gained on how to apply prompts and diaries and which challenges to address provides us valuable insights for the design of the Adaptive Training Support for the MOVING platform.

For the Adaptive Training Support, we will implement reflective prompts in form of reflection interventions as well as reflection amplifiers (Fessl et al., 2015) in order to motivate MOVING users to reflect on their search behaviour. Second, we will also provide a reflective diary in order to capture reflective thoughts of the user (Fessl et al., 2015). We are aware that it is very difficult to motivate users to insert notes in a diary, however, we have experienced that people using a diary really reflect (Fessl et al., 2015; Rivera-Pelayo et al., 2017) and we also need these entries to evaluate the ATS with regard to reflective learning. Third, for the timing of the presentation of such prompts, we will follow Schoen (1984) to motivate users to reflect during as well as after the usage of the MOVING platform.

5.2.2 Adaptive Hypermedia Systems

Brusilovsky (2012) extensively investigated Adaptive Hypermedia Systems in the area of education and training. He defined "*adaptive hypermedia systems build a model of the goals, preferences and knowledge of each individual user; this model is used throughout the interaction with the user in order to adapt to the needs of that particular user*". In his work, he started with a literature research to show the development of adaptive hypermedia systems over time. Furthermore, he explores the nature and mechanisms for adoption and provided several example tools, like QuizGuide (Brusilovsky et al., 2004) or QuizMap (Brusilovsky et al., 2011). In both examples, the visualisations adapt to the users' learning progress by changing the content of the visualisations on the fly.

Brusilovsky's work on adaptive hypermedia systems (Brusilovsky et al., 2004, 2011; Brusilovsky, 2012) as well as his very famous work on user models (Brusilovsky & Millán, 2007) gave valuable insights for the development of the Adaptive Training Support. On the one hand, we use the examples of the adaptive visualisation as inspiring input on how to develop of the ATS visualisations

adapted to the user's needs. Second, we build on Brusilovsky and Millán, (2007) work on user models and designed MOVING user profiles accordingly.

5.2.3 Social comparison and motivation

Social comparisons are fundamental psychological mechanisms to influence users' judgements, experiences and behaviour. Users compare themselves to others in order to achieve certain goals or satisfy needs such as self-evaluation, self-enhancement and self-improvement (Corcoran et al., 2013). Although the results of social downward and upward comparison are not unique, we see social comparison as promising approach for increasing learning and working productivity. One example on how the social comparison can positively influence the user behaviour at work is reported in Rivera-Pelayo et al. (2017). Comparing the own mood with the average team mood of call takers in a call-centre setting does not only show the curiosity of call takers in the mood of colleagues but also motivated for capturing more moods. Also Glahn et al. (2009) used two smart indicators – one for representing user's activity and the other for user's performance in relation to the average user performance – to engage and motivate learners to participate and contribute in an open community platform. The results showed that participants who are "playing the system" to influence the indicators have a positive effect on reflecting about their social context and contextualised their activities to the community.

Social comparison is closely related to the user's motivation, as investigated by Wheeler (1966). He showed that *"…upward comparison is positively related to motivation to have a high score*" in an educational setting. Following Verpoorten et al. (2009), they point out that motivation *"… rests on three key factors: perceived controllability, perceived value of learning tasks and perceived self-efficacy for it*". These aspects strongly depend on the users understanding of the own learning process and their engagement of the learning or working activity they are in. Thereby also, the differentiation between intrinsic and extrinsic motivation needs to be taken into account. While intrinsic motivation refers to "*doing an activity for the inherent satisfaction*", extrinsic motivation refers "*to the performance of an activity in order to attain some separable outcome*" as stated by Ryan and Deci (2000).

For the development of the Adaptive Training Support, we aim at increasing the extrinsic motivation (Ryan and Deci, 2000) in order to improve the own search behaviour on the MOVING platform. This should be achieved by providing performance indicators showing information about own search behaviours in comparison to others (Wheeler, 1966).

5.3 Adaptive Training Support concept

5.3.1 Goals and adaptation of the Adaptive Training Support

The Adaptive Training Support pursues to achieve the following two major goals:

- Support for learning how to use the MOVING Platform

- Support for learning content (i.e. to become an information savvy professional))

In order to reach these goals, the Adaptive Training Support adapts to two types of data:

- Feature-based adaptation: this type of support adapts to the search behaviour of the MOVING user in relation to the used features available on the MOVING platform. It mirrors back feature usage and behaviour and suggests MOVING features aiming at improving the user's search behaviour.
- Content-based adaptation: this type of support adapts to the context of the user. This context might be for example related to the user's search topics or the user's curriculum. Thus, the adaptation refers to presenting more detailed information or content to the user.

Figure 6 presents the relation between the goals of the Adaptive Training Support and how the two types of adaptations refer to them. For training the user of how to use the MOVING platform, the feature-based adaptation will be used while for the learning of content, a combination of feature-based and content-based adaptation will be provided.

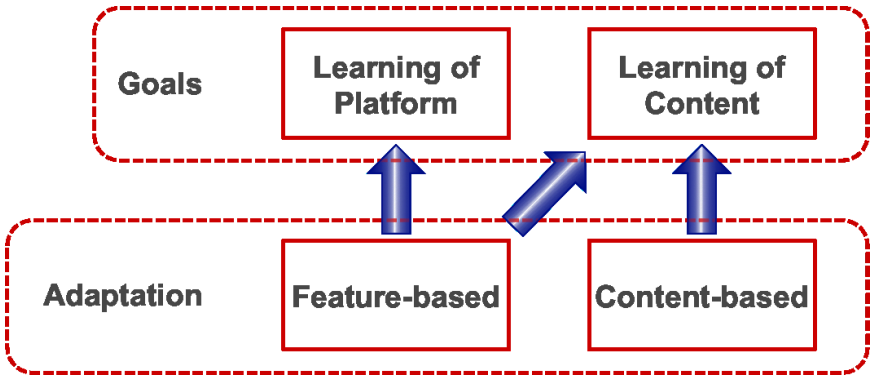


Figure 6: Adaptive Training Support Goal and Adaptation

ATS' data flow is depicted in Figure 6.

Input: The input step consists of two parts, namely i) context and user data and ii) input from the recommender system and curriculum.

Context and user data: the goal of this input step is to collect context and user data in order to use this information as input for the Adaptive Training Support. The context information consists on the one hand of the user's workplace activities, especially the usage of the MOVING platform during work. These activities are automatically tracked by the UCIVIT Tool, an activity logging mechanism provided by UMAN (a short description can be found in Section 5.4.3; a detailed description in D4.1, Section 3.5.1.). On the other hand, the user data consists of user-related information stored in the corresponding user profiles. This information encompass individual user preferences, settings tailored to the user's needs as well as information about the user's knowledge such as gained badges of the curriculum (as described in Section 3).

