MOVING

Deliverable 2.2: Updated curricula and prototypes for adaptive training support and introductory MOVING MOOC for community building

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Work Package 2 Didactic and curricula development

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Executive Summary

This deliverable gives an overview of the learning and training features of the MOVING platform. It outlines the concept of information literacy that is the basis for the MOVING curriculum. It contains an overview of the curriculum design process, the curriculum framework for information literacy and a concept for the provision of learning material. It furthermore gives an update on the individual use case curricula, including learning units and corresponding learning objectives. It also provides an outline for the MOVING MOOC "Science 2.0 and open research methods". Additionally, this deliverable presents the status of the adaptive training support. On the one hand, it describes the current status of the already implemented "Learning-how-to-search" widget. On the other hand, it depicts the newly designed and conceptualised "Curriculum Reflection" widget. Furthermore, it presents a case study on a qualitative exploration of virtualising traditional face-2-face trainings at EY with the goal to enhance the adaptive training support. Finally, it explains the technologies for semantic profiling and content recommendation in the context of learning and training offers on the MOVING platform.

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Abbreviations

Abbreviation	Explanation
ACRL	Association of College and Research Libraries (US)
ALA	American Library Association (US)
ANCIL	A new curriculum for information literacy (UK)
ATS	Adaptive training support
CC	Creative Commons
CILIP	Chartered Institute for Library and Information Professionals (UK)
CoP	Community of practice
CPD	Continuous professional development
FAQ	Frequently asked question
IAESB	International Accounting Education Standards Board
IL	Information literacy
IR	Information Retrieval
ISA	International Standards on Auditing
LMS	Learning management system
MOOC	Massive Open Online Course
OCW	Open courseware
OER	Open educational resource
OSS	Open source software

Abbreviation	Explanation
RA	Reflection Amplifier
RDF	Resource Description Framework
RI	Reflection Intervention
SCONUL	Society of College, National and University Libraries (UK)
UGC	User-generated content
UNESCO	United Nations Educational, Scientific and Cultural Organization

1 Introduction

1.1 History of the document

Table 1: History of the document

Date	Version
30/01/18	MOVING_d2.2_Tocv0.1_draft – first draft D2.2 table of contents (ToC)
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06/02/18	MOVING_d2.2_Tocv0.3_draft – D2.2 ToC ready for QA
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23/03/18	MOVING_d2-2_v0.3_draft – D2.2 final draft after QA revisions, ready for final review by the project coordinator
29/03/18	MOVING_d2.2_v0.1 – D2.2 final version submitted to EC

1.2 Purpose of the document

This report is an update of deliverable D2.1: “Initial conceptual framework, curricula and technical prototypes for adaptive training support”. It is based on the results of the use case studies conducted in WP1 during year 1 that compiled the user requirements for the platform development and provided the basis for the curriculum development. These results are described in detail in deliverable D1.1: “User requirements and Specification of the use cases” and have been updated in deliverable D1.2: “Initial implementation of user studies”. This deliverable investigates for each use case a set of relevant guidance components, including optimal contexts (time, location) for offering guidance. It also describes the initial version of the MOOC built in Task 2.3 regarding community building. D2.2 is also related to the outcomes of deliverable D2.4: “Open innovation systems state-of-the-art and beyond” and further progress on the topic presented will be outlined in deliverable D2.3: “Final conceptual framework, curricula and MOVING MOOC for community building”.

1.3 Structure of the document

Section 2 introduces the MOVING learning and training concept for open innovation leadership on the MOVING platform. It explores the concept of information literacy that is at the basis of the MOVING curriculum and shows how its revival is imperative in today's digital environments. We proceed by explaining why information literacy and information savvy professionals are key in open innovation processes. We conclude this section by introducing the combined work and training concept on the MOVING platform.

Section 3 describes the development of the MOVING curriculum for information literacy. The first part describes the instructional design model that we followed developing the MOVING curriculum for information literacy. Subsection two provides a detailed outline of the MOVING curriculum for information literacy. Subsection three gives an overview of the adaptation of the general information literacy curriculum for the two use cases of the MOVING platform – (1) research on business information by public administrators and (2) managing and mining research information by young researchers. Subsection four outlines the concept for the provision of learning materials on the MOVING platform.

Section 4 outlines the different learning and training options on the MOVING platform. In this section, we show how the unique combination of learning and working environment on the MOVING platform is combined with a community of practice, features that are key for open innovation processes. We introduce the Learning environment where users can search and browse learning resources according to his or her needs and interests, choose learning options and contribute learning content for the MOVING community. And we outline the concept for the combination of work and training and introduce the design of the MOVING MOOC *Science 2.0 and Open Research Methods.* Finally, we give an overview of the provision of learning material and OERs on the platform.

Section 5 describes the adaptive training support (ATS) system on the MOVING platform. In this section, the "Learning-how-to-search" and the "Curriculum reflection" widgets are elucidated and the guidance concept for the combination of work and training on the platform are explicated. This section investigates for each use case a set of relevant guidance components, including optimal context for offering guidance. Furthermore, it is presenting a case study on the benefits of virtualising face-to-face training at EY.

Section 6 explains the technology of semantic profiling and explains the recommender system on the platform. Semantic Profiling helps identifying users' interests and thus enables the training support to adapt to individual users. Depending on the detected interest areas for each user, the ATS is able to recommend relevant information and provide learning offers tailored to individual needs.

We conclude this report in Section 7 and provide an overview of planned activities within WP2 for the coming months of the MOVING project.

2 MOVING training concept for open innovation leadership

2.1 Defining information literacy for the 21st century

In societies of the 21st century information literacy and the access and use of knowledge are becoming a precondition for individuals to actively take part in social, economic, cultural and political life. Information literacy (IL) today, rather than being a specialised skill-set, must be considered a fundamental competency like the ability to read, write and calculate. Information literacy has become essential for participating in society around the globe so that UNESCO even considers it "a basic human right" (Catts and Lau, 2012, p. 8). Likewise, the American Library Association (ALA) (2006) calls information literacy a "survival skill in the Information Age". It states, that "instead of drowning in the abundance of information that floods their lives, information literate people know how to find, evaluate, and use information effectively to solve a particular problem or make a decision–whether the information they select comes from a computer, a book, a government agency, a film, or any number of other possible resources" (ALA, 2006).

As Coonan (2011) points out, "living in the 21st century means that we need to be able to deal with vast amounts of data and information and have the ability to absorb, synthesise, and transfer it into knowledge and understandings that have relevance to our live" (Coonan, 2011, p. 4). Therefore, it is important to give people the means and competences to negotiate meaning in the face of such massive quantities of information.

Information literacy in digital environments is prerequisite for life-long learning. It is a meta-competence that enables learners to acquire new knowledge and skills as well as find, use and share information effectively in professional life. Most international standards agree on a core set of skills and competences that are qualifying information literate individuals to "recognise when information is needed and have the ability to locate, evaluate, and use effectively the needed information" (ACRL, 2000:2). The UNESCO definition states that information literate persons can: "recognise their information needs; locate and evaluate the quality of information; store and retrieve information; make effective and ethical use of information; and apply information to create and communicate knowledge." (Catts and Lau (UNESCO), 2012:3) (Catts and Lau (UNESCO), 2008). The SCONUL standard definition of IL additionally distinguishes between skills/competencies and attitudes/behaviours that are part of IL instruction: "Information literate people will demonstrate an *awareness* of how they gather, use, manage, synthesise and create information and data in an ethical manner and will have the information *skills* to do so effectively." (Bent and Stubbings, 2011 (SCONUL): 1; emphasis mine).

The rise of "Web 2.0", however, has brought about yet another fundamental shift in our understanding of information literacy. While the information landscape of "Web 1.0" was shaped by static websites providing preselected information for retrieval by users, Web 2.0 is characterised by platforms and based on dynamic social networks and online communities, with goals like interactivity

and participation: users now can not only search and access information through the web, but they can actively produce, reuse and share information and content online. Every 60 seconds, there are 500 hours of video uploaded to YouTube[1], 448.800 Tweets sent on Twitter, 1.440 blog posts created on WordPress[2], 65.972 photos uploaded to Instagram, and 3.3 million new entries posted on Facebook (Allen, 2017). "This 'interactivity' materialised through specific site features […] including user profiles; connections between users; the ability to create, post and embed content; and public application programming interfaces which allow third-party developers to build new tools within the site" – all these new socio-technological developments make the 21st century, as Jones (Jones, 2007, p.69) states, "the age of the amateur for information creation and re-creation". Today, easy-to-use software and social media platforms enable all kinds of users, not only professionals like computer scientists, journalists, or media designers, to create, remix, and share content via the Web. Nowadays, social technologies like (micro-)blogs, social networks and bookmarking sites are widely used in both professional and leisure contexts. Even in academia, researchers recently have started to catch up on social technologies and more and more use web-based tools for research (Peters, 2018; Pscheida et al. 2014). Academics today are using Twitter and Facebook to promote publications or announce events, write blogs to document research-in-progress and discuss preliminary findings, and connect to scholars in academic social networks like Academia[3], Mendeley[4], and ResearchGate[5].

Digital competence – or the confident and critical use of ICT tools in these areas – is vital for participation in today's society and economy" (Vuorikari et al., 2016, p. 5). Even though they are not the same, information literacy and digital literacy necessarily complement each other particularly in web-based information ecosystems. To this end, *The European Digital Competence Framework for Citizens*, also known as DigComp, was developed by the European Commission to offer a tool to assess and improve citizens' digital competence (Vuorikari et al., 2016). DigComp 2.0 encompasses the main components of Information Literacy and parts of Media Literacy.

As Tuominen (Tuominen, 2007, p.6) explains, "nowadays, information literate practices are closely entwined with social filtering solutions and services. They form an emerging social information ecosystem that is a precondition for practicing IL effectively in the future". Similarly, Jones (Jones, 2007) stresses the social dimensions of Web 2.0 that revolutionise the organisation and classification of information and knowledge: "hierarchical classification mechanisms for organising paper-based information are not suited to a nonlinear networked information environment", within Web 2.0, the hierarchy of information has been inverted to a "bottom-up rather than top-down classification of

[1] https://www.youtube.com

[2] https://wordpress.com

[3] https://www.academia.edu

[4] https://www.mendeley.com

[5] https://www.researchgate.net

information, found in social bookmarking, tagging, and folksonomies." Hence, the reliability of information is increasingly measured by social attribution rather than individual authority: "recommendation and reputation within communities online is increasingly important, and reflection and feedback are important collaborative processes" (Jones, 2007, p.69). These developments are forcing a revision of IL standards to do justice to the increasingly important collective and interactive dimensions of knowledge production. Jones defines an information literate person as "one who has learned how to learn. They will know how information is organised, where to find what they need, and how to process and package what they find and communicate this with others" (Jones, 2007, p.70). Mackey and Jacobson (Mackey & Jacobson, 2011, p.62) have chosen the term "Metaliteracy" to describe this new understanding of IL:

> Metaliteracy promotes critical thinking and collaboration in a digital age, providing a comprehensive framework to effectively participate in social media and online communities. It is a unified construct that supports the acquisition, production, and sharing of knowledge in collaborative online communities.

They show how the goals of information literacy remain the same, while these goals are linked to "related literacy types that address ongoing shifts in technology" (Mackey & Jacobson, 2011, p. 62), Thereby, they are maintaining the essence of traditional information literacy and rethinking it in the context of participatory information environments. The result is a revival of information literacy which, in addition to the core competencies of understanding, finding, evaluating and using information, also includes the production and exchange of information (Witek & Greatano, 2014, p. 190).

In the way the digital revolution has affected almost all parts of societal life, the term "information literacy" is becoming increasingly similar to that of media literacy and ICT competence (Stöcklin, 2012, p.1). Vuorikari et al. (Vuorikari et al., 2016, p.5) state that "work, employability, education, leisure, inclusion and participation in society – all of these areas and many others in our society are being transformed by digitalisation". Most international standards for information literacy, however, date back to a time when the book was the most important source of knowledge and in consequence the promotion of information literacy has mainly focused on the reception of texts. Stöcklin (Stöcklin 2012) explains "after writing and printing, the electronic media are currently giving rise to a third major change in the leading media. [...] The current shift from a culture dominated by books to a culture dominated by information and communication technologies (ICT) - above all the Internet - requires a new understanding of information literacy." (Stöcklin 2012, p.1; original German, *translation mine*). Tuominen (Tuominen, 2007, p.6) suggests that in order to enable learners to navigate the new information ecosystem Web 2.0, we correspondingly need to introduce Information Literacy 2.0. However, he also acknowledges that because "information literacy has so many faces or aspects it is difficult to give a watertight definition of IL 2.0. What is sure is that IL 2.0 is not a monolithic whole that could be standardised and objectively measured. There is not just one 'right and correct' IL 2.0 but many kinds of literacies that can be practiced both collectively and individually". Similarly, ANCIL re-defines "Information Literacy [as] an umbrella term which

encompasses concepts such as digital, visual and media literacies, academic literacy, information handling, information skills, data curation and data management" (Bent & Stubbings, 2011, p.3). To address the changing information landscape, in recent years several groups have revised their information literacy standards to include these new literacies. Table 2 shows a current overview of the most important international standards for information literacy.

Table 2: Overview international information literacy standards and definitions

Standard	*ACRL*[6]	*CILIP*[7]	*SCONUL*[8]	*Metaliteracy*[9]	*UNESCO*[10]	*EU Digital Competence Framework for Citizens DigComp 2.0/2.1*[11]
Model of IL	5 Standards for IL	8 Skills of IL	Seven Pillars of IL	IL as Metaliteracy, reframing of ACRL standards for Web 2.0	Media and Information Literacy (MIL)	Five Competence Areas with 21 Subcompetences
Definition of IL	"Information literacy is a set of abilities requiring individuals to 'recognize when information is needed and have the ability to locate, evaluate, and use effectively the needed information.' [from the original *Standards* 1989] Information literacy also is increasingly important in the contemporary environment of rapid technological change and proliferating information resources."	Being information literate means "knowing when and why you need information, where to find it, and how to evaluate, use and communicate it in an ethical manner."	"Information literate people will demonstrate an awareness of how they gather, use, manage, synthesise and create information and data in an ethical manner and will have the information skills to do so effectively."	"Someone who is information literate knows how to determine when information is needed, access information using a range of tools, evaluate the information through critical thinking and analysis, and incorporate information into something new through a synthesis of materials." "Metaliteracy expands the scope of traditional information skills (determine, access, locate, understand, produce, and use information) to include the collaborative production and sharing of information in participatory digital environments (collaborate,	"Information Literacy encompasses knowledge of one's information concerns and needs, and the ability to identify, locate, evaluate, organize and effectively create, use and communicate information to address issues or problems at hand" IL "is a prerequisite for participating effectively in the Information Society, and is part of the basic human right of life-long learning."	Digital competence is the confident and critical use of ICT tools in the areas work, employability, education, leisure, inclusion and participation in society. "Like the UNESCO's work on Media and Information Literacy (UNESCO, 2011), […] DigComp 2.0 encompasses the main components of Information Literacy and parts of Media Literacy."

[6] Association of College and Research Libraries/ ACRL (2000), (2015)

[7] CILIP Information Literacy Group (2017), (2012)

[8] Bent & Stubbings (2011)

[9] Mackey & Jacobson (2011), (2014)

[10] UNESCO (2013)

[11] Vuorikari et al. (2016); Carretero et al. (2017)

				participate, produce, and share)."		
IL core competences						
Recognize information need	Determine the extent of information needed	Understanding a need for information	IDENTIFY Able to identify a personal need for information	Determine what and to which extent of information is needed	Recognise information needs	
		Understanding the resources available	SCOPE Can assess current knowledge and identify gaps			
Find information		Understanding how to find information	PLAN Can construct strategies for locating information and data	Determine where to find information needed		Competence area 1: Information and data literacy 1.1 Browsing, searching, filtering data, information and digital content
	Access the needed information effectively and efficiently		GATHER Can locate and access the information and data they need			
Evaluate information	Evaluate information and its sources critically and incorporate selected information into one's knowledge base	Understanding the need to evaluate information	EVALUATE Can review the research process and compare and evaluate information and data	Determine reliability and validity of info sources	Locate and evaluate the quality of information	1.2 Evaluating data, information and digital content
Manage information	Understand the economic, legal, and social issues surrounding the use of information, and access and use information ethically and legally	Understanding ethics and responsibility of use Understanding how to manage your findings	MANAGE Can organise information professionally and ethically	Understand Personal Privacy, Information Ethics and Intellectual Property Issues	Store and retrieve information Make effective and ethical use of information	1.3 Managing data, information and digital content Competence area 3: Digital content creation 3.2 Integrating and re-elaborating digital content 3.3 Copyright and licenses

Use information	Use information effectively to accomplish a specific purpose	Understanding how to work with or exploit results Understanding how to communicate or share your findings	PRESENT Can apply the knowledge gained: presenting the results of their research, synthesising new and old information and data to create new knowledge and disseminating it in a variety of ways	Share Information in Participatory Environments	Apply information to create and communicate knowledge	Competence area 2: Communication and collaboration 2.1 Interacting through digital technologies 2.2 Sharing through digital technologies
Produce Information				Produce Original Content in Multiple Media Formats		Competence area 3: Digital content creation 3.1 Developing digital content Competence area 2: Communication and collaboration 2.4 Collaborating through digital technologies

2.2 Information literacy 2.0 in open innovation

Web 2.0 technologies offer new ways of finding, managing, creating information which has far reaching implications for scientific practice and open innovation processes. Open Innovation is the strategic and systematic opening of internal innovation processes to include external knowledge. It is a distributed innovation process based on purposively managed knowledge flows across organisational boundaries (Chesbrough & Bogers 2014; for a comprehensive overview of open innovation systems see deliverable D2.4). Digital media and the rise of the internet have made information access, sharing and creation easier and cheaper than ever before. However, this wealth of information – accessible anytime from anywhere to anyone – can become "noise if one cannot make sense of it" (Tuominen, 2012). Today, the rise of Web 2.0 – characterised by the proliferation of social technologies, networks and online communities – is transforming "the ways information circulates and, increasingly, the way we interact, access information, communicate, create new knowledge, learn and work" (UNESCO, 2013:9). According to UNESCO (2013, p.26):

> Knowledge creation and sharing will undoubtedly continue to play a central role in shaping economic growth, climate change, societal development, cultural enrichment, political empowerment, and the consolidation of democratic systems. Today, information and the means of communication, including media, the Internet and ICTs, are integral prerequisites for engaging in democratic debate, building communities, stimulating innovation and partnering with others. Print and broadcast delivery models and strict copyright regimes no longer characterise access to information and media content. Information is now accessible anywhere, can be created by anybody as user-generated content, and shared at any time to billions of people around the globe.

Open innovation calls for a redefinition of core institutional concepts like leadership. In the classical sense, leadership is "a process whereby intentional influence is exerted over people to guide, structure, and facilitate activities and relationships in a group or organization" (Yukl, 2010, p.21). However, open innovation processes in interdisciplinary teams with internal and external relationships require a very different leadership based on social skills. These leadership skills are vital for collaborating with other organisations and include mentoring and coaching, workers empowerment and autonomy, effective communication, and joint problem-solving and decision-making. A prerequisite for leadership in open innovation processes are information literate and data savvy individuals that understand the contemporary information landscape and navigate effortlessly between different epistemic communities and sources of knowledge and innovation.

Open innovation processes are especially vital in fast-growing industries like ICT, engineering and software development, where innovation pressures are high, life-cycles of products short, and where novelty is ephemeral. Here, open source systems flourish and events like hackathons are gaining popularity. Crowd-sourcing has opened research and development processes to the wisdom of web-communities and *Netnography* "follows people's social activities and encounters onto the internet"

(Kozinets, 2010, p.1). Not only companies, also not-for-profit organisations benefit from open innovation and use the "wisdom of the crowd" to create common goods – the most popular example of which is Wikipedia.

2.3 MOVING work and training concept for open innovation

MOVING supports open innovation processes in a unique way by providing working and training features within a single platform. It combines analytical features, like document and data retrieval a well as visualisation and analysis tools, in combination with adaptive guidance offers on how to use them. The learning features provide users with a range of self-regulated learning options and give them access to a plethora of learning material and online courses, including MOOCs, in all kind of subjects and disciplines. The MOVING community combines these features with an ecosystem for communication, co-creation and collaboration in a digital project environment and a community of practice. The framework for this ecosystem is the MOVING curriculum for information literacy – the basis for leadership in open innovation. Many frameworks of IL address learning as an ongoing, developmental process, a continuous evaluation of and adaptation to the information environment. As Coonan points out, "information literacy as a vital factor in the development of an individual's learning not only in formal educational settings but also in the wider social, cultural, political and economic arenas. The term 'lifelong learning' is often used to signify the ideal of an informed, independent and self-reliant individual who is capable of finding and using the information s/he needs within all these arenas" (Coonan, 2011, p.4). Self-regulated learning, i.e. the confident acquisition of information and knowledge, is an ongoing process and a precondition for developing open innovation leadership skills. We support users of the MOVING platform in acquiring these skills.

The MOVING platform with its functionalities facilitates knowledge flows between and beyond institutions. The Search environment provides access to vast amounts of documents in a variety of formats (text, RDF, video, slides, webpages, social media, OER etc.). The visualisation and data analysis tools help identifying structures between data and documents. The training options based on the MOVING curriculum for information literacy help users to acquire knowledge and skills, discover helpful tools, and give them the confidence to navigate an ever-changing information landscape. The MOVING community gives users the opportunity to find partners and funding opportunities and collaborate in the virtual working environment on the MOVING platform (see Figure 1).

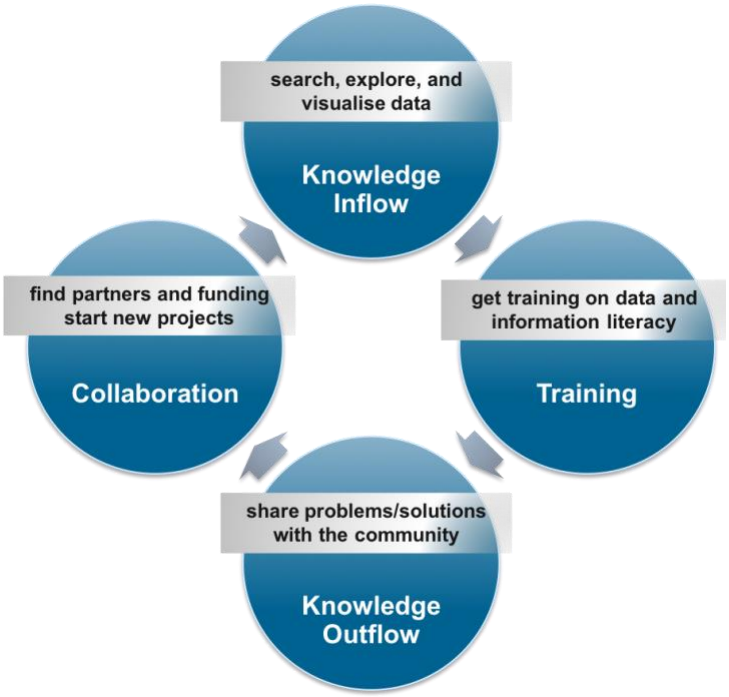

Figure 1: MOVING platform knowledge flow

3 MOVING curriculum for information literacy

3.1 MOVING framework for information literacy

To identify the main topics for the MOVING curriculum, we conducted a comprehensive literature review on the latest international standards for IL curricula in digital environments (see chapter 2). Teaching information literacy needs to be tailored to the realities of the digital environments that are familiar to today's learners. Witek and Greatano (2014) point out that today's "students have grown up in a digital age, wherein social media platforms are playing a central role in defining the ways they interact with information" with the result that "information literacy, as it has been taught since the turn of the millennium, is in crisis" (Witek & Greatano, 2014, p.189).

The multitude of literacies that extend the definition of information literacy 2.0, requires a general shift in pedagogy: we move away from an instructional teaching model, where knowledge is imparted from a teacher to a learner, and instead, as Coonan (2011) advocates, "design opportunities to involve students in their own learning and open up discussion and peer exchange". The goal of teaching IL should not be limited to a set of general, domain-independent skills, but enabling learners to orientate themselves within this new and ever transforming information landscape. Coonen suggests that "if we are to equip students with the strategies and attitudes which will enable them to become inquiring scholars and lifelong, autonomous learners, we must recognise that we do not have all the answers (Coonan, 2011, p.22).

Within the MOVING curriculum we shift the focus away from mere "library skills", like database search strategies and citation styles that have too often been at the centre of IL instruction, and instead want to empower learners to navigate their information environment and encourage them to utilise the social technologies of Web 2.0 to build networks and acquire, use, create and share knowledge in collaboration with others.

3.2 MOVING curriculum development model

3.2.1 The ADDIE model

For the development of the MOVING curriculum for information literacy we follow a general roadmap for instructional systems design based on the ADDIE model (Branch & Koptcha, 2014, p.80-84; Forest, 2010; Branch, 2009; see also Ghirardini, 2011). The ADDIE model includes five stages: **A**nalysis, **D**esign, **D**evelopment, **I**mplementation and **E**valuation. Each of the five stages comprises certain tasks in the development of the learning environment (see Figure 2).

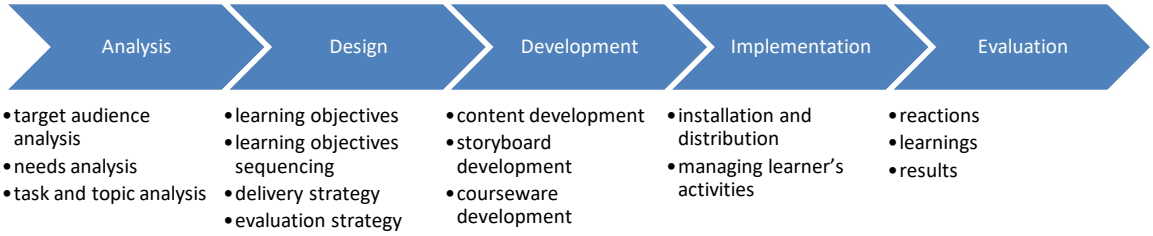

Figure 2: The ADDIE model

The analyses (stage 1) that formed the basis for the development of the curriculum were conducted during year 1 of the MOVING project period in WP1. The results of the initial requirements analysis were complemented by a comprehensive literature review on current standards for teaching information literacy in digital environments (see Table 2 above). Based on the outcomes of the analysis, we started the design and development phases (stages 2 and 3) in year 2. Stage 4 encompasses the actual implementation of learning options on the platform after the design of the learning units is concluded. For this purpose, a set of technical requirements will be composed and implemented within the existing platform architecture. During the development process throughout year 3, the learning units we produce are tested, evaluated and improved, if necessary. The development phases of the MOVING curriculum for information literacy are elaborated in further detail in the sections below.

3.2.2 Analysis

The course design depends on the population of learners that the curriculum will address. The *target audience analysis* determines key characteristics of the learners (e.g. their previous knowledge and skills, geographical provenience, learning context and access to technology) and determines the design and delivery of learning options on the platform. MOVING is addressing users from all societal sectors and disciplines that want to improve their data and information literacy in digital environments. Therefore, the basic curriculum for information literacy is intentionally designed broad-spectrum so that skills, competences and attitudes that users gain using the training options on the platform can be, on the one hand, generalised for a wide range of work, study and research situations, and on the other hand, can be tailored to users' individual needs and interests. Based on to the general curriculum, we develop training options for two use cases– (1) research on business information by public administrators and (2) managing and mining research information by young researchers – each including specific scenarios of using the platform.

The *needs analysis* helped identify the general, high-level learning and training goals for the target audiences of the MOVING platform. Regarding the development of training and learning options, the use case studies indicated what kind of training is required for the users to fill gaps in professional knowledge and skills. The two use cases complemented the general framework with a hands-on, practice-oriented focus for the planning of learning sessions. The *needs analysis* as well as the *task*

and topics analysis for each use case were based on interviews and focus group discussions conducted in the user studies in WP1 of the MOVING project and were described in detail in deliverable D1.1 (Sections 2 and 3). *Task analysis* identified the job tasks that learners should acquire or improve and the knowledge and skills that need to be developed. The task analysis helps to establish a connection between learners' needs and specific course elements. This enables learners to select a subset of sessions under the main course. *Topic analysis* is carried out to define the major topics and subtopics as well as to identify and classify the content elements. Classifying content elements helps to further recognise connections among them thus contributing to the refinement of the draft course outline.

3.2.3 Design

The design stage starts with a statement on the general purpose and an outline of the curriculum. First, we define the overall purpose of the curriculum, which clarifies why someone should take this course. With the outline, we explain the idea of the course content, the approach teaching it, and why it is significant and important to learn. Once the general purpose and outline are defined, the design stage encompasses lesson planning, which is marked by the following activities (Ghirardini, 2011):

(1) formulating a set of learning objectives required to achieve the general, high-level course objective;
(2) defining the order in which the learning objectives should be achieved (sequencing);
(3) and selecting instructional, media, evaluation and delivery strategies.

The outcome of the design stage is a blueprint that will be used as a reference to develop the learning options (Ghirardini, 2011). The blueprint illustrates the curriculum structure (its organisation in courses, units, lessons, activities), the learning objectives associated with each unit, and the delivery methods and formats for each unit.

The overall design of the MOVING curriculum for information literacy is informed by the following principles:

- **General:** to be adaptable to all kinds of work and study situations and address a wide audience of learners.
- **Modular**: to allow different learning paths that correspond to the learners' pre-existing skills, individual needs, and interests.
- **Practice-oriented**: to relate to practical work situations and actual information needs with activities and problems directly related to learners' work context.
- **Active and assessed**: to provide a significant element of active and reflective learning, including peer assessment elements.
- **Flexible**: to provide opportunities for learners to select learning content and learning paths that relate to their individual learning needs and interests.

- **Open**: to provide a framework in which learning content can be updated to keep up to date with new tools, content and trends and that allows the integration of user-generated content.

Defining the learning objectives and topics consists of two key components: defining what learners need to know and what they'll be able to do with it. The outcome of the first phase of designing the curriculum is a number of learning units that correspond to the overall course objective. A learning objective is a statement describing a competency or performance capability to be acquired by the learner. Learning objectives are specified for both the overall learning unit as well as for each learning session (Ghirardini, 2011). After defining titles and learning goals for each learning unit, we list essential questions that will be explored through the learning units. In a next step, we define skills (and higher-level thinking skills), tools, applications, knowledge and attitudes that we want to teach in each unit. Having outlined the learning goals, we proceed to organise the learning units in a logical sequence. The outcome of sequencing is a course structure where each element corresponds to a specific learning objective and contributes to the achievement of the overall learning goal of the curriculum.

The MOVING curriculum is developed along the current standards for information literacy and digital competency discussed above. The curriculum will encompass three main competence areas organised as learning units that are each consisting of a sequence of learning sessions:

(1) Searching information in digital environments.

(2) Communication and collaboration in digital environments.

(3) Content creation in digital environments.

Table 3 shows for each of the three learning units corresponding sessions and learning objectives. These will form the basic framework of the curriculum and will inform the design of learning experiences within each of the modules.

Table 3: Framework of the MOVING curriculum for information literacy

LEARNING UNIT	SESSIONS	LEARNING OBJECTIVES
DATA AND INFORMATION SEARCH	Browsing, searching and filtering data, information and digital content	to articulate information needs, turn a (research) question into a search strategy,
		to search and access data, information and content;
		to create and update personal search strategies;
	Evaluating data, information and digital content	to analyse, compare and critically evaluate the credibility and reliability of sources and the data, information and content;
	Managing data, information and digital content	to organise, store, retrieve and process data, information, and content;

COMMUNICATION AND COLLABORATION	Interacting through digital technologies	to interact through a variety of digital technologies
		to communicate information products, using the appropriate technologies and designs, to meet the needs of the audience
	Sharing through digital technologies	to share data, information and digital content with others
		to act as an intermediary, to know about referencing and attribution practices
	Collaborating through digital technologies	to use digital tools and technologies for collaborative processes
		to use digital tools and technologies for co-construction and co-creation
CONTENT CREATION	Developing content	to create and edit digital content in various formats for different media
	Integrating and re-elaborating digital content	to modify, refine, improve and integrate information and content into an existing body of knowledge
	Copyright and licenses	to understand how copyright and licenses apply to data, digital information and content

According to Ghirardini (Ghirardini, 2011, p.14), the following five qualities significantly enhance the learning experience for learners in online environments and have therefore been carefully considered when designing the MOVING curriculum:

- **Learner-centred content:** E-learning curricula should be relevant and specific to learners' needs, roles and responsibilities in professional life. Skills, knowledge and information should be provided to this end.
- **Granularity:** E-learning content should be segmented to facilitate assimilation of new knowledge and to allow flexible scheduling of time for learning.
- **Engaging content:** Instructional methods and techniques should be used creatively to develop an engaging and motivating learning experience.
- **Interactivity:** Frequent learner interaction is needed to sustain attention and promote learning.
- **Personalisation:** Self-paced courses should be customizable to reflect learners' interests and needs.