Recommender system and curriculum: The goal of this input phase is to provide meaningful recommendations and topics of the Curriculum. The recommendations consist of scientific

publications, videos, etc. with regard to the user's context (see Section 4). The curriculum topics consist of topics referring to the user's chosen curriculum (see Section 3).

Analysis: The goal of the analysis part is to use the data collected and provided by the input step and analyse these data to prepare data for visualisation, social comparison and to provide reflection guidance that will be presented in the ATS. For the feature-based ATS, the analysis step will take into account the context and user data in order to derive information with regard to the user behaviour and search patterns including the features and functionalities of the MOVING platform used. It will compute data for being presented as visuals, performance indicators and guidance in the form of questions or sentence starters for reflective learning. For the content-based ATS, not only the context and user data will be used, but also the input received from the recommender systems and the curriculum. Out of these data, the analysis step will additionally decide, which recommendations and curriculum topics are worth being presented to the user.

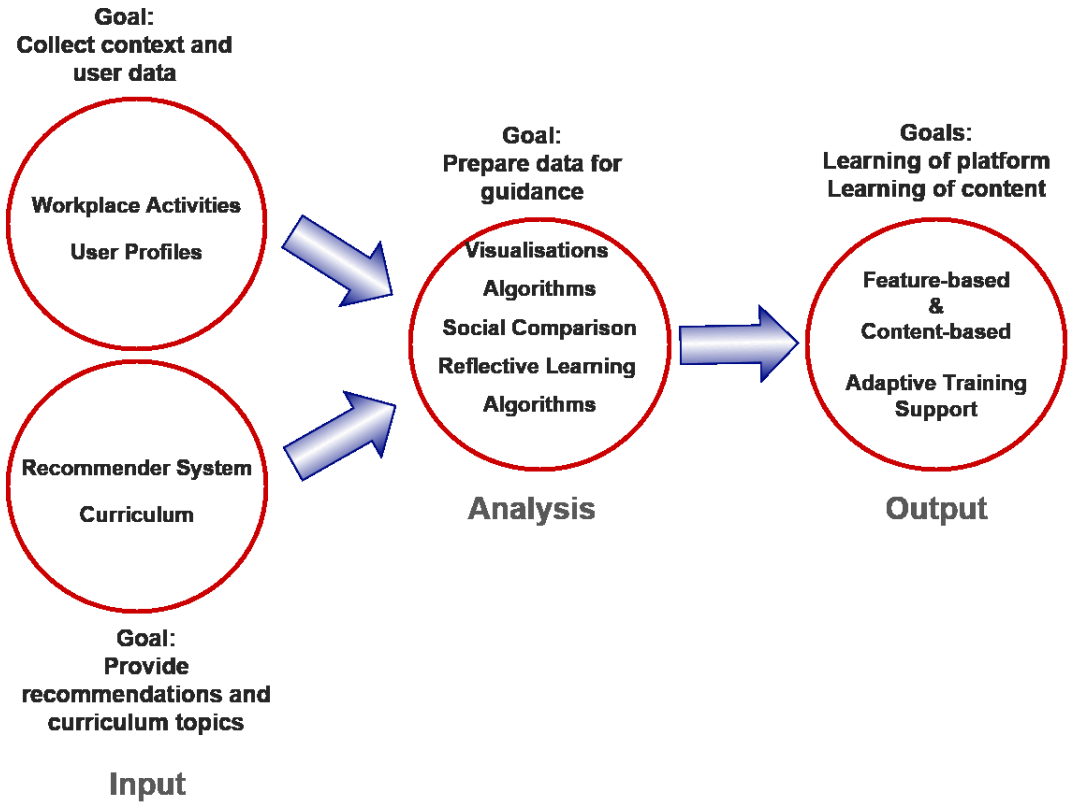


Figure 7: Adaptive Training Support DataFlow

Output: The goal of the output phase is twofold: First, it provides learning support for learning how to use the platform as well as opportunities on how to improve the search behaviour by suggesting not used or unknown features to the user. Second, it provides learning support by suggesting content for learning. Therefore, the Adaptive Training Support will consist of two parts, feature-based and content-based Adaptive Training Support, which will be described in more detail below.

5.3.2 Feature-based Adaptive Training Support

The feature-based Adaptive Training Support puts its focus on providing guidance for training MOVING users on how to efficiently and effectively use the MOVING platform. The goal of the ATS is to make MOVING users aware of the available MOVING functionalities in order to be later able to exploit the complete potential of MOVING platform functionalities. This exploitation includes the user's awareness of all MOVING features, to quickly retrieve the desired and relevant information and finally to enhance the user's search satisfaction. To achieve this training support, the ATS provides different types of guidance and triggers for raising awareness and reflection. The guidance and triggers consist on small hints in form of tiny visualisations in combination with questions or sentence starters to motivate users to think about the own search behaviour (Fessl et al. 2015). Thus the ATS consists of three different parts. First, the ATS mirrors back the user behaviour in relation to the features used (Malacria et al., 2013). Second, the ATS presents various performance indicators (e.g. number of search terms used, search speed) for comparing the own search behaviour with other MOVING users as motivational triggers to improve the own search behaviour (Corcoran et al., 2013). Third, the ATS presents motivational triggers for example in form of sentence starters (Davis, 2003), questions (Rivera-Pelayo et al., 2017), or recommendations with the goal to motivate users to reflect on already used features or to try out new functionalities.

5.3.3 Content-based Adaptive Training Support

The content-based Adaptive Training Support puts its focus on recommending content tailored to the MOVING users' needs and the users' current learning and working context. To achieve this working support, the ATS provides recommendations of content on different levels. On the one hand, it will provide recommendations based on the user's search context and on the other hand curriculum topics depending on the user's selected curriculum and the corresponding learning progress. For example, it will present recommendations about further literature, research documents or videos. For the curriculum in addition, the ATS will also present reflective prompts referring to curriculum topics the user is engaged in. For example, these prompts should make aware of curriculum topics not visited yet by the user or ask to reflect about curriculum topics and the corresponding learning progress.

5.3.4 Challenges for Adaptive Training Support

Out of literature and from experiences collected in the MIRROR project (see Fessl et al. 2012; Fessl et al. 2015; Rivera-Pelayo, 2017; Fessl et al. 2017), we are aware that in order to be able to successfully provide Adaptive Training Support several challenges needs to be taken into account. These challenges will be to find out, when (timing for guidance) to present what guidance (feature vs. content), how (e.g. push notification) and where (e.g. desktop vs mobile) to motivate MOVING users to follow and use the content provided by the ATS (Thillmann et al., 2009, Fessl et al., 2015). The following four major challenges have to be scrutinised in more detail:

- **Timing of Guidance**: the timing of guidance is of crucial relevance in order to not disturb the MOVING user during training and working but being perceived as useful. Thus, it needs to be carefully considered when to present for example triggers for reflection (e.g. questions) especially in the use case of EY, when the auditors have time-paced and stressful working activities to perform.
- **Content of Guidance**: the content of guidance is also of central importance. On the one hand, the content of the visualisations, questions or sentence starters needs to be adapted to the context of the current MOVING user (independent if feature-based or content-based). On the other hand, the content needs to be diversified to keep the motivation high for reflection and to stir up the users' curiosity using the Adaptive Training Support.
- **Type of Guidance**: the approach of how to motivate people to guide needs also careful considerations. Push notifications (e.g. when something occurs or to a user defined time), silent notifications (e.g. blinking icons) as well as fading in/out widgets might be useful. However, they need to be adapted to the users' preferences.
- **Location of Guidance**: the location or device of where to present the ATS is also essential. On the one hand, the presentation will be implemented directly in the MOVING platform itself and be presented to the user during the usage of the platform. The advantage is that the user can directly use the ATS during the usage of the platform; the disadvantage is that the user might not have the time to, e.g. reflect when looking for necessary information in a work-intensive time. On the other hand, the ATS can also be shown on mobile devices after having used the MOVING platform, e.g. after a working day, or on the way home in a bus. The advantage here is the user might have time to for example, reflect or check out own usage behaviour when being caught-up in a relaxed moment. The disadvantage might be that the user does not like to be bothered with work-related topics, when having left the office.

5.4 ATS prototype

For developing the ATS prototype we started with the development of paper-based mock-ups and focussed on the development of the feature-based Adaptive Training Support.

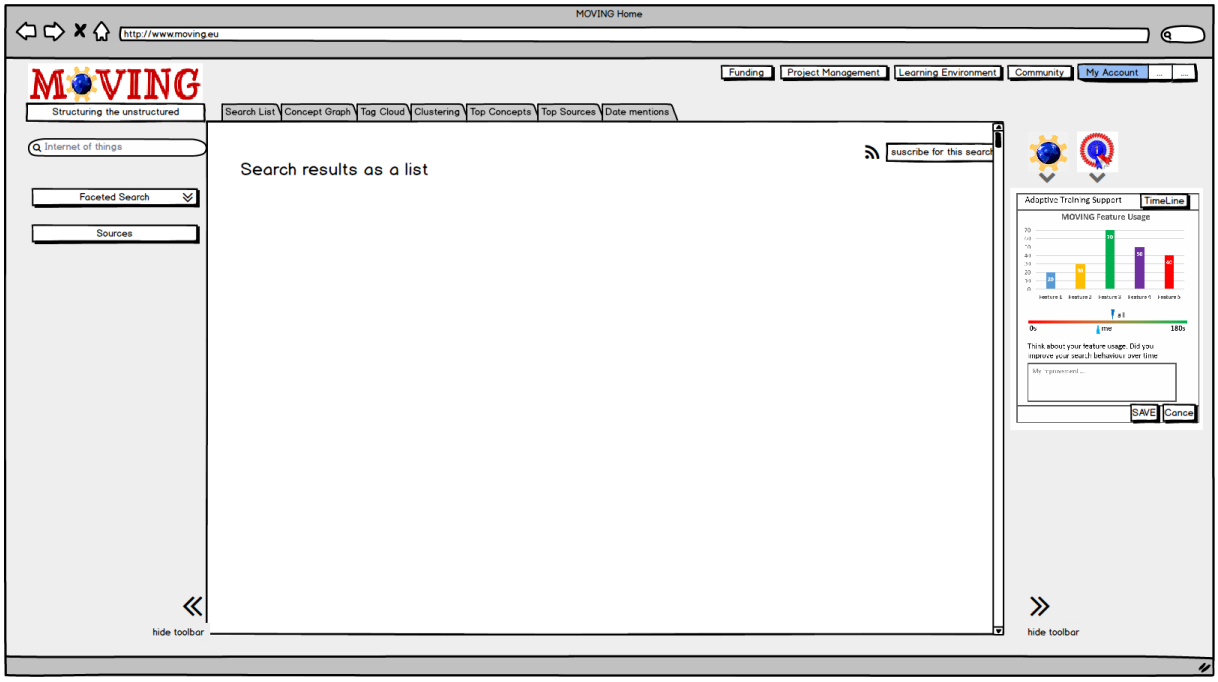


Figure 8: Clickable Mockup of the MOVING Platform with ATS on the right bar

Figure 8 shows the MOVING platform as a whole and depicts that the feature-based ATS is integrated on the ATS Bar on the right side of the MOVING platform. When designing the feature-based Adaptive Training Support Widget, the insights gained out of literature (see Section 5.2) were taken into account. In addition, for implementing the ATS widget in a sophisticated and meaningful way, we also used the work of Malacria et al. (2012) as a good example. Thus, the basic widget consists of a tripartite user interface with the goal to (i) visualise the feature usage behaviour of the MOVING platform to the current user (Figure 9, top), (ii) provide motivation for improvement by comparison (Figure 9, middle) and (iii) motivate for reflection and action by prompts and sentence starters (Figure 9, bottom).

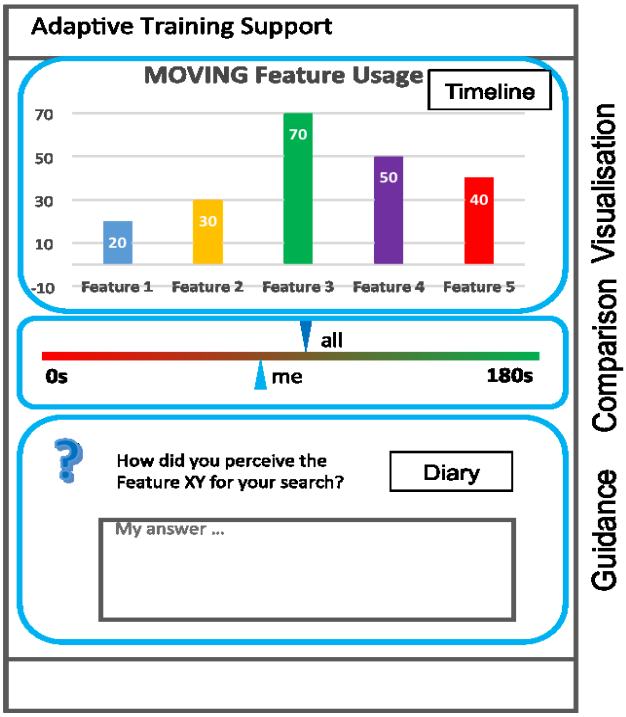


Figure 9: Adaptive Training Support widget

Visualisation: Feature Usage. This visualisation (see Figure 9, top) presents the last five used MOVING features with the goal to raise the user's awareness of the user's individual feature usage and subsequently the search behaviour on the MOVING platform. The visualisation is updated on-the-fly depending on the user's interaction in order to show a change in behaviour. In the first ATS prototype, our understanding of features refers to, for examples, inserting keywords in the platform, using different facets of the faceted search or select different sources as well as the usage of different visualisation presenting the search results. How fine-grained the definition of a feature is – e.g. just switching from one visualisation to another versus using one visualisation more in-depth by zooming in or clicking on nodes in the graph visualisation – will be defined during project runtime.