The MOVING curriculum consists of several modules that are self-contained and can therefore be adapted to learners' interests and skill levels. A modular curriculum is made up of standardised units that can be separated from each other and rearranged or reused. Designing the curriculum in a modular fashion gives the learner the opportunity to choose personal learning paths that respond to

different individual interests and learning needs. The diagram in Figure 3 shows the structure of the MOVING curriculum. It includes three units with a number of sessions for each unit.

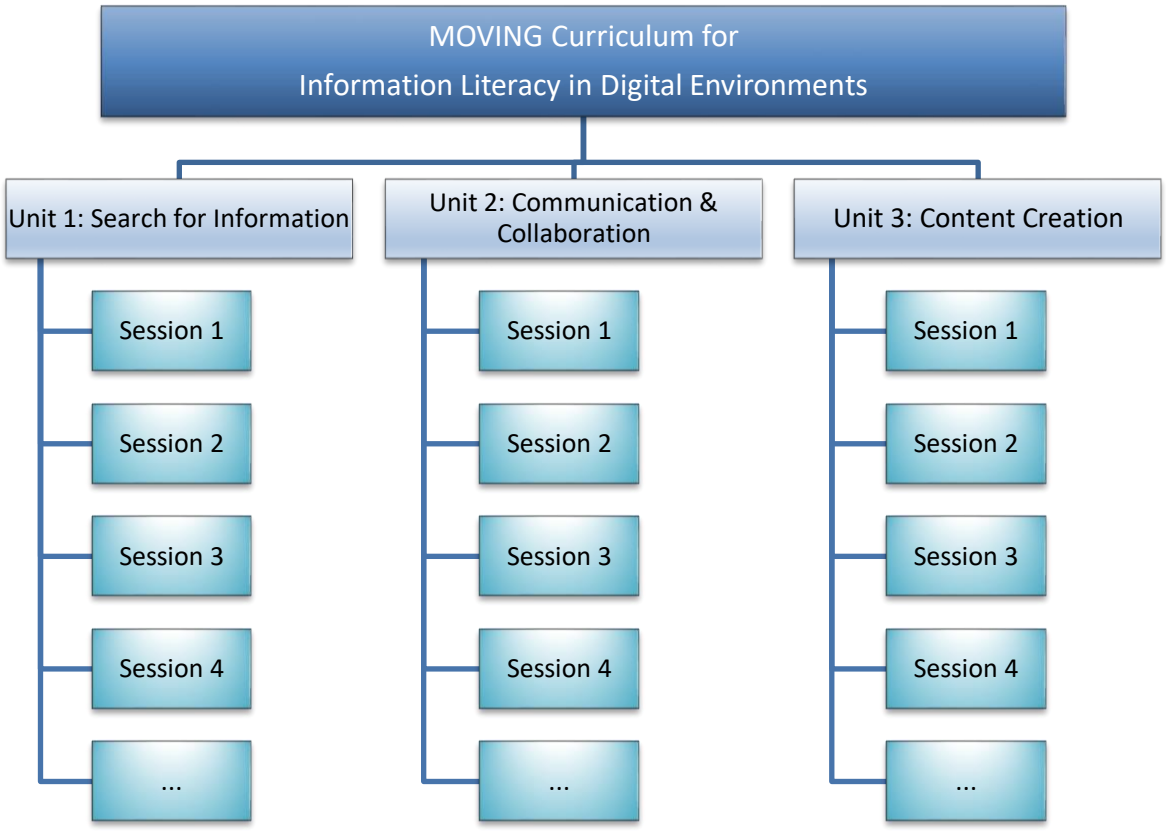

Figure 3: MOVING curriculum structure

3.2.4 Development

In this stage, the learning content is actually produced (Ghirardini, 2011). Content elements (see Figure 4) can be classified according to the types of content they represent including (1) facts, (2) procedures, (3) concepts, (4) principles, (5) skills, and (6) attitudes (Morrison et al. 2011)).

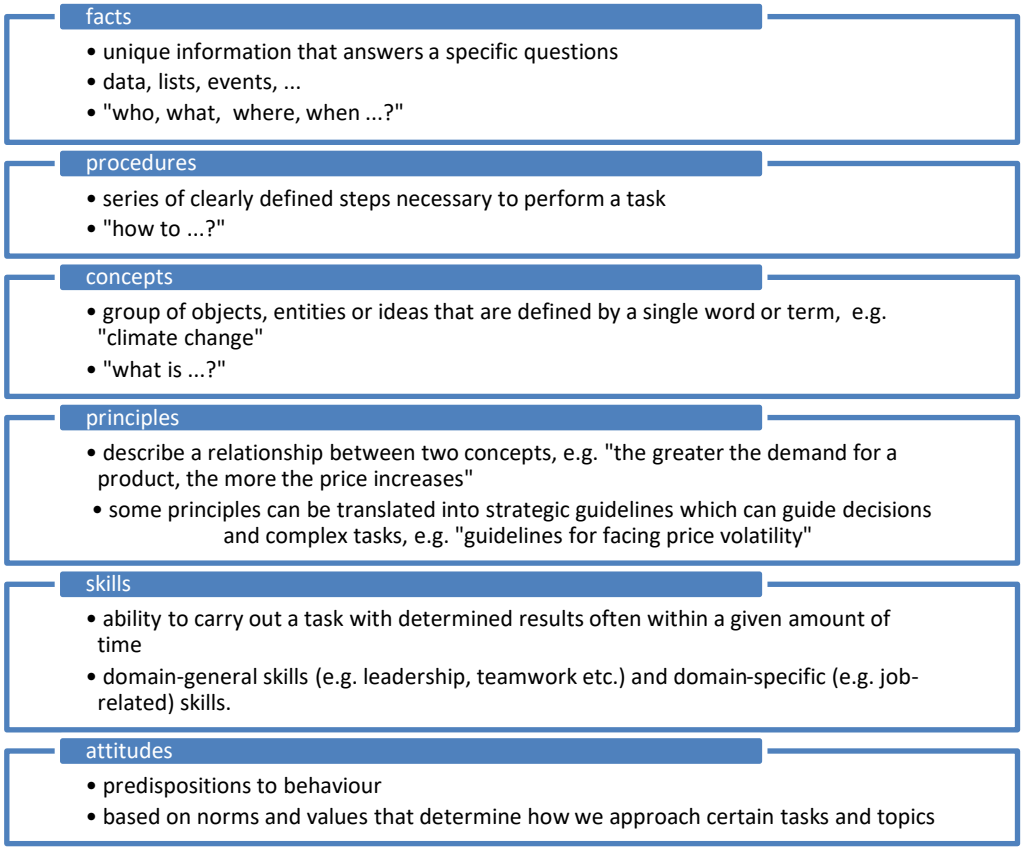

Figure 4 Types of learning content

The learning content is developed according to the set of learning objectives developed above and is delivered using different media elements, such as text, graphics, audio and video. In order to make learners self-sufficient, it must also provide learning support in various forms (through explanations, examples, interactivity, feedback, glossaries, etc.) particularly because on the MOVING platform the learners cannot ask someone directly for support and advice.

Learning content can consist of different formats ranging from simpler materials with little or no interactivity, such as structured PDF documents, audio or video files combined with assignments and tests, to interactive multimedia content. The development of multimedia content for the learning units is comprised of three main steps: *content development*, *storyboard development*, and *courseware development*. *Content development* includes the writing or collecting of all the required knowledge and information. *Storyboard development* is integrating instructional methods (all the pedagogical elements needed to support the learning process) and media elements (Ghirardini, 2011). The use of media and electronic interactions generates the learning experiences and activities for the learners. The storyboard is a document that describes all the components of the final interactive products, including images, text, interactions, assessment tests, etc. The last step, *courseware development*, covers developing and integrating of media and interactive components, producing the course for web delivery and integrating the content elements into the learning environment of the MOVING platform.

When selecting instructional, media, evaluation and delivery strategies, the timeline and scope of learning content have to be estimated and teaching methods and tools have to be developed. Tools are the resources that learners use to gather the knowledge they need. This includes e-learning materials, external resources like articles or videos, and supporting materials that give them an overview of the topics as well as resources like tutorials and glossaries that provide them with information on how to use the digital environment in which they access the content.

The MOVING curriculum is designed as a self-paced course. That means learners are free to learn at their own pace and to define personal learning paths based on their individual needs and interests. Communication tools for self-paced learning experiences are asynchronous and include discussion forums, wikis, blogs or webcasts (e.g. video and audio sessions that can be recorded and made available for learners who cannot attend a live event). Incorporating learning support is one of the most essential but often overlooked aspects of creating a curriculum (Ghirardini 2011). Online learners must be able to understand the purpose of the course elements and must be able to reach out to peers or facilitators when questions arise. In e-learning environments, this comes in the form of social media groups or online forums. Practical support involves peer-based resources like forums and information provided by the facilitator. For instance, a glossary of FAQs (frequently asked questions) can help learners get the missing information they seek or online discussion groups can facilitate collaboration in e-learning environments.

Lesson planning encompasses the preparation of the learning experience. Figure 5 shows a sample course plan that includes learning objectives, target audience, planned sessions including learning steps to achieve the learning goals, and panned learning activities.

UNIT 1: SEARCH FOR INFORMATION IN DIGITAL ENVIRONMENTS
Learning Objective (Unit objectives describe the main skills learners will have acquired by the end of the unit) At the end of this unit, learners will be able to identify information needs and know where to find and how to access the information they need. They will be capable of developing and updating individual search strategies according to different information needs. Learners will understand how to evaluate information from different sources and in different formats.

Lesson 1.1 Browsing, searching and filtering data, information and digital content
Learning Objectives (Lesson learning objectives describe the knowledge and skills that the learners will have acquired by the end of the lesson) At the end of this session, learners should be able to • to articulate information needs, turn a (research) question into a search strategy • understand and use different sources of information • to create and update personal search strategies
Target audience (indicates the primary target audience group for the lesson (Group 1 and/or Group 2, according to the

<table>
<tr><td colspan="2">previous definition of the target audience groups)

This lesson addresses a general audience of learners who want to improve their information and data search competences. It particularly aims at young researchers who want to expand and improve skills that are key in the search for information and data in academic practices.

general audience, young researchers</td></tr>
<tr><td colspan="2">Lesson guidelines (help define the scope and the approach of the lesson)

This lesson consists of a combination of practical skills for effectively searching and filtering information that can be practiced on the MOVING platform and contextual knowledge that helps learners to understand the digital information landscape: learners will understand different sources of information and will develop strategies to evaluate the validity, actuality and reliability of information from classical and digital sources.</td></tr>
<tr><td>Learning Steps</td><td>Planned learning activities

(provide advice to authors on the information to include and the topics and concepts to be developed in detail)</td></tr>
<tr><td>to articulate information needs, turn a (research) question into a search strategy,</td><td>What is a search strategy? Where and how can I find what I am looking for?

Understanding search fields, limiters, filters and search terms.

Keyword searching, find most relevant keywords, finding keywords in indexes.

Using Boolean operators and truncation.</td></tr>
<tr><td>understand und use different sources of information,</td><td>Traditional vs new sources of information, libraries and databases, social media and social networks as resources.

Understand how to use social media and social technologies as information resource, RSS, blogs, wikis, forums etc.</td></tr>
<tr><td>to create and update personal search strategies;</td><td>How to determine the scope of the question or task required to meet my needs, know when my search is completed, matching information needs and search strategies to appropriate search tools, be aware of fluidity and transient nature of digital environments and update search strategies.

Know how to engage in informed and self-directed learning.</td></tr>
<tr><td colspan="2">Learning Resources (Resource pointers for each lesson, which provide additional sources of information which might be useful to both content authors and the learners

List of references and links (books, videos, websites, wikis, slides etc.)</td></tr>
</table>

Figure 5: Sample course plan

Finding the right learning resources typically involves extensive research and content curation. However, since MOVING is hosting a community of practice (CoP) in which users can actively create and share content and knowledge, the roles of learner and instructor can be inverted. The curriculum structure is intentionally designed to be open, flexible and dynamic in order to include user-generated content, which enables it to evolve and adapt to an ever-changing information landscape.

3.2.5 Implementation

At this stage the course is delivered to learners. The courseware is installed on the server and made accessible for learners. This stage also includes managing and facilitating learners' activities. This process includes the establishment of communication and collaboration means and the provision of learner support systems like glossaries, FAQs, forums, or wikis where accompanying information on the course content or tools and technologies can be found. The implementation of the curriculum as well as the hosting of the MOVING MOOC will necessitate a range of features for virtual learning environments. Therefore, we will develop a set of new requirements for the platform development. These requirements will be implemented in the MOVING platform within year three of the project and will be described in detail in deliverable D2.3.

3.2.6 Evaluation

The evaluation strategy for the implemented curriculum can have different specific evaluation purposes in various stages of the curriculum development process. Evaluation allows the course designers to assess learners' progress, the quality and effectiveness of the course, and improve future learning activities and content (Ghirardini 2011). Evaluation can check the quality of the curriculum to improve it before it is implemented or measure the effectiveness of training and learning immediately after the learning unit has been implemented. Thereby, it is important to ensure that the assessment tests are aligned with the learning objectives. It is vital to start drafting the assessment tests from the early stages on once the learning objectives for each learning unit are defined.

Assessments serve different purposes: they give students the opportunity to acquire and practice skills, they give the developers of the curriculum feedback on the learner's experience, and they allow measuring learning progress. Therefore, we are including, whenever possible, assessments based on innovative techniques such as peer assessment. Our approach to assessment is to give learners opportunities to reflect on the learning process. Reflection is a key element of the MOVING curriculum as it enables the learner to develop an autonomous learning framework. As Secker and Coonan (2011) point out, teaching information literacy is not just a set of skills and competences, it is a transformative experience that helps learners to find orientation in an ever-changing information ecosystem. Therefore, "using active and reflective learning strategies, within a peer setting allowing for discussion, assessment, and mutual support, offers the most fruitful environment for enabling this transformative process to take place" (Secker & Coonan, 2011, p.7).

Assessing lessons before they are implemented is important to test if the intended learning goals can be achieved with the learning materials and learning experiences that we have provided for this purpose. We will test lessons with focus groups and test learners. Evaluating learners' reactions means understanding how those who participate in the program react to it, if they participate actively, and if they like the course. This can be measured through questionnaires and surveys, which are submitted to learners at the end of the course unit. Depending on the outcomes of this evaluation individual lessons will be improved and finally implemented.

3.3 MOVING adapted curricula for use cases

This section illustrates the adaptation of the general curriculum for information literacy for the two use cases of the MOVING platform. The first subsection gives an update on the curriculum for use case 1: training public administrators. Subsection two gives an overview of the adaptation of the curriculum for use case 2: training for young scholars.

3.3.1 Use Case 1: MOVING curriculum for public administrators

3.3.1.1 Purpose of the curriculum

Professional education in accounting and auditing is constantly changing. A continuous improvement in applicable accounting and auditing standards is expected by a dynamic market environment. For that purpose, International Education Standards (IES) are issued and revised by the International Auditing Education Standards Board (IAESB).

IES 7, *Continuing professional development,* describes the continuing professional development (CPD) that professional accountants are required to develop and maintain through professional competences. These are necessary to provide high-quality services to clients, employers, and other stakeholders. High-quality audit aids to strengthen public trust in the audit profession (IES 7 Para. A1). Typically, CPD can be attained through education, training and practical experience. Moreover, CPD can include a number of learning and development activities, such as: (1) coaching and mentoring, (2) networking, (3) observation, feedback, and reflection, and (4) the self-directed and unstructured gaining of knowledge. In the MOVING context, these can be achieved using the platform's features and functionalities, like the community and the ATS.

Measuring the attainment of CPD can be achieved by three different approaches: (1) Output-based approaches—by requiring professional accountants to demonstrate that they have developed and maintained professional competence; (2) Input-based approaches—by establishing an amount of learning activity for professional accountants to develop and maintain professional competence; and (3) Combination approaches—by combining elements of the input- and output-based approaches, setting the amount of required learning activity, and demonstrating the outcomes achieved, whereby professional accountants develop and maintain professional competence. To that effect, we described in D2.1 the learning approach at EY. 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. Multiple learning delivery methods are included in the learning development of financial professionals, such as web-based learnings (WBLs), classroom classes, self-study manuals, videos, and learning-on-the-job.