In addition, the visualisation part does not only visualise the last five used features of the MOVING platform, but when clicking on the Timeline Button the development of the MOVING feature usage behaviour over time is presented, as shown in Figure 10.

Comparison: Performance Indicator. The goal of the performance indicator is to raise the awareness of the current user regarding the individual performance in comparison to the average performance of other MOVING platform users. By providing this direct comparison opportunity, the user's intrinsic motivation to improve should be raised to change and/or improve the own search behaviour. The performance indicator itself is adapted to the user's needs and the user's context (e.g. use cases EY or TUD students) and therefore not limited to only one type of indicator. In the example presented in Figure 9, the performance indicator shows the individual search time of the user in comparison the

average duration of all users performing a search. Other examples are the number of search terms inserted or the number of clicks used to get the desired results.

Guidance: Reflection and Recommendation. This part presents either reflective prompts to motivate to reflect on past user behaviour or activities done, or to motivate the user to use another MOVING feature (see Section 5.2) or a sentence starter in combination with a suggestion to rate a used MOVING feature. All prompts are adapted to the user's preferences, user behaviour and user needs. In addition, when clicking on the Diary button as shown in Figure 9 the ATS diary is opened and shows how different prompts were answered by the user and which different new features or content recommendations were accepted, as depicted in Figure 11.

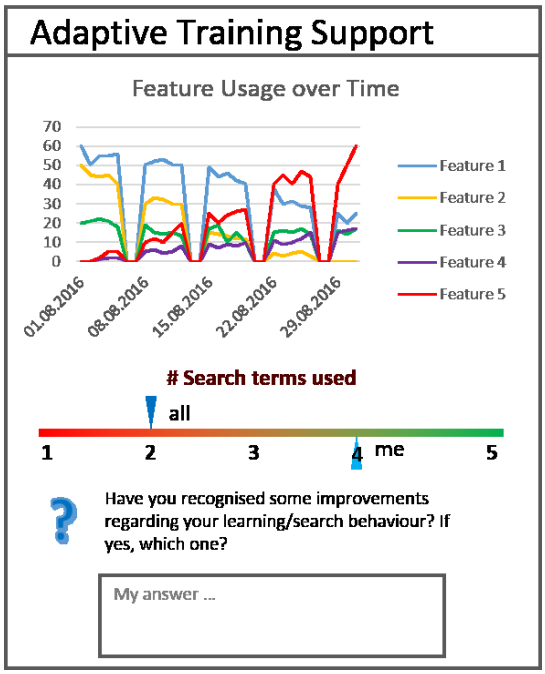


Figure 10: Feature development over time

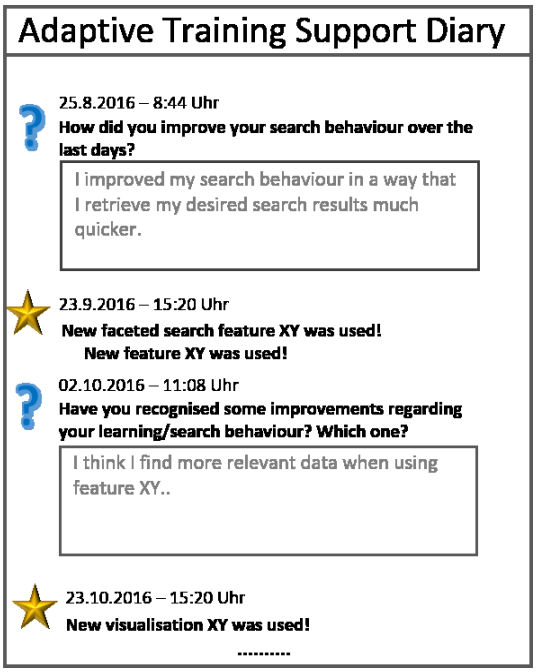


Figure 11: Adaptive Training Support diary

5.4.1 ATS architecture

The architecture of the Adaptive Training Support (feature-based and content-based) consists of typical client-server architecture as depicted in Figure 12.

On the client-side, the Adaptive Training Support will be implemented in form of a widget that is a lightweight and flexible representation form that can be easily integrated into the web user-interface of the MOVING platform. For the client, we use HTML 5, JavaScript and CSS to represent the ATS visualisations and prompts.

On the server-side, we implement an Adaptive Training Support Engine that performs the following tasks: i) gather data from data providers like Recommender System (see Section 4.2) , UCIVIT - the click-log activity tracking tool - (for details see D4.1, Section 3.5.1) and the curriculum (see Section 3.1.2), ii) gather information from and store information in the user profiles and ATS databases and

iii) analyse and prepare triggers to be presented in the ATS widget on the client side. The communication between the client and the server is established with REST API calls. The data is sent in a JSON-encoded format.