Table 4: Input and Output based approach

Output-based	Evaluation or assessment of written or published material by a reviewer
	Assessments of learning outcomes achieved
	Publication of a professional article or of the results of a research project
	Periodic re-examination
	Specialist or other qualification
	Records of work performed (work logs) that have been verified against a competency map
	Objective assessments measured against a competency map developed either by the employer or by the professional body to reflect the individual's level of competence
	Independent practice inspections that assess CPD
Input-based	Input-based CPD measures activity in terms of hours or equivalent learning units
	Time spent on learning activity
	Units allocated to the learning activity by a CPD provider
	Course outlines and teaching materials
	Confirmation of participation by a provider, instructor, employer, mentor, or tutor
	Independent assessments that a learning activity has occurred

IES 8, *Professional competence for Engagement Partners responsible for audits of financial statements* (Revised), describes the professional competence that professional accountants are required to develop and maintain when performing the role of an Engagement Partner responsible for audits of financial statements (IES 8, Para A2). Furthermore, the IES 8 applies the requirements of IES 7 to the role of an engagement partner. IES 7 and IES 8 will be followed consistently when developing and implementing the curriculum for use case 1 target users.

According to the IES 7, CPD is mandatory to all professional accountants to a certain extent. The MOVING platform is the perfect tool to apply a combination approach to CPD, using a system made of both input-based and output-based. A combined approach would use a mix of the measurements displayed in Table 4 (IES 7, Para 14 & Para 15). As professional competence is more than just knowledge of principles, standards, concepts, facts, and procedures, we must understand that it is the integration and application of (1) technical competence, (2) professional skills, and (3) professional values, ethics, and attitudes. Developing and maintaining professional competence are demonstrated, according to IES 8, by the learning outcomes of Table 5.

The MOVING platform is a great aid to the curriculum for financial professionals. Its features and functionalities can greatly improve the learning process. Moreover, the multitude of features will be included in the curriculum for the users to continuously improve their digital searching capabilities. Furthermore, in a time of continuous improvement of the audit process and most importantly a continuous digitalisation of the services of financial companies, the target users of use case 1 should learn how to combine a classical learning program with text mining and analysis methods to improve performance on the job.

Table 5: Learning outcomes for the professional competence (IES 8)

Competence Area Learning Outcomes	**Competence Area Learning Outcomes**
Audit	I. Lead the identification and assessment of the risks of material misstatement as part of an overall audit strategy. II. Evaluate responses to the risks of material misstatement. III. Evaluate whether the audit was performed and documented in accordance with applicable auditing standards (e.g., ISAs) and relevant laws and regulations. IV. Develop an appropriate audit opinion and related audit report, including a description of key audit matters as applicable.
Financial accounting and reporting	I. Evaluate whether an entity has prepared, in all material respects, financial statements in accordance with the applicable financial reporting framework and regulatory requirements. II. Evaluate the recognition, measurement, presentation, and disclosure of transactions and events within the financial statements in accordance with the applicable financial

	reporting framework and regulatory requirements. III. Evaluate accounting judgments and estimates, including fair value estimates, made by management. IV. Evaluate the fair presentation of financial statements relative to the nature of the business, the operating environment, and the entity's ability to continue as a going concern.
Governance and risk management	I. Evaluate corporate governance structures and risk assessment processes affecting the financial statements of an entity as part of the overall audit strategy.
Business environment	I. Analyse relevant industry, regulatory, and other external factors that are used to inform audit risk assessments including, but not limited to, market, competition, product technology, and environmental requirements.
Information technology	I. Evaluate the information technology (IT) environment to identify controls that relate to the financial statements to determine the impact on the overall audit strategy.
Business laws and regulations	I. Evaluate identified or suspected non-compliance with laws and regulations to determine the effect on the overall audit strategy and audit opinion.
Finance and financial management	I. Evaluate the various sources of financing available to, and financial instruments used by, an entity to determine the impact on the overall audit strategy. II. Evaluate an entity's cash flow, budgets, and forecasts, as well as working capital requirements to determine the impact on the overall audit strategy.
Interpersonal and communication	I. Communicate effectively and appropriately with the engagement team, management, and those charged with governance of the entity. II. Resolve audit issues through effective consultation when necessary.
Professional scepticism and professional judgment	I. Apply a sceptical mind-set and professional judgment in planning and performing an audit and reaching conclusions on which to base an audit opinion.
Ethical principles	I. Apply the ethical principles of integrity, objectivity, professional competence and due care, confidentiality, and professional behaviour in the context of an audit and determine an appropriate resolution to ethical dilemmas. II. Evaluate and respond to threats to objectivity and independence that can occur during an audit. III. Protect the confidential information of the entity in accordance with ethical responsibilities and relevant legal requirements.
Commitment to the public interest	I. Promote audit quality in all activities with a focus on protecting the public interest.

3.3.1.2 Structure of the curriculum

The MOVING platform is designed to support the professional accountants in fulfilling the requirements of the ISAs and in making informed analyses, evaluations and decisions. The curriculum to be developed for the target users of use case 1 will include the following competencies: (1) ability to assess risks, (2) understand the business, (3) understand governance and risks, (4) ability to assess compliance, (5) evaluate management decisions, and (6) build professional judgement. To attain these competencies, we describe a series of learning objectives to create a structured measurement and assessment of the learning process (Table 6).

The learning objectives above are in very close relation to the requirements of the ISAs. Specifically, ISA 315, *Identifying and assessing the risks of material misstatement through understanding the entity and its environment* based on which the user scenarios of use case 1 were developed. In the context of MOVING, the users will have the possibility to consult the learning page of the platform to follow with the competencies, learning objectives and learning modules specifically created to teach the use case 1 users, in a focused and organised structure.

Table 6: Structured curriculum for Use Case 1

Learning Unit/Sessions	*Learning objectives*
International Standards on Auditing	The target users of use case 1 will learn how to combine the knowledge gained during basic internal training and the functionalities of the platform. The following learning sessions will teach users how to improve their skills and competencies in the digital financial audit.
Understand the business	Understand the nature of the business, the operating environment and assess the entity's ability to continue as a going concern.
Risk assessment	Analyse relevant industry, regulatory, and other external factors including market, competition, product technology and environmental requirements.
Compliance assessment	Evaluate the compliance with applicable accounting standards and relevant laws and regulations.
Understand governance and risk	Evaluate corporate governance structures and risk assessment processes.
Evaluate management decisions	Evaluate accounting judgements estimates made by management.
Build professional judgement	Apply a sceptical mind-set and professional judgment.
Communication and Collaboration	Communication and collaboration is a form of continuous professional development for financial professionals. Combined with on the job training,

	collaboration adds an efficient and effective improvement to the quality of the job.
Content Creation	Financial professionals will appreciate content creation by other users they could collaborate with in a common project (an engagement). Users can start discussions with other user on created content within an engagement and evaluate/improve their own contributions and those from others.

The modules will be structured based on the competencies described above and could be structured into *understanding the business*, *risk assessment* and *professional scepticism.* Moreover, the learning modules could include a series of tasks and achievements in a successive manner where the user can follow her/his own progress. In between, at specific intervals or the end of a lesson/module, the user could take tests to follow on learned input, learning quality and learning capacity. Furthermore, study cases can be used throughout the learning process to better fortify the learning objectives. Additional competencies and learning objectives will be added to the use case 1 curriculum to include the features of the MOVING platform such as learning how to use the concept graph, uRank etc., to maximise the information extractions and therefore improve the continuous development of the user. In addition, other learning platforms and online courses platforms could be included in the curriculum and therefore to the learning plan.

3.3.2 Use Case 2: MOVING curriculum for young researchers

3.3.2.1 Information Literacy in Science 2.0

In the modern, networked and globalised world a multitude of new phenomena can, due to their complexity, only be researched in trans- or interdisciplinary collaborations. “Science 2.0” means the opening of the research process using Web 2.0 collaborative social technologies like blogs, wikis and forums to increase transparency and encourage collaboration throughout the research process. It means seeing web-based social technologies and online communities not just as object of study, but as way of doing research: to building networks, discuss findings, and collaborate with scholars globally across disciplinary, cultural and geographical boundaries. These social technologies and web-based tools provide an opportunity to create scholarly innovations and make scientific findings accessible to a broader public, a development with wide implications for the excellence of research – its creativity, productivity, reliability, and validity. Information literacy is a fundamental element of scientific practice. As Coonan (Coonan, 2011, p.7) states:

> The academic perception of information, in the sense of knowledge, is both organic and individual. Innovative thought is prized most highly – insights that enrich, challenge or even break with existing knowledge structures whilst displaying a sophisticated grasp of the disciplinary context and conventions. To contribute to knowledge demands not only the highest order of intellectual agility but also an unassailable familiarity with the landscape of the discipline: what has gone before, and how this new information will complement or conflict with it.

Information literacy can here be considered a threshold concept. Threshold concepts are *transformative*, in that they fundamentally change how students view an idea or a discipline or even a whole worldview; they are *integrative* because students suddenly perceive topics in relation to each other rather than separate islands of knowledge; and they are *irreversible*, once a concept is internalised it cannot be 'unlearned' or forgotten. According to Tuominen (Tuominen, 2007, p.6), "the most important goal of IL education should be to increase users' conceptual understandings of their information environment". Likewise, Coonan (Coonan, 2011, p.7) emphasises that we need "to rehabilitate the perception of information literacy and recognise that it is not merely a set of skills and competences, but a continuum that starts with skills and competences and ascends towards high-level intellectual and metacognitive behaviours and approaches". For example, a student who has internalised the idea that scientific research is not a growing compilation of knowledge like an archive, but instead is an ongoing conversation between scholars, "no longer sees a scientific article as a stand-alone document in a database, but as a voice in a continuous dynamic conversation". (Sühl-Strohmenger 2017, p. 12; original German, translation mine). Once a student has internalised this idea, the way in which he or she conducts research will also change profoundly.

Science 2.0 is closely related to the concept of "Open Science", which proclaims the removal of barriers that restrict access to scientific data and knowledge. Movements like Open Data, Open Access, or Open Educational Resources advocate the free access to knowledge as a precondition for human development and are questioning the institutional power of for-profit scientific journal and data publishers who often keep and research findings behind a paywall. Social technologies like blogs, wikis and social bookmarking services together with movements like Creative Commons offer entirely new ways to publish, share, discuss and reproduce scientific findings and data. This international and interdisciplinary opening of science in the 21st century requires a new set of competences and attitudes for young researchers to thrive in this environment.

3.3.2.2 Purpose of the curriculum

The purpose of the MOVING curriculum for use case 2: training young researchers is to support students in developing academic information literacy. The target audience are junior researchers (PhDs, Post-docs) and students at an advanced level (graduate students). Information literacy – acquired along to the principles of open science: open, transparent, and collaborative – is a fundamental component of learning, scholarship and research and gives researchers the means to engage Web 2.0 technologies for all aspects of scientific practice. The curriculum is based on current international standards for information literacy curricula in institutions of higher education (see table 7). Based on this comparison we identified a number of topics with corresponding learning objectives that informed the framework of the MOVING curriculum for young scholars. MOVING will enable young academics to utilise the means of the internet to search, access and use information, to organise knowledge, extract new ideas, and build networks of scholars, public institutions, civil society and private companies to spread a culture of open innovation. To this end we have designed a number of learning goals that suit the particular needs of young scholars. This curriculum framework will also be the basis for the MOVING MOOC "Science 2.0 and open research methods"

(see section 4.3). The MOOC will be held in year three of the project and the user-generated content produced during the live events will be reused as learning material for the use case curriculum in the learning environment of the platform.

Table 7: Comparison curriculum frameworks for IL

FRAMEWORK	ACRL (FRAMEWORKS)[12]	A NEW CURRICULUM FOR INFORMATION LITERACY (ANCIL)[13]	METALITERACY IN PRACTICE[14]	DIGCOMP 2.0/2.1[15]
MODEL	Six frames for teaching IL	Ten thematic strands (*with five corresponding learning categories)*	Four overarching learning goals (2014) with corresponding learning objectives	Five Competence Areas with 21 Subcompetences (updated Framework DigComp 2.1 adds 8 proficiency levels for digital competence)
LEARNING UNITS/ LEARNING OBJECTIVES	Frame 1: Authority Is Constructed and Contextual Frame 6: Searching as Strategic Exploration	Strand 4 Mapping and evaluating the information landscape *(subject-specific competences (navigating the information landscape, resource discovery))* Strand 5 Resource discovery in your discipline *(subject-specific competences (navigating the information landscape, resource discovery))* Strand 6 Managing information *(key skills)*	Goal 1: Evaluate content critically, including dynamic, online content that changes and evolves, such as article preprints, blogs, and wikis 1. Place an information source in its context (for example, author's purpose, format of information, and delivery mode) in order to ascertain the value of the material for that particular situation 2. Distinguish between editorial commentary and information presented from a more research-based perspective, recognizing that values and beliefs are embedded in all information 3. Determine the value of formal and informal information from various networked sources (scholarly, user-generated, OERs, etc.) 4. Evaluate user response as an active researcher; understand the differing natures of feedback mechanisms and context in traditional and social media platforms 5. Appreciate the importance of assessing content from different sources, including dynamic content from social media, critically	Competence area 1: Information and data literacy 1.1 Browsing, searching, filtering data, information and digital content 1.2 Evaluating data, information and digital content 1.3 Managing data, information and digital content

[12] ACRL (2016)

[13] Secker and Coonan (2011), (2013)

[14] Mackey & Jacobson (2014); Forte et al. (2014)

[15] Vuorikari et al. (2016); Carretero et al. (2017)

	Frame 3: Information Has Value	Strand 7 Ethical dimension of information *(advanced information handling (e.g. evaluation, source critique, synthesis))*	Goal 2: understand personal privacy, information ethics and intellectual property issues in changing technology environments 1. Differentiate between the production of original information and remixing or re-purposing open resources 2. Distinguish the kinds of information appropriate to reproduce and share publicly, and private information disseminated in more restricted/discreet environments 3. Use technology to build a positive web presence 4. Apply copyright and Creative Commons licensing as appropriate to the creation of original or repurposed information 5. Recognize the ethical considerations of sharing information 6. Articulate the necessity of attribution when borrowing the intellectual property of others, regardless of format 7. Identify the context for which accurate attribution is needed and consistently apply that attribution 8.	Competence area 2: Communication and collaboration 2.5 Netiquette 2.6 Managing digital identity
	Frame 2: Information Creation as a Process Frame 4: Research as Inquiry Frame 5: Scholarship as Conversation	Strand 8 Presenting and communicating knowledge *(advanced information handling (e.g. evaluation, source critique, synthesis))* Strand 9 Synthesising information and creating new knowledge *(advanced information handling (e.g. evaluation, source critique, synthesis))*	Goal 3: share information in a variety of participatory environments 1. Participate conscientiously in collaborative environments 2. Take responsibility for participation in collaborative environments 3. Compare the unique attributes of different information formats (e.g., scholarly article, blog, wiki, online community), and have the ability to use effectively and to cite information for the development of original content) 4. Describe the potential impact of online resources for sharing information (text, images, video, and other media) in collaboration with others 5. Demonstrate the ability to translate information presented in one manner to another in order to best meet the needs of particular audiences; Integrate information from multiple sources into coherent new forms 6. Effectively communicate personal and professional experiences to inform and assist others; and recognize that learners can also be teachers 7. Produce original content appropriate to specific needs in multiple media formats; transfer knowledge gained to new formats in unpredictable and evolving environments 8. Value user-generated content and critically evaluate contributions made by others: see self as a producer as well as consumer, of information 9. Be open to global perspectives; use communication with others in a global context to encourage deep learning	Competence area 2: Communication and collaboration 2.1 Interacting through digital technologies 2.2 Sharing through digital technologies 2.4 Collaborating through digital technologies Competence area 3: Digital content creation 3.1 Developing digital content 3.2 Integrating and re-elaborating digital content 3.3 Copyright and licences 3.4 Programming
		Strand 1 Transition from school to higher education *(learning to learn)*	Goal 4: Demonstrate ability to connect learning and research strategies with lifelong learning processes and personal, academic,	2.3 Engaging in citizenship through digital technologies

		Strand 2 Becoming an independent learner *(learning to learn)* Strand 3 Developing academic literacies *(developing academic literacies)* Strand 10 Social dimension of information *(learning to learn)*	and professional goals 1. Determine scope of the question or task required to meet one's needs 2. Reevaluate needs and next steps throughout the process 3. Demonstrate the importance of matching information needs and search strategies to appropriate search tools 4. Use self-reflection to assess one's own learning and knowledge of the learning process 5. Demonstrate the ability to think critically in context and to transfer critical thinking to new learning 6. Value persistence, adaptability, and flexibility 7. Communicate effectively with collaborators in shared spaces and learn from multiple points of view 8. Recognize that learning is a process and that reflecting on errors or mistakes leads to new insights and discoveries 9. Engage in informed, self-directed learning that encourages a broader worldview through the global reach of today's information technology 10. Demonstrate self-empowerment through interaction and the presentation of ideas; gain the ability to see what is transferable, translatable, and teachable (learners are both students and teachers) 11. Conclude that metaliteracy is a lifelong value and practice	Competence area 4: Safety 4.1 Protecting devices 4.2 Protecting personal data and privacy 4.3 Protecting health and well-being 4.4 Protecting the environment Competence area 5: Problem solving 5.1 Solving technical problems 5.2 Identifying needs and technological responses 5.3 Creatively using digital technologies 5.4 Identifying digital competence gaps (Competences marked in grey are not considered part of information and media literacy training)

3.3.2.3 Structure of the Curriculum

The curriculum structure is based on the general MOVING curriculum for information literacy and contains three major units: (1) Search for information, (2) communication and collaboration in digital environments, and (3) digital content creation. Learning objectives and learning sessions will be tailored to the needs and interests of young scholars. Table 8 shows the outline of the curriculum including the three main learning units with corresponding learning sessions. Each learning unit has an overarching learning goal, corresponding to this goal we defined related learning objectives for each individual session.

Table 8: Curriculum outline: science 2.0 for young scholars

Learning Unit/Sessions	*Learning objectives*
Search for Information	Students will understand that searching information is a strategic exploration and that research is an inquiry. They will develop creative and flexible strategies on how and where to find information they need and will be able to critically evaluate and effectively manage information. They are consciously mapping and evaluating the information landscape and are able to discover resources in their discipline. Students will understand that authority is constructed and depends on the information context and will be able to place an information source in its context (author's purpose, media format and delivery mode of information).
Browsing, searching, filtering information, data and digital content in Web 2.0 environments	Students will develop strategies to match different information needs. They understand how to search, filter and browse information effectively by using a range of tools for information retrieval (including classical database searches, as well as web sites and social media streams, or new media technologies like RSS feeds). Students will understand that information has different purposes, can come from different sources (formal/ informal; print-based/web-based; static/dynamic etc.) and is provided in various media formats (text, video, audio, simulations etc.) for different audiences. They can alter and refine search strategies if necessary and can use different types of search language appropriately.
Evaluating information and data in digital environments	Students will understand the values of different formats of information (scholarly articles, user-generated content, OERs etc.). They recognize that there are values and beliefs embedded in information, they know the different feedback mechanisms used in traditional as well as dynamic Web 2.0 information contexts (e.g. scholarly journals vs. social media comments), and they appreciate the importance of assessing content from different sources critically.

Managing information, data, and content in participatory digital environments	Students will develop strategies to store, manage and retrieve information and content effectively in their scholarly practice (e.g. bibliographic management software), including social technologies (like wikis, tagging, and social bookmarking). Students will have the ability to integrate information from multiple sources into coherent new forms, present information in ways that best meet a particular audience and know how to effectively cite information for the development of original content.
Communication and Collaboration	Students will communicate effectively with collaborators in shared spaces and learn from multiple points of view. They will understand that information has value and that there are ethical and legal dimensions in the sharing and use of information. They engage in informed, self-directed learning and communities of practice. They broaden their worldview through the global reach of current information technologies and engage with people from all kinds of disciplinary, cultural and professional backgrounds in collaborative networks. Students demonstrate self-empowerment through interaction and presentation of ideas and see what knowledge is transferable, translatable and teachable (they see themselves both as learners and teachers)
Interacting through Web 2.0 technologies	Students use digital technologies to present and communicate knowledge in interactive environments. As creators and user of information, they understand their rights and responsibilities when (inter)acting as experts and participating in a community of scholarship and are inclined to examine their information privilege.
Sharing information and content in Web 2.0 environments	Students value Web 2.0 technologies (e.g. blogs, wikis, microblogs, and social media) to share information and content with others. They understand the difference between the production of original information and remixing or re-purposing o existing content. They know about the necessity of attribution when borrowing and using the intellectual products of others. They know that they are responsible for making deliberate choices about when to comply and when to contest current legal and socioeconomic practices concerning the value of information.
Collaborating using digital and Web 2.0 tools	Students engage consciously in collaborative environments. They are familiar with tools and technologies (e.g. wikis, RSS feeds, and project management software, like virtual Kanban boards) that support collaboration and teamwork in digital work-spaces.
Content Creation	Students will understand that information creation is a process and that scholarship is a conversation. They will learn how to become an active voice in that conversation and understand the benefits of Web 2.0 technologies (journals,

	networks, blogs, wikis, social bookmarking etc.) in making this voice heard (to publish findings, discuss research-in-progress etc.). Students will value user-generated content and critically evaluate contributions made by others; they consider themselves both as users and producers of information. They know about copyright and Creative Commons licensing as appropriate for the creation of original and repurposed content

4 Training options on the MOVING platform

4.1 Combination of work and training on the MOVING platform

MOVING provides a wide range of learning options that can be tailored to the users' needs and interests. The access to knowledge and self-regulated learning are preconditions for professionals to engage actively in open innovation processes. To be an information-savvy professional means also to be self-aware of information needs and knowledge deficits and to actively seek education and training opportunities to fill these knowledge gaps. MOVING provides a platform on which users can not only find information they need, it also offers a wide range of learning options, training materials and online courses (MOOCs) that assist users in lifelong learning and make targeted training offers according to individual interests and specific needs. Providing work and training environments in a single platform is a unique characteristic that sets MOVING apart from other projects. Combining the work and training options with social technologies that allow the sharing of knowledge and content as well as collaboration the platform, makes MOVING not only a platform but a community of practice for open innovation processes. Figure 6 gives an overview of the combination of features that support working, training and learning flows on the MOVING platform.

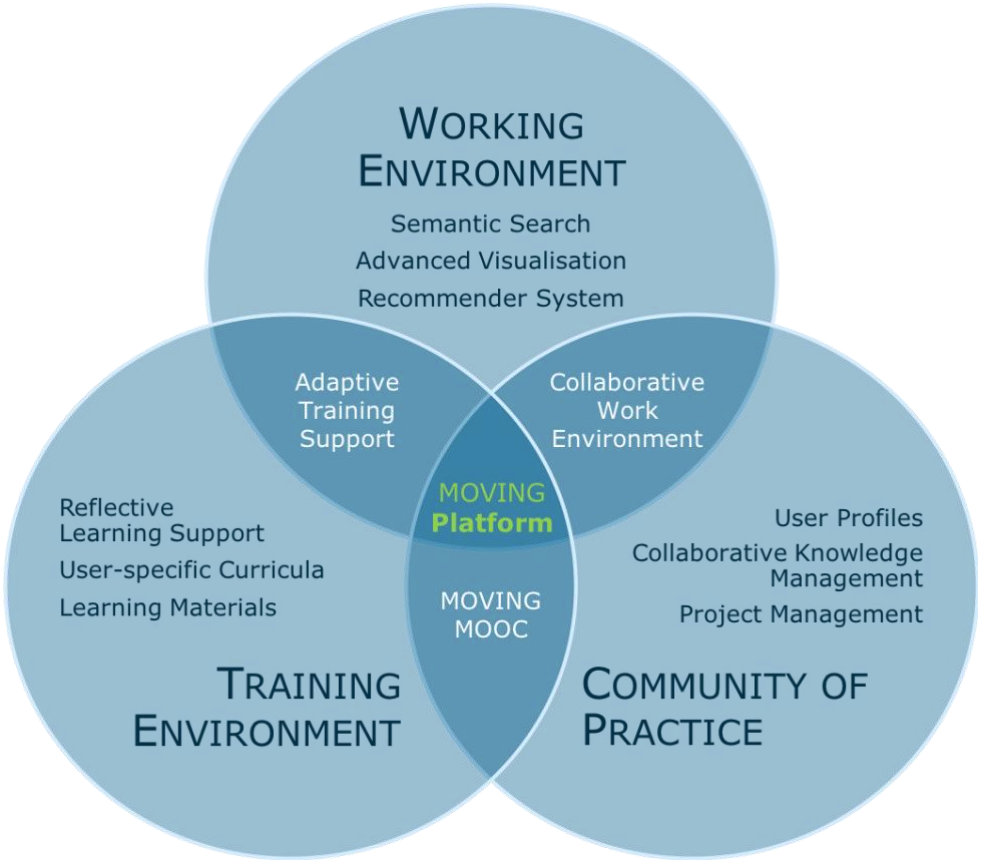

Figure 6: MOVING working, training and learning features

4.2 MOVING learning environment

The MOVING learning environment gives users of the platform a range of self-regulated learning options. Users who want to learn more about the platform and its features can take a guided tour through the platform, in which the different environments (search, projects, community and learning environment) are introduced. This learning option consists of a short introduction video and a range of tutorials, video clips that explain where to find and how to use the technical features of MOVING, with the purpose of familiarising the user with the platform.

Additionally, the learning environment provides every user with learning opportunities due to his or her former search queries. The learning material (texts, videos, online courses and tutorials, or MOOCs) that this option suggests is retrieved from the MOVING databases based on the last five search queries that the user conducted in the Search environment of the platform. This provides users with the opportunity to not only find information on a given topic but also to choose from the vast inventory of open educational resources (OERs) that are accessible through the MOVING search. Furthermore, the user can systematically search for learning material and online courses within the search environment by simply switching the search domain from “Research” to “Learning”.

The third learning option within the Learning environment is based on the MOVING curriculum for information literacy. Users can improve their information literacy and digital competencies by browsing the resources or deliberately selecting lessons from the three main competence areas that are outlined in the curriculum that will be elaborated in detail in the sections below. This compendium of learning materials is also the basis for the training offers that are conveyed to users of the platform through the adaptive training support (ATS) “curriculum reflection” widget that is described in more detail in Section 5 of this deliverable.

Offering a wide range of social technologies on the MOVING platform helps establishing MOVING as a community of practice (CoP). That means users in the MOVING Community are encouraged to actively add resources and contribute to this dynamic compendium of OERs by writing comments and blog posts, creating wikis, starting forum discussions or uploading and linking user-generated content that can be embedded in the curriculum framework. The curriculum will also be the basis for the MOVING MOOC “Science 2.0 and open research methods”, which is described in section 4.3, that will be conducted on the MOVING platform during the project phase. This massive open online course will be hosted on the MOVING platform and is open to all interested learners. After the real-time run through of the course, the MOOC will be edited and all the learning sessions and materials will remain open for participation, so that users interested in the topic can still take the course even if they did not have the opportunity to participate in the live event. The MOOC will serve a double purpose on the platform: first, it will attract new users to the platform to create a MOVING community of practice. And second, it will produce content for the learning resources of the platform that can then be utilised for the ATS “curriculum reflection” widget and potentially also for the recommender system.

4.3 MOVING work and training environment

In addition to the self-directed learning options within the Learning environment and the web-based OER database that is accessible through the search, the MOVING platform provides users with training offers in data and information literacy while they are using the different work environments (search, projects, community). The ATS "curriculum reflection" widget, described in more detail in section 5.6, guides the user along the curriculum to relevant learning material. During the registration and onboarding process every user is asked to fill in a short self-assessment survey that determines his or her level of competence in information literacy (see Appendix I). The individual score from the prior knowledge assessment then determines on which competence level of the curriculum the ATS starts the guidance for each user.

The timing and location of the guidance offers are adapting to the users' behaviour. This means, the type of support offered by the ATS depends on where the user is currently located on the platform and what he or she has been interested in when using the search functions before. Depending on whether the user is currently using the project environment, the search environment or the community environment, different learning contents are offered to him or her. The basic curriculum is constructed in a modular way so it is customisable to each learner's level of competence and specific interests and needs. There will be specific learning materials provided for the two use cases of the MOVING platform – (1) research on business information by public administrators and (2) managing and mining research information by young researchers.

Competence area (1), searching for information, is concentrating on the **search environment** and will contain sessions on data and information mining, data analysis and visualisation and information management. Competence area (2), communication and collaboration, and (3), content creation, will be focused on the **projects** and **community environment** of the platform. Here, the curriculum will provide knowledge on utilising digital tools to collaborate and communicate with others on the platform and in digital environments in general and how to create, re-mix or share web-based content within the community. Learning sessions in this part of the curriculum will contain e.g., how to create and maintain a wiki, how to use blogs to create and embed content, how to share documents and files or schedule tasks in a digital working environment using the MOVING platform.

4.4 Introductory MOVING MOOC "Science 2.0 and open research methods"

In this section, the initial version of the MOVING MOOC *Science 2.0 and open research methods* is described. Section 4.4.1 gives an overview of the goals, design and target group of the MOOC. Section 4.4.2 outlines the pedagogical approach and the design of the MOOC. It describes learning objectives and activities and defines platform functionalities that are required for the implementation of the MOOC. Finally, section 4.4.3 provides a schedule for the further development of the MOOC.

4.4.1 Overview of the MOVING MOOC

In this subsection an overview of the goals, the design, and the target group of the MOVING MOOC are presented.

Goals

The MOVING MOOC *Science 2.0 and open research methods* pursues three goals. First, the MOOC will contribute to building a community on the MOVING platform where users can exchange ideas on scientific problems and approaches, share solutions and experiences with each other and critically reflect on various methods used. The networking and reflective learning approaches of MOVING are in the spirit of MOOCs to bring together learners as a community. Secondly, the participants of the MOOC are encouraged to create content within the course, thus the MOOC will provide user-generated content that afterwards can be used as learning material by other learners in the learning environment of the MOVING platform. Thirdly, the MOOC aims at stipulating in learners a fundamental understanding of subjects that support open innovation, particularly Science 2.0 and open research methods, including methods of data mining and analysis.

Design

The MOOC will consist of theoretical units (enhanced by learning videos or scheduled live sessions) as well as practical sessions in which learners perform, for example, data visualisations on the MOVING platform. Specific real-life challenges like the search for information are discussed in forums; detailed results of the visualisation are reflected in blog posts and tips are shown in small self-produced “How-to” videos. The added value of the MOOC for the participants lies primarily in the application of the topics Science 2.0 and data mining. Not only theory but also practice is imparted through the application of the features (search and visualisation functions, community tools) of the platform. Through reflective activities, such as writing blog posts and commenting in forums, the participants will be able to put more emphasis on what they have learned.

Target group and MOOC developers

The MOOC is principally open to all kinds of learners interested in the topic *Science 2.0 and open research methods*. However, the subject is particularly addressing young researchers from all disciplines who want to learn more about the possibilities and benefits of social technologies in academic practice. Nevertheless, the subject is open and generally comprehensible enough to be of interest to the broader public.

The MOOC is developed at TUD. Here, the learning content is developed, learning material is selected, edited and provided to the course. TUD staff is also acting as facilitators and moderators and will provide support for the participants during the live-run of the MOOC.

4.4.2 Pedagogical approach and design of the MOVING MOOC

In this section, the didactic approach and the design of the MOOC are elaborated in more detail.

Popular formats of MOOCs, like cMOOCs or xMOOCs, are based on specific pedagogical approaches. In a connectivist MOOC (cMOOC) participants learn mainly through collaborating with other participants and they are participating in developing their own contributions (like blog posts) and co-creating content (Crosslin, 2016; Ebner et al., 2015; Schulmeister, 2013) (see also Section 2.1 in deliverable D2.1). xMOOCs follow a cognitivist approach and are similar to a traditional lecture where the learning content is highly structured (van Treek, Himpsel-Gutermann & Robes, 2013). Learning in xMOOCs takes place via video lectures, regular knowledge queries, exams and homework (Schulmeister, 2013).

Because one of the goals is building a MOVING community, the integration of connectivist elements in the MOOC is significant. Within the connectivist approach "the emphasis is on learning in a networked context, through a distributed community of peers" (Conole, 2015, p.244), where the participants decide and contribute content and become already a community of practice (Gamage, Fernando, & Perera, 2016). Nevertheless, also characteristics of the cognitive approach are considered in the MOOC. In addition to community building, the goal is familiarising the user with the platform's functions. For this reason, the moderators specify tasks to be solved with the use of the platform. Furthermore, recordings of lectures are also taken into account for the collection of materials and learning activities. Accordingly, it becomes evident that the MOVING MOOC does not pursue one pedagogical approach, but rather a mix of the connectivist and cognitivist approaches.

Conole argues that the classification in cMOOCs and xMOOCs "is an inadequate way of describing the variety of MOOCs and the ways in which learners engage with them" (Conole, 2014, p.65). Instead of focusing on different types of MOOCs, she suggests concentrating on an effective design of MOOCs based on 12 dimensions including context and pedagogy aspects of MOOCs (Conole, 2015). As a starting point to designing the MOVING MOOC the following classification schema is used. The first column of Table 9 shows the dimensions of the MOOC, the second column describes how the MOVING MOOC will tackle these dimensions.