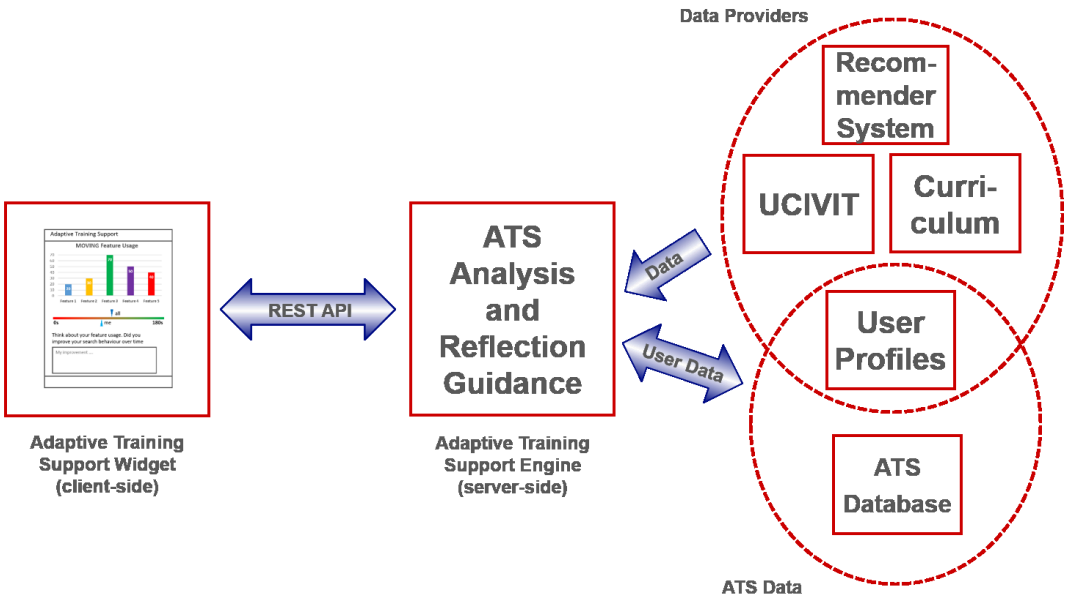


Figure 12: Schematic representation of the ATS implementation

5.4.2 Client-Side: ATS widget

The prototype of the feature-based ATS will be developed according the defined and presented mock-ups (shown at the beginning of Section 5.4).

The first prototype of the content-based Adaptive Training Support will be implemented after the first version of the feature-based ATS is implemented. The content-based ATS will be aligned to the Curriculum developed in Section 3.2. The first idea is to use reflective questions and sentence starters to initiate reflective learning with regard to the content of the Curriculum. Therefore, we will develop a set of predefined questions and sentence starters that include a placeholder for being replaced with a topic of the curriculum. Examples of reflective questions are:

- "How do you perceive your learning progress with regard to the topic "placeholder" of the MOVING curriculum?"
- "Why the document you just visited on the topic "placeholder" useful or not useful for you?"
- "You have visited the most important documents regarding the topic "placeholder". We would recommend you to go on with topic "placeholder" of the MOVING curriculum."
- "I would recommend the document on the topic "placeholder" to other students, because …"

The development of the first content-based ATS will start after having implemented the first prototype of the feature-based ATS, thus we cannot guarantee that the prototype of the content-based ATS will be ready for the first review.

5.4.3 Server-side: Adaptive Training Support engine

On the server-side, the Adaptive Training Support engine has to conduct the following tasks: i) it gathers data from data providers, user profiles and the ATS database, ii) it analyses these data to create information and triggers worth being reflected on and iii) it stores ATS information (the triggers created and the input received from the ATS widget) in the ATS database.

The main task of the ATS engine is to do the analysis necessary for extracting the knowledge worth being displayed in the widget. For the visualisation of the last five used MOVING features as well as the implemented performance indicators, the collected data of the activity tracking system (UCIVIT) is used. The UCIVIT stores all clicks done by the user on the MOVING platform and is therefore used to extract the last five MOVING features used by the user. This data serves also additionally as source for the performance indicators. The engine takes into account the user's preferences stored in the user profiles for example when to present a prompt. The ATS engine uses the MOVING recommender as well as the curriculum in order to recommend and suggests content adapted to the user's context. Finally the ATS stores its own created data in the ATS database. Bringing all this together, the engine has then to decide based on all available data provided by all data providers and ATS data, which type of trigger or recommendation is presented to the user when, where, how often and how.

The data providers consist of an activity tracking system called UCIVIT developed by U, a recommender system developed by ZBW and the curriculum database developed by TUD. The user profiles, also developed by ZWB, will serve as data provider but will also store ATS information related to the user. Moreover, the ATS database will store information about the ATS. Each of the tools mentioned will be described below in more detail and where possible, we will refer to other MOVING work packages and MOVING deliverables.

Semantic profiling and recommender system

The recommender system of the MOVING platform will be capable of capturing the user interests from their utterances on the platform such as social media postings and recommend them some scientific publication. A detailed description is presented in Section 4.

User Activity Tracking System (UCIVIT)

The UCIVIT will be used for tracking all user interaction of interest (mouse and keyboard interaction, but also browser window events and changes to the state of elements on the page) on the MOVING platform. By doing so it provides the data the ATS relies on for calculating and visualising the user's last used features, their usage frequency and other implemented performance indicators. A detailed

description of the UCIVIT as well as the list of events it captures can be found in Deliverable 4.1 Section 3.5.1.

Curriculum

The developed curriculum will be used for the content-based Adaptive Training Support in order to provide working support. A detailed description about the curriculum and the available information is described in Section 3.2 of this deliverable.

ATS database

The ATS Database will be either become a part of the user profiles or implemented on its own. This is under consideration as both tools are still at the beginning of their development.

The ATS will store possible questions or text modules or sentence starters, necessary for presenting prompts. The questions or text modules will be chosen based on the analysis results of the data and on the previously presented prompts.

In addition, the ATS Database will store the following information per user: the prompts and recommendations presented to the user (including date and time and type of presentation), the answers given and the recommendations followed by the user. The first is relevant for tracking which kind of prompt or content recommendation was already presented to the user and to make the presentation of the triggers and recommendations as varied as possible. The second is relevant for both, to present the answers given to prompts in the user's ATS diary. Furthermore, the analysis of the answers given and the recommendations used will show over time, which of the triggers and recommendations work for the user with regard to reflective learning and which of them the user is not interested in.

5.5 Evaluation procedure

For the evaluation of the Adaptive Training Support, we will follow a three-step model as depicted in Figure 13. This model combines three types of evaluations during the 3-year runtime of the MOVING project: as starting point in year 1 we evaluate the iteratively developed and improved ATS concept and the corresponding ATS mock-ups (see Section 5.1 and Section 5.4). Therefore, we conducted a focus group with EY (see Section 5.6) and a design workshop with MOVING members (see Section 5.7) to evaluate the concept. Second, the formative evaluations in year 2 will focus on the evaluation of the developed ATS prototype. These evaluations aim at having at the end of year 2 a stable and mature Adaptive Training Support tool including the required functionalities and an intuitive user-interface. Third, summative evaluations conducted in year 3 will show the achieved impact of the developed Adaptive Training Support. Below, we will describe the three steps in more detail:

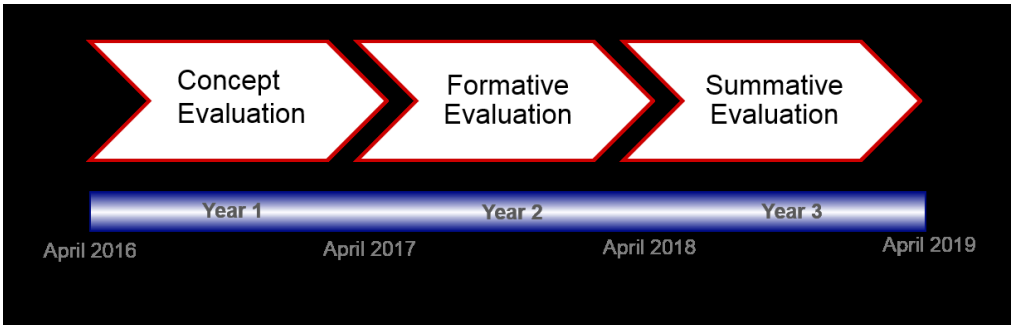


Figure 13: Evaluation procedure for the Adaptive Training Support

Step 1: ATS requirements engineering and concept evaluation

Requirements Engineering phase was closed with the evaluation of the ATS concept to check if the concept is suitable for the target group. For this purpose, we conducted a focus group for the Adaptive Training Support concept with 7 target users of EY in February 2017 (see Section 5.6) and a design workshop at the MOVING consortium meeting in March in Graz with 10 participants in March 2017 (Section 5.7).

Focus Group: Focus groups (Morgan, 1997) are moderated group discussions, in which researchers bring a focus via different impulses into a group. The goal of a focus group is to narrow down existing ideas and to concentrate on one possible solution applicable for the corresponding work-related setting.

Design Workshop: Design workshops based on participatory design approaches (Kensing and Blomberg, 1998) are used to discuss with end-users the design and features of a tool or application, after an initial trial has taken place. The goal of a design study is the improvement of the discussed application with regard to the user interface and features.

Step 2: Formative evaluations

The focus of formative evaluations (Faltin, 2013) is to improve the Adaptive Training Support with regard to its functionality and user interface. These formative evaluations will include not only small experiments but also field studies in the use case environments of the MOVING project. The received feedback of these users is then used to drive the next software development cycle. At the beginning of the development cycle, the test users need not necessarily be from the target user group, doing first improvement iterations with other users will help create a more mature and robust app. After some first improvements through non-target users, target users should evaluate the application in order to enhance the relevance of the feedback.

In more detail, the ATS will be tested in 2-3 rounds by 10-20 users, including employees from EY, students from the TUD, students from Graz University of Technology and employees of the Know-Center. A first evaluation will take place in first half of year 2, with the goal to get first insights on how to improve the Adaptive Training Support with regard to its functionality and user interface. In the second half of year 2, we plan to do 1-2 further formative evaluations with persons from EY and

TUD and perhaps from Graz University of Technology. The goal of these formative evaluations is to iteratively evaluate and improve the ATS aiming at having at the end of Y2 a stable, mature and robust ATS with regard to its functionality and user interface. This version of the ATS will then be used for the summative evaluations to measure the impact of the ATS on the search and learning behaviour of MOVING users.

Step 3: Summative evaluations

Summative evaluations (Knipfer et al., 2012; Faltin, 2013) are used after the application and the usage method have reached a good maturity. Thus, the goal is not longer to improve the application, but to measure the impact of the application with high reliability and precision. To measure the impact of an application, we need both a larger number of users to reach statistical reliability and a continuous ATS usage for several weeks in the target setting. In the case of the Adapted Training Support this means to evaluate both, the feature-based as well as the content-based ATS, with regard to their support and usefulness for the MOVING users

In more detail, in year 3 we plan to conduct 2 summative evaluations one at EY and one at the TUD and the Graz University of Technology. The goal of the summative evaluation is to investigate the impact of the implemented ATS. Therefore, the summative evaluations should last for at least 4 – 8 weeks each. During each evaluation, the MOVING platform and the integrated ATS should be consequently used by EY employees during work (at EY) and by students (of both universities) learning or conducting research activities. For each evaluation we will prepare pre-, in-between and post questionnaires. Where possible we will either conduct final interviews or final workshops discussing the subjective impression of the participants. In addition we will also analyse the data collected with the activity logging tool to get objective user behaviour information.

5.6 Focus group at EY: evaluation of the ATS concept and mock-ups

At the end of the requirements engineering process and after having developed the ATS concept and the clickable mock-ups, we conducted a focus group to investigate the developed ATS. The focus group was prepared to discuss the Adaptive Training Support with the target users from EY. The goal of the focus group was twofold: First, we wanted to find out for which of the seven user stories (A detailed description of the user stories can be found in D1.1, Section 4) provided by EY the Adaptive Training Support would fit best or should focus on. Second, we wanted to investigate in more detail the functionality of the ATS and here with focus on the performance indicators and the prompts and their corresponding timing. Therefore, we prepared a slide set covering the following three topics: i) Introduction of the MOVING Platform, ii) EY user stories and iii) performance indicators and prompts.

5.6.1 Procedure

Introduction to the MOVING Platform: We presented 3 screens of the clickable mock-up of the MOVING platform including the ATS (see Figure 8). We explained the participants how the MOVING platform will look like and how the ATS will be integrated in the platform and its purpose.

EY user stories: We recapitalised the seven user stories provided by EY. Then we asked the participants to award a first, second and third place for the user stories regarding their importance and where the ATS should be tailored to most.

Performance indicators and prompts: We presented several diverse examples of performance indicators (see Figure 14) and reflective prompts (see Figure 15) both of them either supporting the feature-based ATS or the content-based ATS. The goal was on the one hand to discuss which performance indicators and prompts might be valuable and meaningful for EY users. On the other hand, we wanted to investigate criteria for when to present which type of prompt on which device. All insights gained from the focus group will be taken into account during the development of the ATS.