Table 9: twelve-dimensional classification schema (Conole, 2015) for designing the MOVING MOOC

Dimension	**Description**	**Description for MOVING MOOC**
Context		
Open	How open is the MOOC?	As the MOOC will be hosted on the MOVING platform it is necessary to have a login. OER materials will be used and remixed in the MOOC and all produced material and results of instructors as well as students will also be reused as OER on the platform.
Massive	How many participants will participate in the course?	The MOOC will have at least 150 participants.
Diversity	How is the diversity of the participant population?	The course is aimed at people with little or no prior knowledge who plan or need to use data and/or text mining tools to cope with their working tasks. However, due to the use case implemented it is expected that a certain number of researchers will participate. The MOOC will be held in English.
Learning		
Use of multimedia	How much and what type of multimedia is used?	The MOOC is primary video-based. There will be links to open access articles and videos. Participants are encouraged to produce short “How-to” videos.

Dimension	Description	Description for MOVING MOOC
Degree of communication	In which way are participants encouraged to communicate with their peers and their tutors?	As it is the goal to build a vivid community on the platform participants are encouraged to communicate with each other through forums and the use of social media.
Degree of collaboration	To which extent do the participants collaborate together?	In the MOVING MOOC participants are encouraged to create knowledge through communicating with each other. It is not intended to fulfil tasks and via group work.
Amount of Reflection	To which extent are the participants encouraged to reflect on (and perhaps apply) their learning?	The participants are encouraged to write reflective blog posts and to comment blogs of other participants. In addition, they are encouraged to post questions in a forum thread. Participants are going to apply their knowledge on the MOVING platform (e.g. with the data visualisation).
Learning pathway	To which extent are learning paths available and how are they structured?	There will be week-specific topics with extra material, but participants are not obliged to follow a specific learning path. Each participant can choose which topic to focus on, depending on his/her interest.
Quality assurance	To which extent is the quality assured?	Before the MOOC is going online it will be tested by test users. There will be also a checklist to ensure its quality.
Certification	Will the participants get badges or certifications?	It is aimed to motivate the participants (e.g. to communicate with each other) by using badges.

Dimension	Description	Description for MOVING MOOC
Formal learning	Is the MOOC is linked to a formal educational offering?	It is planned to integrate the MOOC into a formal education offering at TU Dresden. Nevertheless, the course is open for people interested in the respective subjects. It supports informal and lifelong learning.
Autonomy	To which extent participants are expected to work individually through the MOOC and take control of their learning with little or no tutor support?	To achieve a badge, participants are expected to take control of their learning for accomplishing tasks. In addition, it is planned to have peer-assessment and automatic assessment on certain stages in the MOOC.

4.4.2.1 Learning objectives, activities and material

In this subsection learning goals, activities and material for the MOVING MOOC are described in detail.

Learning objectives

As described in the previous chapter the pedagogical concept of the MOVING MOOC is based on a connectivist approach. In this understanding, learning is seen as a self-organised process with mainly establishing connections between learners (Crosslin, 2016). Besides this, learners create their own learning objectives and learning paths through the materials (Conole, 2015). Therefore, the MOVING MOOC has no fixed learning objectives for the participants. It rather encourages them to think about their personal learning objectives, also based on their prior knowledge and experience with the subject. Through reflecting and discussing the provided material with other participants learning objectives can also develop.

Activities

The learning activities of the MOVING MOOC are based on the cMOOC learning activities by 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 learning management system (LMS) discussion, etc.
4. Sharing: with others and making connections.

The participants will make use of the videos and reading materials provided by the course facilitators *(Aggregation)*. They will use forums to initiate a discussion when looking at a topic in a controversial way *(Reflection)*. Next to stimulating topics they are encouraged to record videos *(Creation)*, e.g. about the use of the MOVING platform to solve a research problem. The participants are also going to share these videos with the other participants *(Sharing)* and review blog posts from other participants. The participants of the MOVING MOOC are encouraged to apply the learnings through various activities and thus to deepen their knowledge. They will use the MOVING platform to accomplish research tasks with the features the platform offers, like the search and the visualisation tools.

Material

The material that will be used in the MOVING MOOC is based on OER, with a focus on creative commons licensed material that can be shared and modified. In that way, it is possible to create new content by mixing already existing content (Pscheida, Lißner & Kahnwald, 2014; Saadatmand & Kumpulainen, 2014). The course facilitators are going to use existing OER material for the video input sessions. Besides this, open access articles about the respective subjects are going to be used as reading material. On the base of these two main input areas the participants are invited to reflect

their thoughts in blog posts and other communication means like forums and wiki pages which are on the platform. The quality will be ensured through peer-review assessment which is motivated by the use of badges (e.g. for one blog post review the participant earns a badge).

4.4.2.2 Functionalities to implement on the platform

In this section functionalities for the MOOC on the MOVING platform are outlined. These functionalities are depending on the pedagogical approach and the course design considerations for the MOOC. Within D2.1 an initial list of functions for the MOOC was provided. In particular, blog functions that are used by different user groups (Admin, Tutor, Users) and the iframe function have already been listed in the report. This list of functions will be continually extended now and in the next months.

Platform

The MOOC is conducted on the MOVING platform. Therefore, participants have to register on the platform. After the registration, the course and the content are accessible to the learners.

MOOC system

A blog system like WordPress[16] is used to embed interactive videos, to display the course content, the instructions for activities and further reading material.

Collaboration and communication

To enable collaboration and communication within the MOOC discussion forums, a blog function within the users' profile page and social plug-ins are integrated into the platform. These features can only be integrated if they are compliant with the privacy policy of the Technische Universität Dresden, which hosts the platform.

Assessment and motivation tools

Within the interactive course videos small quizzes will pop up. In these quizzes, participants can check to what extent they have internalised the content they have just seen, heard or read. For that is essential to extend the blog system with the feature for the interactive course videos. Besides this, peer-assessment features will be integrated. At this point, it is not sure whether an extra tool will be implemented for that. Badges are integrated to motivate the participants to finish the course and to assess content that is produced by other participants. In that way, badges act as a reward system. Furthermore, they can be awarded for partial progress or individual learning activities. Since they support the Mozilla Foundation[17] standard, they can be exported and reimported to the platform. The overall course progress and the badges earnt in the course can be displayed on the personal profile pages.

[16] https://wordpress.com

[17] https://www.mozilla.org

4.4.3 Schedule

Table 10, provides a schedule for the steps that need to be taken to implement the MOOC. A MOOC run will take between 3 and 6 weeks and is planned twice within the duration of the project. After the live-runs are completed, the MOOC will remain open for registration so that learners interested in the subject *Science 2.0 and open research methods* can access the learning resources and use materials that were collected during the MOOC for self-regulated learning purposes.

Table 10: Schedule for developing the MOVING MOOC

March 2018	Design - Development of course design
April 2018	Design - Development of course design
May 2018	Develop - Development of content
June 2018	Develop - Development of content - Integration of technical functionalities
July 2018	Develop and advertise - Development of content - Integration of technical functionalities - Course advertisement (Flyers, stickers, online)
September 2018	Develop and advertise - Development of content - Integration of technical functionalities - Course advertisement (Flyer, sticker, online)
October 2018	Test and revision - Test of design and materials with beta test users - Revisions
November 2018	Buffer and last checks

December 2018	First implementation and evaluation - Communication and course moderation - Analyse outcomes
January 2019	Manage & Optimize
February 2019	Second implementation and evaluation - Communication and course moderation - Analyse outcomes - Processing user-generated content for learning environment

4.5 Provision of learning materials

4.5.1 Open educational resources

The access to knowledge and lifelong learning are key factors not only in open innovation processes but social, technological and scientific progress in general. Since the late 2000s, a global movement, gained momentum that endorses free and open access to educational resources as a prerequisite for human development. Inspired by the UNESCO Paris Declaration (2012), many governments, universities and enthused activists have contributed to the free sharing and open licensing of knowledge and educational material. Open educational resources (OERs) are most commonly defined as "teaching, learning and research materials in any medium – digital or otherwise – that reside in the public domain or have been released under an open license that permits no-cost access, use, adaptation and redistribution by others with no or limited restrictions" (The William and Flora Hewlett Foundation, 2018). The intention of the OER movement is to provide people everywhere in the world with high-quality learning and research materials as an expression of their human rights to education and access to knowledge.

OERs can be produced in any medium and contain "full courses, course materials, modules, textbooks, videos, tests, software, and any other tools, materials, or techniques used to support access to knowledge" (Atkins et al., 2007, p.4). OERs can not only be freely accessed, they can also be altered, repurposed, re-mixed under a Creative Commons (CC) licence. And, even though they are not exactly the same, OERs are closely related to Open Source Software (OSS) and Open Courseware (OCW) developments. In recent years, platforms that offer free online courses like KhanAcademy[18], MITOpenCourseWare[19], Udacity[20], Coursera[21] and edX[22] attracted large numbers of learners.

[18] http://www.khanacademy.org/

[19] https://ocw.mit.edu/index.htm

[20] https://www.udacity.com/

Particularly MOOCs are gaining extraordinary popularity: in 2016, Class Central[23], a platform listing online courses, counted a total number of 58 million students worldwide, of which 23 million people had registered for a MOOC for the first time. They listed a total of 6850 courses offered by 700+ universities (Shah, 2016). These trends have massively altered the access to knowledge and education and are tearing down barriers for lifelong learning around the globe.

MOVING gives users access to a wide range of OERs covering all levels of education. Our most important OER repository in the MOVING database is provided by VideoLectures.Net[24], which is currently hosting 21.614 educational videos of average 42 minutes length. The video lectures are archived for long-term preservation and are a rich resource of lectures by distinguished scholars and scientists at some of the world's most prestigious universities as well as presentations at internationally significant conferences, summer schools, workshops promotional events from many fields of science. VideoLectures.NET is counting more than 10,000 unique visitors per day, from all over the world and is one of the leading open scientific media and video services in the world by offering high-quality multilingual learning. In respect to OERs there are many competitors, but they are mostly monolingual offering in more than 95% of materials only English, which is not the case of VideoLectures.Net, which provides video transcriptions and translations handling English, German, French, Spanish, Catalan and Slovenian languages and has proved to be adding significant value to OERs videos with providing transcriptions and translations as subtitles. The goal of VideoLectures.Net is to be one of the most sought-after OER services in Europe and in the world offering diverse and high-quality peer-reviewed content.

4.5.2 Tutorials and guidance videos

Based on Task 2.3, JSI is producing MOVING tutorials, which will be provided on the MOVING platform to train data-savvy information professionals. Tutorials are a central part of videos specifically related to the introduction and explanation of the functionalities of the MOVING platform, respectively the MOVING technology. Until M24 of the project MOVING is serving with 9 tutorials: Visualisations Concept Graph, Visualisations uRank, ATS, data acquisition with LODatio, Platform promo tutorial, recommender system, Video Analysis Lecture video linking, Video Analysis online service, Web interaction patterns WevQuery. In year 3, JSI will provide more of them, based on the needs of MOVING users.

MOVING tutorials are also uploaded to a MOVING channel on both VideoLectures.NET[25] and YouTube[26].

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[21] https://www.coursera.org/

[22] http://www.edx.org/

[23] https://www.class-central.com

[24] http://videolectures.net

[25] http://videolectures.net/moving_videos

5 Adaptive Training Support

In this section, we give an overview of Task 2.1 Adaptive Training Support (ATS) and the corresponding activities conducted in year 2 of MOVING led by Know-Center.

The overarching goal of the Adaptive Training Support is to provide MOVING users with the possibility of acquiring Digital Information Literacy Skills and Competence.

To achieve this overarching goal, the main activities of Task 2.1 within Y2 were as follows:

- Development of the "Learning-how-to-search" widget and its integration in the MOVING platform.
- Development of a theoretical concept and mock-ups for the "Curriculum Reflection Widget".
- Integration of the Prior Knowledge Assessment in form of a questionnaire in the MOVING platform.
- Case Study: A qualitative exploration of virtualising traditional face-2-face training at EY.
- Investigation of whether exploiting additional textual information (e.g. user reviews) and Linked Data[27] can improve content recommendations
- Integration of a recommender system in the MOVING platform (ongoing)

Most of the described activities have been carried out together with other work packages (mainly WP1 and WP4) and between multiple project partners (i.e. EY, TUD, ZBW, UMAN and JSI) and will, therefore, be referred to where applicable. For each of the main activities stated above, we will describe in the following sections the conducted work in more detail.

5.1 Learning-how-to-search Widget

5.1.1 Goal

The goal of the Learning-how-to-search widget is to support users on **learning how to search with the MOVING platform** to become an experienced searcher.

The Learning-how-to-search widget focuses on providing guidance for training MOVING users on how to efficiently and effectively use the MOVING platform including all its search functionalities. The goal of the Learning-how-to-search widget is to make MOVING users aware of the available MOVING functionalities in order to be later able to exploit the complete potential of the MOVING platform. This exploitation enables users to quickly retrieve the desired and relevant information and finally enhance the user's search expertise and search satisfaction.

[26] https://www.youtube.com/channel/UCLpMLXQQaHDv0CJMG5Sc7mg/videos

[27] http://linkeddata.org

As underlying learning strategy, we have decided for reflective learning. Reflective learning is a viable mean to re-evaluate past (search) behaviour or (search) experiences in order to learn from them for improving future (search) behaviour. In order to provide guidance for initiating reflective learning, the Learning-how-to-search widget adapts to the search behaviour of the MOVING user in relation to the used features. It mirrors back feature usage and behaviour and suggests features and reflective prompts aiming at improving the user's search behaviour.

5.1.2 Literature Review

Skill level development for becoming an expert searcher

Before starting a discussion about what is expertise or who is an expert regarding a specific profession or topic, in our case an expert searcher, it is worth to consider the skill development starting from novices, or beginners, to experts. Dreyfus & Dreyfus (1988; and summarised in Dreyfus, 2004) suggested the following five-stage model of adult skill acquisition.

- Stage 1: Novice: S/he is given a set of rules or facts to apply without any contextual situations. The decisions taken are analytical similar to a computer program following given rules. No emotions are involved.
- Stage 2: Advanced Beginner: The beginner applies the given rules in real situations. S/he starts to develop an understanding in a specific context and starts to collect meaningful aspects and experiences in the situation. Still, no emotions are involved.
- Stage 3: Competence: With more experience, applying rules starts to be replaced by reasoning. As the number of relevant elements and procedures increases but the sense of what is important in a particular situation is still missing, s/he sometimes becomes overwhelmed, nerve-wracked and exhausted. Thus, s/he starts to develop rules and context to set goals.
- Stage 4: Proficiency: Over time, the rule-following stance of the novice and advanced beginner is replaced by involvement. The experienced performer sees goals and salient aspects but not how to reach them. However, there is less need for planning and problem-solving but increasing situational discrimination.
- Stage 5: Expertise: S/he combines practical wisdom and experiences with intuition and is able to derive patterns from these experiences. Thus s/he is able to make more subtle and refined discriminations, as well as to apply intuitive and involved decision-making.

Novice–expert continuums were studied in extensive research studies and in many different professions in order to understand what expertise is with regard to a given profession or discipline. Following Tucker (Tucker, 2014), the novice-expert research investigates "*what novices and experts do in similar ways; how and where their thoughts and behaviours diverge; and how and where they diverge within their own groups*." This is also in line with Perrone (Perrone, 2004), who concluded in a novice-expert study, which involved information professionals, that "*expertise – regardless of the specific domain – is an outcome of skill and knowledge acquired after years of training and practice*."

Bridging the gap between being an expert to being an expert searcher can be based on various research models for information seeking behaviour. In general, information retrieval consists of "*the integration of a number of complex processes within the context of three major factors and entities: an information need, an information searcher and an information environment*" as stated by Knight and Spink (Knight & Spink, 2008). Information behaviour is often related to the information needs of the search including his or her inner, cognitive processes and the environmental factors relating to the information. Several models exist that try to map these processes from different perspectives. Kuhlthau's information search process (ISP) (Kuhltau, 2003) is the "*user's constructive activity of finding meaning from information*" in order to extend his or her state of knowledge on a particular problem or topic by taking into account thoughts, feelings and actions. Ingwersen (Ingwersen, 1992; Ingwersen, 1996) proposed that information retrieval is a set of dynamic interactive processes, which occurred at multiple levels within the cognitive space of the user and the "information space" of the information retrieval (IR) system. Bates's berry-picking model (Bates, 1989) represents the actual behavior (e.g. the activity of browsing) of information searchers and how the search results found provoke a cognitive response of the searcher. This cognitive response could lead to a reinforcement of a query, an enhancement or variation of a query until a complete abandonment of a query. Thus, the model tries to understand how the search process evolves and how searchers engage with the information environment.

From a novice to becoming an (search) expert, s/he needs a lot time in order to gather the necessary experience, to gain the required skills and to apply them in an efficient and beneficial way. Additionally, learning how to search is learning in a continuous changing environment as technology evolves rapidly (Edwards and Bruce, 2002). This is also in line with Tucker (Tucker, 2014) who defines that expertise "*continues to develop*" as does the information experience of a search expert. The information experience includes the information environment, the information structures, the information vocabularies as well as the concept fusion, which is the ability to integrate and apply these three concepts. Thus, learning how to search is an important skill to acquire and to advance continuously.

During this learning process, also reflective learning plays a significant role. Edwards and Bruce (Edwards & Bruce, 2006) derived from a study a model of four categories of how students are experiencing information searching (similar to Bates, 1989). While novice or beginners in information searching focus on the search topic, do not have a plan for search and do not reflect, experienced information searchers who are "*panning for gold*" focus on the usage of appropriate tools to find the primary source of information. In addition, strong planning and reflection are relevant and include not only the preceding analysis of terms or potential synonyms before the search but also to note down changes in search strategies. In addition, their results have been used to extend an existing curriculum "*to enable future students to develop a more powerful understanding of the information searching phenomenon.*" (Edwards, 2004) using reflective learning as an underlying learning strategy.

For MOVING this means that learning how to search is a continuous process to gather information experience necessary to become a search expert. Important is thereby to take into account the

MOVING platform and its features as search or information environment and the Learning-how-to-search widget as tool for guiding this learning process. In the Learning-how-to-search widgets reflective learning is the underlying search strategy to empower information professionals.

Reflective Learning

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 (e.g. content, activity, location, time) in the sense of adapting context where possible (Thillman et al., 2009).

Taking the theory of reflection interventions, reflection amplifiers as well as the timing of prompting into account, we developed and implemented a general reflection guidance concept for the Learning-how-to-search widget for the MOVING platform that is described in Section 0.

Further related work relevant for the Learning-how-to-search widget, referring to adaptive hypermedia systems, social comparison and motivation were already reported in D2.1 (Section 5.2.2 and Section 5.2.3).

5.1.3 Challenges and Research Questions

The major challenge of the Learning-how-to-search widget is ensuring that the widget really supports the users on learning how to search with the MOVING platform to become an experienced searcher.

Thus, the major sub-challenges are defined as follows:

- **Challenge 1**. Visualising the usage behaviour to support the development of search expertise by allowing the user to visualise their past and potential future search behaviour.
- **Challenge 2**. Implementation of a reflection guidance concept to motivate people to reflect about their search behaviour with the goal to improve.

According to these challenges, we have defined the following three research questions:

- Do study participants use and accept the Learning-how-to-search widget? (Reaction)
- Do study participants change their search behaviour and use new/different search functionalities available on the MOVING platform? (Learning)
- Do study participants reflect on their search behaviour and improve their search expertise? (Behaviour and Reflection)

5.1.4 Methodology

In order to develop the Learning-how-to-search widget, we conducted, on the one hand, a focus group as reported in D2.1. On the other hand, we conducted an interview design study, to evaluate and improve the mock-ups we prepared for the Learning-how-to-search widget. As a result, we adapted first mock-ups of the Learning-how-to-search accordingly and implemented the Learning-how-to-search widget as described below.

In order to have a good and stable version of the "Learning-how-to-search" widget implemented in the platform, we decided to focus in year 2 on the development and integration of the widget and moved the planned experiments and evaluation to year 3 of the project.

A change in design was referred to the implementation of the performance indicator. In the first mock-ups of the Learning-how-to-search widget (see D2.1), we also planned to implement a performance indicator to give users the possibility to compare their own search behaviour with the search behaviour of others. Due to privacy reasons (as one needs access to all user profiles and not only to their own) as well as for open research challenges (e.g. whom should I compare myself with, on which topic should I compare myself with others such as search speed, number of keywords used, etc..), we decided to discard the implementation of a performance indicator.

5.1.5 Learning-how-to-Search Concept and Implementation

Reflection Guidance Concept for the Learning-how-to-Search Widget

In order to provide meaningful reflection guidance to MOVING users, we developed a concept for MOVING that relates reflection interventions (RI) and reflection amplifiers (RA) to the model of Kirkpatrick, a four-level training evaluation model (Kirkpatrick & Kirkpatrick, 2006). The goal of this model is to provide a guideline using four levels to objectively measure the effectiveness and impact of training in general. For our case, we slightly adjusted the model to apply it as a model for technology-supported training and guidance.

- *Level 1 - Reaction*. This level tries to find out to what degree participants react favorably to the application, in our case to the widget.
- *Level 2 - Learning*. This level investigates to what degree participants acquire knowledge, skills, attitudes, confidence, and commitment. Therefore, this level addresses the actual support of reflection that the widget provides and if new features of the platform are used (objective usage via activity tracking). Furthermore, it assesses the participants' general tendency to reflect and the importance that they place on reflection.

- *Level 3 - Behaviour*. This level focuses on to what degree participants apply what they learned, in our case, if the changed or improved their search behavior or learning behavior.
- *Level 4 - Result*. This level evaluates to what degree the targeted outcomes occur as result, meaning how effective training was for improving the search behaviour. These comprise, for example, the impact on the organisation (e.g. via KPI) or the individual MOVING user (e.g. performance measurements).

Taking into account the four levels of Kirkpatrick, we designed the implemented reflection interventions in the widget accordingly. To do so, the developed prompts are related to one of the first three levels, as depicted in Figure 7. We left out "Level 4 - Result" as this cannot be addressed with prompts provided by the widget. Currently, we are describing the enhancements with regard to the Learning-how-to-search widget, as this is already implemented in the MOVING platform and the prompts used behave in accordance with this concept. For the Curriculum Reflection widget, we will adapt the reflection interventions accordingly and adapt the concept if necessary.

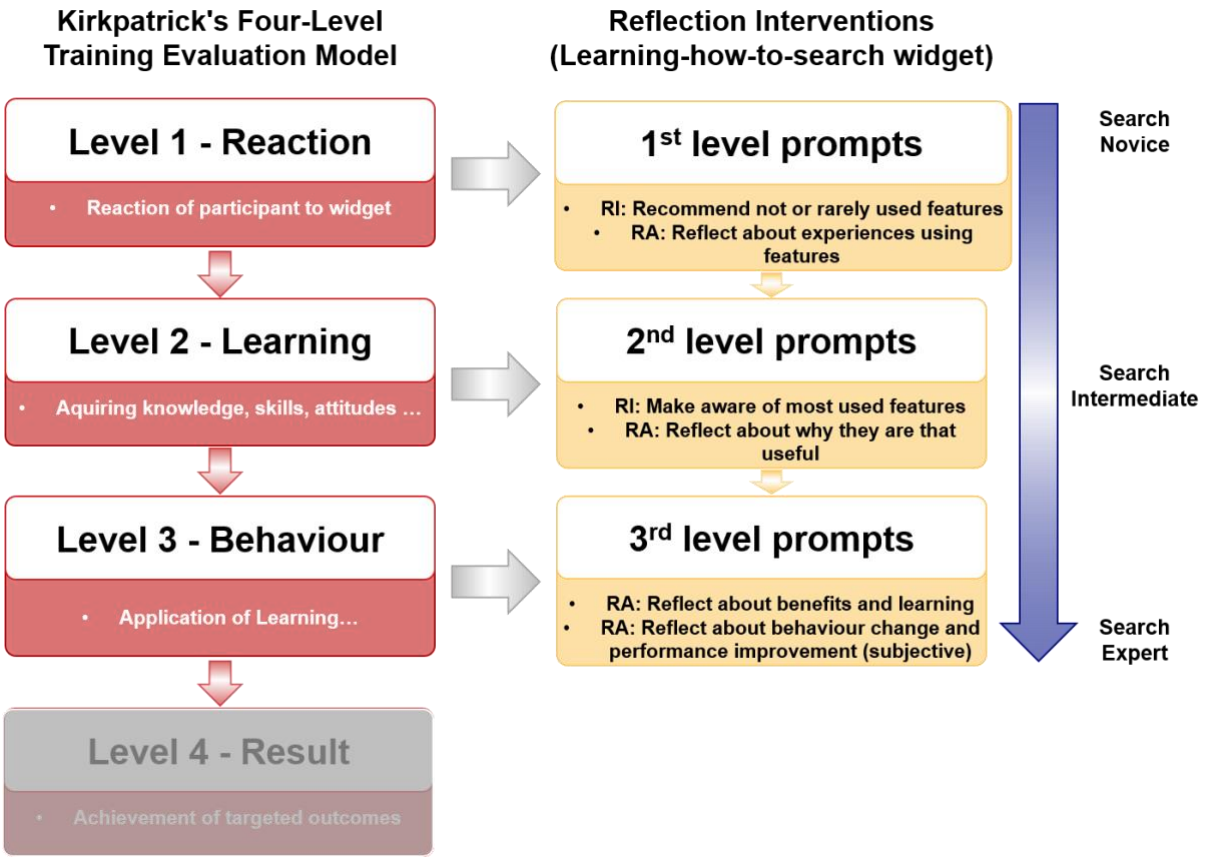

Figure 7: Relations between the model of Kirkpatrick and the implemented reflection interventions (RI) and amplifiers (RA)

In more detail, presenting reflection interventions and reflection amplifiers in a useful way to the user is not trivial at all. On the one hand, the prompts should be manifold and as varied as possible to keep the curiosity of the user high (see D2.1). On the other hand, the more experienced a user is, the higher the user's search expertise on the MOVING platform, the more learning has already taken place and subsequently the more challenging the reflective questions needs to be.

Implementation of the widget

During the second year, the Learning-how-to-search widget was developed and implemented in the MOVING platform as depicted in Figure 8.

Visualising the feature usage of the MOVING platform per user is based on the work of Malacria et al. (Malacria, 2012). In the first prototype (Nov. 2017), we started to visualise the usage behaviour of the first four MOVING features within the bar chart: “Simple Search”, “Advanced Search”, “Result List” and “Concept Graph”. After the implementation and integration of further visualisations like “uRank”, “Tag cloud”, “Top concepts”, and “Top Sources”, the Learning-how-to-search widget was updated accordingly (see Figure 8, on the right). Our goal is to mirror the user back all features s/he used on the platform in order to derive insights for improving the own search expertise. Besides visualising the feature usage per user, we also implemented a reflection guidance concept to show reflective prompts adapted to the user’s needs. Such a prompt could be either a reflective question or sentence starter to stimulate reflection on the feature usage so far or provides a suggestion to use another feature rarely used. Which prompt is presented to the user depends on the user’s experience with the search features on the MOVING platform. A user who is new to the platform receives prompts (“first level prompts”) asking for features that are less or not used and also about the benefits of or satisfaction with a specific feature. A user who has already some experience with the platform gets prompts (“second level prompts”) about the feature mostly used in the platform and prompts asking for fostering to think about the feature usages. Finally, most experiences users get prompts (“third level prompts”) asking about most beneficial/satisfactory features, skill/performance improvement and behaviour change. By changing the level of prompts according to the experience of the user, we aim at supporting the user to become an expert searcher on the MOVING platform.

Therefore, we developed prompts on three different levels depending on the user’s search experience on the MOVING platform. Examples of the prompts on all levels are available in Table 11.

A search novice will receive 1st level reflection interventions and reflection amplifiers based on the “Level 1 - Reaction”. This means that this kind of questions will make her/him aware of not used features of the platform (reflection interventions) and ask questions to think about the first experiences while using them. The goal is to make the user aware of the MOVING platform functionality.

After having used the MOVING platform for a certain period of time, the user will become a search intermediate. The presented prompts will then be 2nd level reflection interventions and reflection amplifiers based on the “Level 2 - Learning”. The corresponding questions will then make the user aware of his/her feature usage behaviour (reflection intervention) and motivate him/her to reflect on why different features are perceived as useful (reflection amplifier).

Finally, when having used the MOVING platform for a longer period of time and get to know all available MOVING features, the user will become an expert searcher. According to the user’s progress, the 3rd level reflection amplifiers will be presented according the “Level 3 - Behaviour” of

the Kirkpatrick model. Their goal is now to stimulate reflection about the user's perceived benefit and learning on the MOVING platform as well as to motivate users to think about whether a subjectively perceived behavior change or an individual performance improvement has taken place.

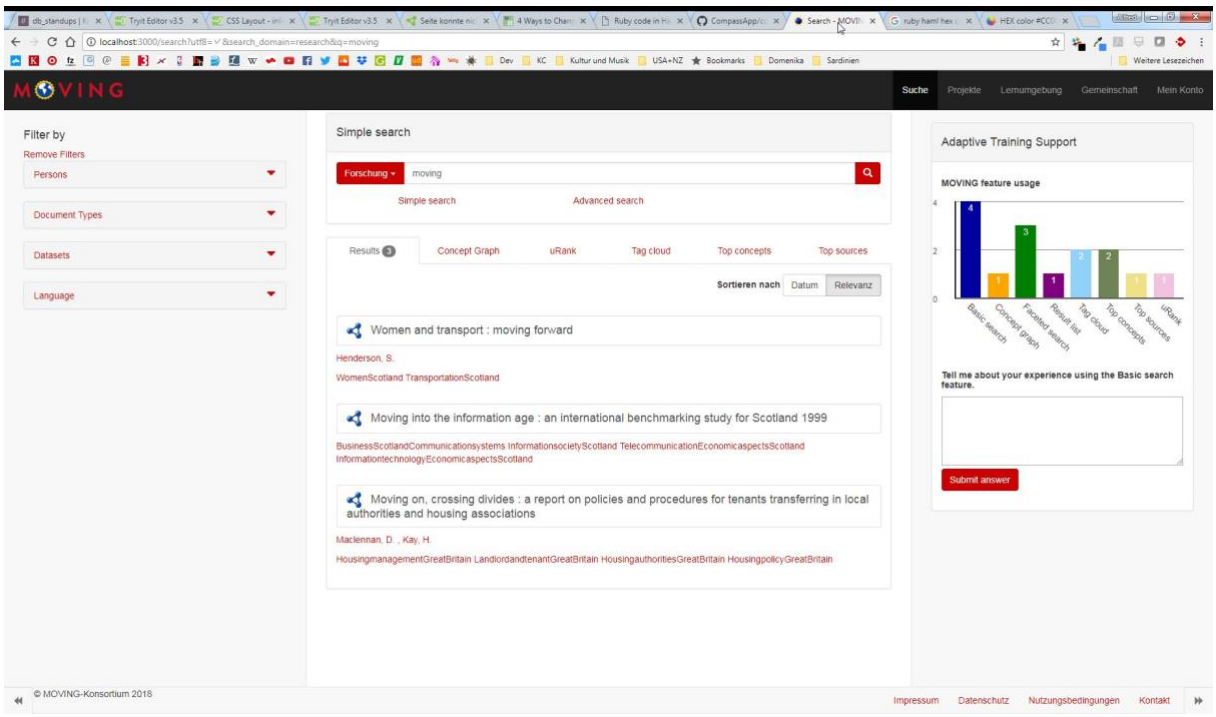

Figure 8: The Learning-how-to-search widget in the MOVING platform.

Table 11: Examples of reflective prompts according to the three levels of Kirkpatrick for the Learning-how-to-search widget.

Level	**Example of Reflection Interventions (RI) and Reflection Amplifiers (RA)**
Level 1: Reaction 1st level prompts	RI: It seems you like using the "Concept Graph" feature. You already used it 10 times. Please try out also "uRank". RI: You have not tried the "Tag Cloud". Why haven't you tried it out before? What is the reason why you have not used it?
	RA: Think about your experience using the "Faceted Search" RA: Why do you like using the "Top Concepts" visualisation?
Level 2: Learning 2nd level prompts	RI: The "Faceted Search" is the most used feature on the MOVING platform. Why don't you use it?"
	RA: The "Top Sources" visualisation is less used than the "Concept Graph" feature, why do you think is this the case?"

Level	Example of Reflection Interventions (RI) and Reflection Amplifiers (RA)
Level 3: Behaviour 3rd level prompts	RA: What did you learn by using the "Concept Graph" feature? RA: Did using the "List View" to improve your performance. And if yes how?

5.1.6 Outlook for year 3

As the implementation of the widget is finalised, the major focus of year 3 will be the evaluation of the Learning-how-to-search widget. Therefore, we will set up an experiment and later on a field study in spring/summer 2018 with the goal to evaluate the implemented widget according to the challenges and research questions stated in Section 0.

5.2 Curriculum Reflection Widget

5.2.1 Goal

The goal of the Curriculum Reflection widget is to support users to become information-savvy professionals by **providing an overview of their competence status and learning progress with regard to the curriculum**.

The Curriculum Reflection widget puts its focus on providing guidance for learning competences and skills according the three major modules of the MOVING curriculum. To do so, the widget makes users aware of the own competence status, shows resources according the user's current competences status, and presents the learning progress with regard to the curriculum.