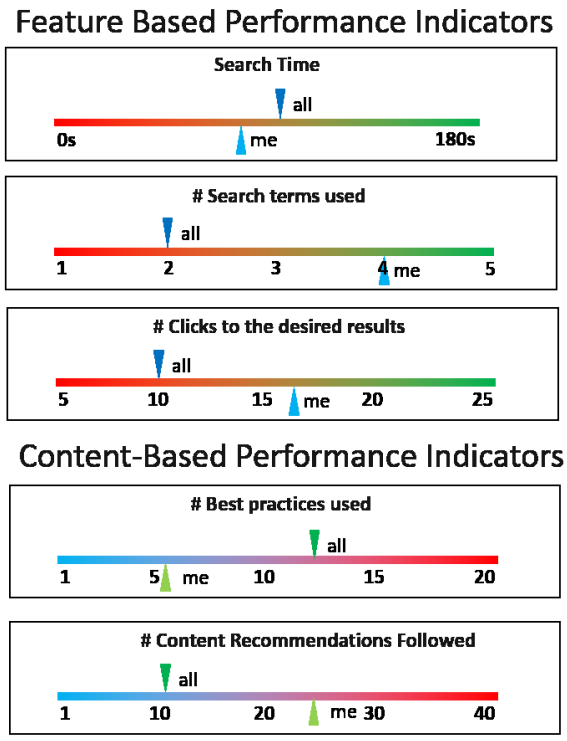


Figure 14: Examples for performance indicators

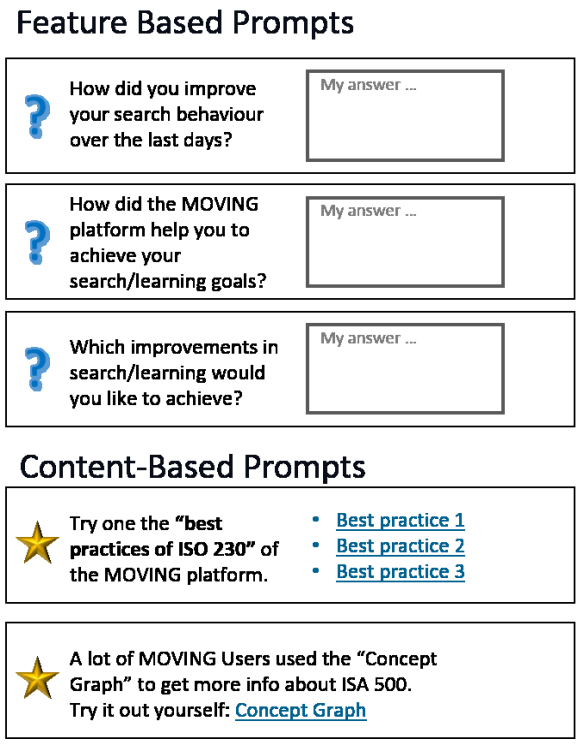


Figure 15: Examples for reflective prompts

5.6.2 Results

Altogether, 7 participants from EY attended the focus group, which lasted for 1.5 hours. The focus group was held online via the Adobe Connect conference solution.

Voting of the EY user stories

Table 13 summarises the voting results of the EY user stories in relation to the Adaptive Training Support. 6 out of 7 users voted at the first place (gold) for "ISA 315 – Understand the entity and the environment" as the most relevant user story for the ATS. This is followed by the user story "ISA 550 – Related parties search" rated with 4 votes for the second place (silver) and 1 vote for the third

place (bronze) as second important user story. “ISA 720 – Analyse other information published by the entity” was rated with 2 second places (silver) and 1 third place (bronze) just before “ISA 500 – Scan other information available” with 1 second place (silver) and 2 third places (bronze). The other 3 user stories did not get any votes. For the ATS, this means that when developing the content-based ATS the voting results on the user stories will be taken into account.

EY User Stories	Voting
ISA 315 – Understand the entity and the environment	6
ISA 550 – Related parties search	5
ISA 250 – Inform on laws and regulations and changes therein	2 1
ISA 500 – Scan other information available	1 2
ISA 240 – Unusual journal entry identification	
ISA 720 – Analyse other information published by the entity	
ISA 230 – Quality of audit documentation	

Table 13: Voting results of the EY user stories in relation to the Adaptive Training Support

Performance indicators

The discussion about the performance indicators centred on the following three major topics: i) comparison with whom, ii) end of a search and iii) content of the indicators.

Comparison with whom: the discussion focussed on the questions “With whom should I compare me with?” more or less independent of the content of the performance indicator. Suggestions for comparison which came up during the discussion were top performer, persons with high search performance, colleagues doing a similar job or colleagues who are in the same team or department. Finally, a suggestion would be that the user can select in the user profile to whom s/he wants to compare with, if different groups are predefined their users are assigned to these groups.

End of search: the second point of the discussion centred on the end of a search. “When is the goal of a search achieved?” Here the participants wanted to know if there is a button available a user can click on when s/he has found the desired results. Or if the “end of a search” can be automatically detected and if yes what are the criteria for the detection. However, this question could not be answered during the discussion and is still a research question for the project.

Content of the indicators: the discussion mixed a bit up feature-based and content based performance indicators. From a company’s point of view, the search performance and the corresponding search time are of crucial relevance. From the end-users point of view, the number of click’s used to get the desired results was of major interest for them. Also the number of search

terms used was also of interest especially when context-related and often used search terms would be recommended as well. In addition, the participants also suggested to present not only one performance indicator at once but two or three in relation to each other.

Reflective prompts

The discussion on the reflective prompts was rather short. It has become clear that the users of EY would prefer prompts either with rating on, for example, a five-star scale in relation to questions like "How would you rate the result from a quality and quantitative perspective" or simple "Yes", "No" or "Not finished" options for questions like "Did you find what you were searching for?". In a fast-paced and stressful environment like EY, open questions asking for answers in the form of text entries would be ignored. Furthermore, content-based prompts were seen as valuable when suggesting best practices or documents with regard to the search context.

Timing

The discussion on when to present which prompt was not trivial at all. On the one hand, prompts should not disrupt the workflow the user is currently in, on the other hand the prompt should be presented as close as possible to the conducted search to have it still in mind. The result of the discussion ended up with the suggestion that the user should be able to choose in the user preferences when s/he wants to receive a prompt. Suggestion of the timing should be to a specific point at a day, at the end of a day or end of a week or when closing the MOVING platform. Content-based prompts recommending content depending on the currently inserted search terms should be presented at the same time or even before the search results of a query are displayed.

Take-up for the ATS development

For the development of the ATS, we will take the following insight gained out of the focus group into account: Regarding the user stories, we will especially focus on supporting the four one's with the ATS who were seen as the most important. These four were "ISA 315 – Understand the entity and the environment", "ISA 550 – Related parties search", "ISA 250 – Inform on laws and regulations and changes therein" and "ISA 500 – Scan other information available". For implementing the smart indicators, we will start with the number of search terms used as well as plan to present the number of clicks used to find the desired search result (still we need to define, when the desired result was found). For the reflective prompts, we plan to implement a mixture of "YES-NO" questions, rating options as well as open questions (although not wanted by EY but necessary to achieve a deeper level of reflection). With regard to the timing of the prompts, we plan to offer users the possibility of defining themselves when they would like to get a prompt.

5.7 Mock-up workshop at MOVING consortium meeting

In the MOVING consortium meeting, the TUD organised a workshop in order to discuss with all MOVING partners the developed mock-ups and to get insights on how to improve them.

5.7.1 Procedure

As a first step, TUD printed-out the mock-ups The mock-ups were then distributed on three tables, where different functionalities regarding the mock-ups were discussed. The participants were asked to spend 15 minutes on each table and put their ideas, thoughts or improvements regarding the mock-ups with post-its on the print-outs. On each table, one person was available throughout the whole workshop to guide the discussion topics.

For the discussion of the ATS, altogether five mock-ups were printed out on A3. Most of the discussions centred on the feature-based ATS widget as depicted in Figure 16. The notes written on post-its and attached to the print-outs of the ATS were analysed afterwards by the ATS responsible persons. These analyses included on the one hand to discuss the usefulness and the feasibility of the suggestions (what is possible from a technological point of view to be implemented and what is not possible, does it make sense to implement the suggestion or not). On the other hand the analysis took into account on how to address the posed questions (some of them are still open challenges that need further discussions on the ATS developer's side).

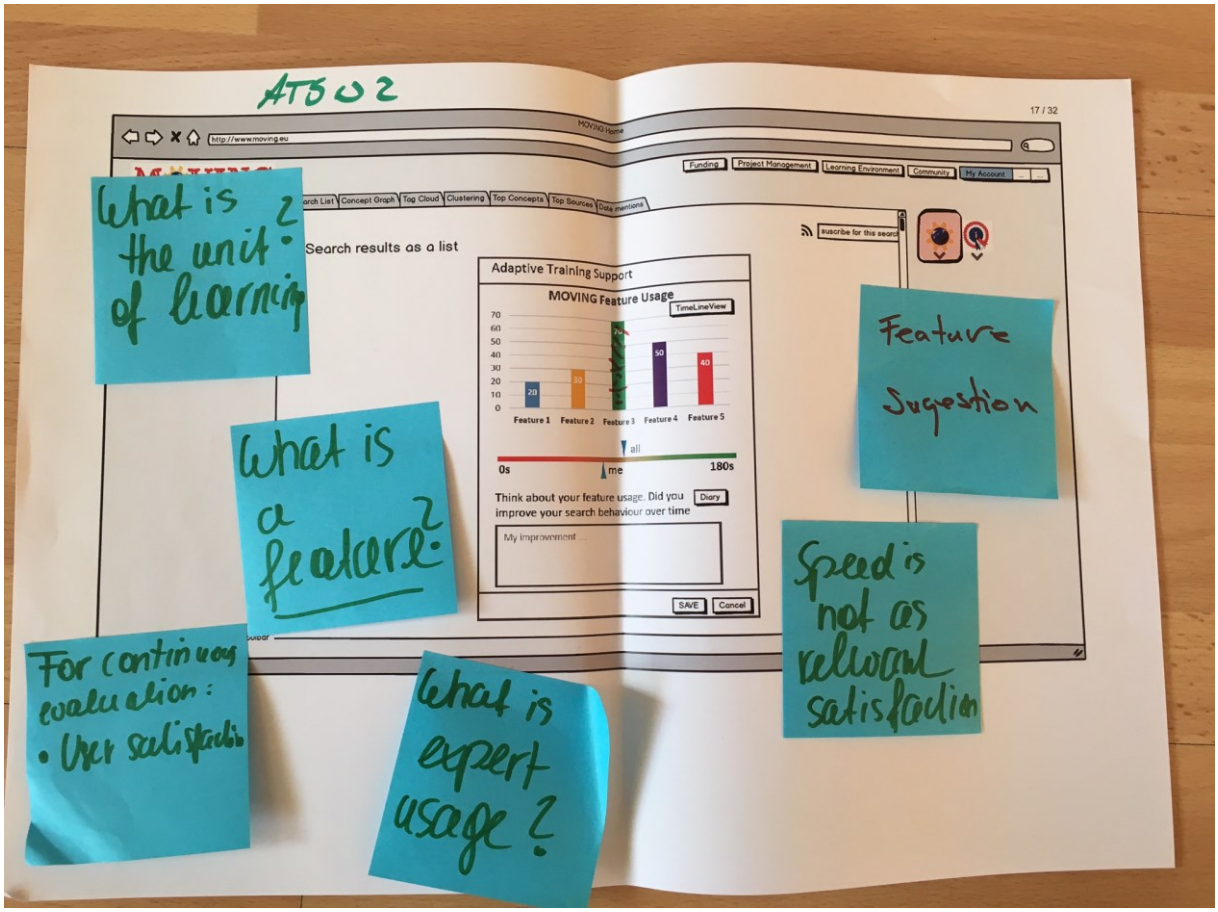


Figure 16: ATS mock-up discussion at MOVING consortium meeting

5.7.2 Results

The discussions regarding the ATS mock-up as well as the analysis afterwards revealed mostly some questions relevant for the implementation of the prototype and that needs to be solved before the implementation of the ATS can begin. These questions consist of “What is the unit of learning?”, “What is a feature?” and “What is expert usage?” For continuous evaluation of the ATS, the user satisfaction might play a crucial role, while to provide a performance indicator representing the speed of searches conducted at the platform seems to be of not so high interest. Two other suggestions of improvement were to provide recommendations in form of “Other users used …” and to take preferences stored in the user profiles into account, which was planned anyway. In the end, we will take-up the questions that have been raised during the workshop and that needs to be answered for the implementation of the first ATS prototype.

6 Conclusion and outlook

We have presented the status of the current work of WP 2 after Y1. The conceptual framework shows the connection of all training options within the MOVING platform and the learning paths of how to use the platform for training purposes to match different needs of becoming information literate. The curriculum delivers the necessary learning objectives of teaching information literacy within the MOVING platform. It is the basis for the use case specific developments of learning objectives. The requirements for use cases include first results of the use case analysis done in WP 1.

To develop the Adaptive Training Support for the MOVING platform, we focussed our activities in Y1 on i) the development of an Adaptive Training Support (ATS) concept, ii) the development of clickable mock-ups and the underlying technical architecture as well as on the iii) evaluation of the ATS concept and mock-ups. For the Adaptive Training Support in Y2, we plan to implement an initial version, which guides users in how to use the platform. We will also do a cycle of formative evaluations with the goal to evaluate different visual representations of ATS at different levels of granularity (first round: March/April 2017). In addition, we plan an in-depth literature survey on what constitutes search expertise to further extend ATS functionalities.

Furthermore, we plan to integrate the semantic profiling and recommendations methods in the MOVING platform. Finally, we aim to classify users of the MOVING platform based on their behaviour into experts and non-experts. For both user groups, we measure the user's satisfaction with the Adaptive Training Support. We will also elaborate and implement a concept for reflection support on curricular learning goals and learning content recommendation. We aim to create a curriculum for training public administrators (use case of EY: research on business information by public administrators) and a curriculum for training young researchers (use case of TUD: managing and mining research information by PhD and Master students). This two curricula will contain questions and learning materials for the ATS-recommendations and a badge concept for the cMOOC and the ATS.

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