Again, we use as underlying learning strategy reflective learning in combination with approaches of learning analytics for providing guidance for reflection. The reflective prompts follow the same concept we developed for the Learning-how-to-search widget and are adapted to the context of the user with regard to the curriculum.

Thus, we have conducted the following steps:

(1) We use the MOVING curriculum (see Section 3) developed by TUD as the basis for suggesting learning material to provide MOVING users with the possibility to enhance their digital competences, especially to become data-savvy professionals with a focus on search expertise.
(2) We implement reflection interventions and reflection amplifiers based on the reflection guidance concept presented in Section 0.
(3) We visualise the user's learning progress with regard to the curriculum and the user's own competency level.
(4) We implemented the prior knowledge assessment in form of a questionnaire based on the curriculum to determine the user's competency level.

5.2.2 Background/Related Work

Learning analytics

Learning analytics deals with methods for analysing and detecting patterns within data collected from educational settings or learning environments about the learner, and leverage those methods to support adaptation, personalisation, recommendation, and reflection.

Siemens (Siemens, 2010) defined learning analytics as "*the use of intelligent data, learner-produced data, and analysis models to discover information and social connections, and to predict and advise on learning*". The focus of learning analytics is on the learner support informal learning settings, while in this work the focus is to support the knowledge worker in any informal learning setting. Approaches like learning dashboards for example described in (Duval, 2011; Santos et al., 2013) present an overview of the learner's own learning activities and learning progress often in relation to colleagues at one glance. Such combined visualisations support self-monitoring of learners and awareness for teachers and empower the learners to reflect on their own activity and that of their peers. Explicit traces (e.g. the learner's entries in a chat or a discussion forum) and implicit traces (e.g. the learner entering a course or clicking on a document or button) stored in the corresponding learner profiles serve here as basis for the aggregation and visualisation of the gathered data.

Thus, analysing the activity data captured of the MOVING user with regard to the curriculum via the MOVING platform is obvious to consider for the Curriculum Reflection widget. On the one hand, we will use the insights for corresponding visualisations, on the other hand we will use learning analytics for analysing the learner's progress.

User profile/model

User profiles are models that computer systems have about their users. The data stored in such user models are automatically captured by the system (e.g. logging mechanisms or activity tracking tools). Typically, user models are not only used in information retrieval or intelligent tutoring systems but also in learning environments as well as adaptive learning systems (see e.g., Fischer, 2001; Adomavicius & Tuzhilin, 2005). User models established in learning environment systems for modelling the learner and the corresponding learning activities are called learner models. These types of user models are created by the systems automatically. Furthermore, user models are often used to adapt teaching strategies or to inform the learner about the learning progress as basis for reflective learning. Additionally, Brusilovsky and Millán (Brusilovsky & Millán, 2007) suggested that learner models should keep data like knowledge, interests, goals, background, and individual traits, thus abstract concepts relevant for learning. In order to apply a user model or learner model as basis for reflection on one's own learning activities, achievements, or progress towards the individual learning goals, it is necessary to make the models accessible and manageable for the user, which was explicitly suggested by Kay (Kay, 2001) and mentioned in Bull et al. 2007, Bull and Kay, 2007, and Kay and Kummerfield, 2011.

In the case of the MOVING user profile, the data is automatically as well as manually captured. The activity tracking tool of UMAN automatically captures all activities a user is doing on the MOVING platform. This includes, beside the search request, also the documents visited, the duration of the visit as well as the visualisations used. During the onboarding process of becoming a MOVING user, the user has to explicitly fill in a questionnaire for the prior knowledge assessment to derive his/her skill level with regard to the curriculum. Therefore, both types of data are stored in the MOVING user profile will serve as basis for the Curriculum Reflection widget. Additionally, the semantic profiling method based on HCF-IDF, previously described in D2.1, models the user interests based on the previous search history.

5.2.3 Challenges and research questions

The major challenge of the Curriculum Reflection widget to provide and visualise the correct competence status and learning progress with regard to the curriculum by analysing and inferencing automatically captured activity tracking data.

The sub-challenges are defined as follows:

- **Challenge 1.** Correct inferencing the competence status of a user from automatically tracked activity data.
- **Challenge 2.** Visualising the learning progress in an understandable and meaningful way.

According these challenges, we have defined the following three research questions:

- Does the presented competence status (derived from activity tracking data) of the study participant correctly reflect the real competence status of the user?
- Does the visualisation help to follow the own competence development with regard to the curriculum?
- Does the implemented reflection guidance concept motivate study participants to reflect on their competence status and motivate to advance their learning progress?

5.2.4 Approach

For developing the Curriculum Reflection widget, we did, on the one hand, an extensive literature review. On the other hand, we discussed with our project partners TUD and JSI in the integration week in Essen (Nov. 2018) and at the Consortium Meeting in Köln (Jan. 2018) in face-to-face meetings how the Curriculum Reflection widget should look like and which functionality it should provide. As a result, we came up with a general concept of the widget and designed mock-ups that will both be presented in the sections below.

5.2.5 Solution

Curriculum Reflection Widget Concept

Figure 9 depicts the technological concept, which will serve as blueprint for the implementation of the Curriculum Reflection widget. It consists of several high-level concepts that have to fulfil specific

tasks in order to be able to implement the Curriculum Reflection widget. Subsequently, we will describe for each of the relevant concepts a detailed description of the tasks, including which data is stored in the user profile of the MOVING user and how this data will be analysed and used for the widget.

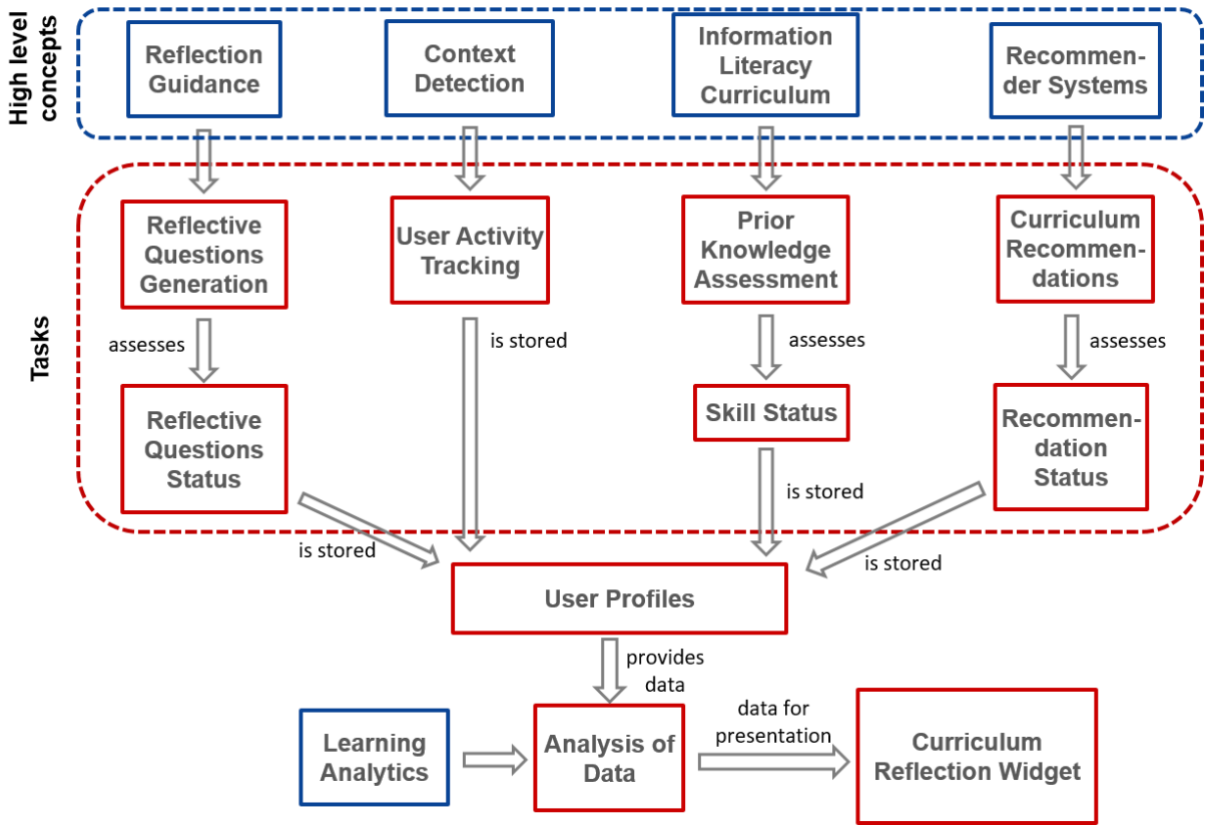

Figure 9: Technical Concept of the Curriculum Reflection Widget

Reflection Guidance: The reflection guidance (see Section 0) will provide guidance in form reflection interventions and reflection amplifiers (Fessl et al., 2015; Fessl et al., 2017) in order to motivate the users to reflect. The objectives of reflection are strongly related to the MOVING curriculum. On the one hand, the objective of reflection are the recommended documents and resources for progressing through the curriculum and their usefulness in relation to the competences the user needs to acquire and on the other hand the user's learning progress with regard to the three main modules of the MOVING curriculum. For generating the prompts (see Reflective Questions Generation in Figure 9) according to the user's needs, a pool of sentence starters and reflective questions is created. These prompts contain placeholders with regard to the competences of the curriculum per module in order to be adapted to the content and competence the user is currently learning. In addition, the prompts will consist of different difficulty levels depending on the user's competence status and progress, as described in Section 0. Furthermore, the tool will track and store which prompts were presented to the user, which answers were given to which prompt and depending on the skill status it will show prompts that are adapted to the competence level of the user (Reflective Questions Status). The prompts, the given answers as well as the competence level of each individual user will be stored in the corresponding user profile.

Context Detection: Context detection in general tracks and stores meaningful information about the user's current context. This context detection is necessary to infer the optimal time and location (with regard to the MOVING platform) to be able to provide meaningful reflection guidance tailored to the user's needs (the right timing for reflection was already be discussed in D2.1). The context detection can be done automatically by using sensors, tools or in MOVING with the activity logging mechanism (see D4.1, D4.2) developed by UMAN that is implemented in the MOVING platform (User Activity Tracking see Figure 9). For the Curriculum Reflection widget it is necessary to track and log the user's activities on the MOVING platform especially focussing on the documents and recourses visited with respect to the curriculum, and the subsequent learning progress. The tracked activities will then be related to the results of the prior knowledge assessment questionnaire to interfere the current knowledge status of the user with regard to the curriculum. Thus, the activity tracking tool collects and stores all interactions of a user including mouse clicks, documents opened and is stored in the MOVING database per user, so that we can see this information as part of the user profile (although physically separately stored).

Information Literacy Curriculum: The curriculum developed by TUD (see Section 3) is based on current standards in information literacy, with the goal to educate MOVING users to become data-savvy professionals. With the Prior Knowledge Assessment questionnaire, which is based on DigComp 2.0 (Vuorikari et al. 2016), we are able to elicit the users' competence status regarding the learning modules and the corresponding learning goals in the information literacy curriculum. The competence status depends on the answers given in the questionnaire, which is described in detail in Section 5.3, and evolves over time while using the MOVING platform. The competence status of each MOVING user is stored in his or her corresponding user profile. Motivating users to fill in the questionnaire as well as to use the Curriculum Reflection widget on a regular base is not trivial at all. To overcome these challenges it is on the one hand important to be able to infer the correct knowledge status of the user and on the other hand to really visualise the learning progress in a sophisticated and easy to understandable way. Both approaches are aiming at giving the user a clear benefit for themselves to increase the user's intrinsic motivation to improve themselves.

Recommender Systems: In literature, there exist several different types of recommender systems based on different algorithms such as collaborative filtering, hybrid recommendation algorithms to provide users the most relevant documents, objects or persons according the user's current needs. Although its goal is to provide learning content with regard to the learning progress and the skill status of the user based on the curriculum, we will implement a very simple type of recommender system. For each of the module and its competencies in the curriculum there will be a list of documents related to each of the competences (Curriculum Recommendations, see Figure 9). In addition, these documents are categorised according the competence level they support when being opened by a user. Depending on the user's competence level, documents that have not been visited/opened by the user yet or were visited too short, relevant documents and resources are recommended in the widget. Which document of which level was already visited for a specific duration of time and which of the documents have not been seen by the user are stored in the user

profile (Recommendation Status, see Figure 9). Beside the curriculum reflection widget recommender, we are integrating a recommender system to provide content suggestions primarily based on the user's search history, as described in Section 6.2. This has the advantage to not only recommend documents related to the curriculum but also documents related to the user's interests.

User Profiles: In general, a user profile or user model is understood as model that computer systems have of their users (see Section 0). Such models are then used by computers to adapt their behaviour or information representation according the user. In order to be able to build up the Curriculum Reflection Widget on the MOVING platform, the user profile contains the following information about the user: the user's activities on the MOVING platform, the reflective questions status, the skill status, and the recommendation status.

Learning Analytics: To be able to use the data collected and stored in the user profile, we will use methods out of the research area of learning analytics (see Section 0). Learning analytics deals with methods for analyzing and detecting patterns within data collected from educational settings or learning environments about the learner (Duval, 2011; Santos et al., 2013), and leverage those methods to support adaptation, personalisation, recommendation, and reflection (Fessl et al., 2015; Fessl, 2016; Fessl et al., 2017). In the case of our Curriculum Reflection widget, we will analyse the data stored in the user profile of the MOVING platform to fill the widget. Therefore, we will analyse the data about the skill, recommender and reflective questions status to detect the learning progress with regard to the curriculum, and select the corresponding reflective question and relevant recommendations.

Curriculum Reflection Widget: The widget will use the data captured above striving for the following tasks:

(1) Recommend relevant material with regard to the three modules of the curriculum and the individual skill level.
(2) Nudge users to reflect on own proficiency in terms of the curriculum.
(3) Visualise the learner's progress with regard to the three modules of the curriculum.

In the next section, we will present how the Curriculum Reflection widget will look like and how it will be integrated in the MOVING platform.

Curriculum Reflection widget mock-ups

In general, the Curriculum Reflection widget consists of two different parts. The first part, as depicted in Figure 10, presents recommendations as well as a reflective prompt both with regard to the module and the corresponding competence that should be acquired by the user. In this example, the widget recommends documents referring to the competence "Filtering of Data" belonging to the module "Information & Data Literacy". In addition, it shows a reflective question on how these resources could help the user to improve his/her competence in order to not only see and open the documents but also motivate users to reflect about the progress of developing or improving the own competence.

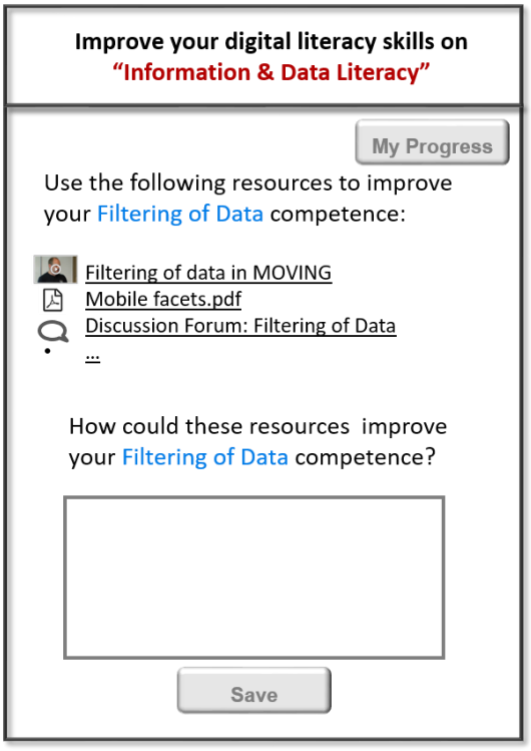

Figure 10: Curriculum Reflection widget: curriculum recommendations and reflective prompt

The second part of the widget shows the learning progress and status of the current user in relation to the curriculum. Figure 11 presents an overview of the already achieved competences in percentage per module ("Information and Data Literacy", "Communication & Collaboration" and "Content Creation") giving to each competence a fixed defined colour. For example, the current user has already achieved 45% of the competencies in the module "Information and Data Literacy". When clicking on one of the modules, the detailed competences and the current status of these are displayed as shown in Figure 12. Depending on how intense the colour is (e.g. from dark to light yellow), the more competences were already acquired. For example, the competence "Filtering data, information and content" has dark yellow background meaning that these competences are already acquired, while the competence "Managing data, information and content" has a grey background meaning that the user has not yet started learning on this topic. The competence "Evaluating data, information and content" with a light-yellow background, represents a competence where the user is already working on but still some progress needs to be done.

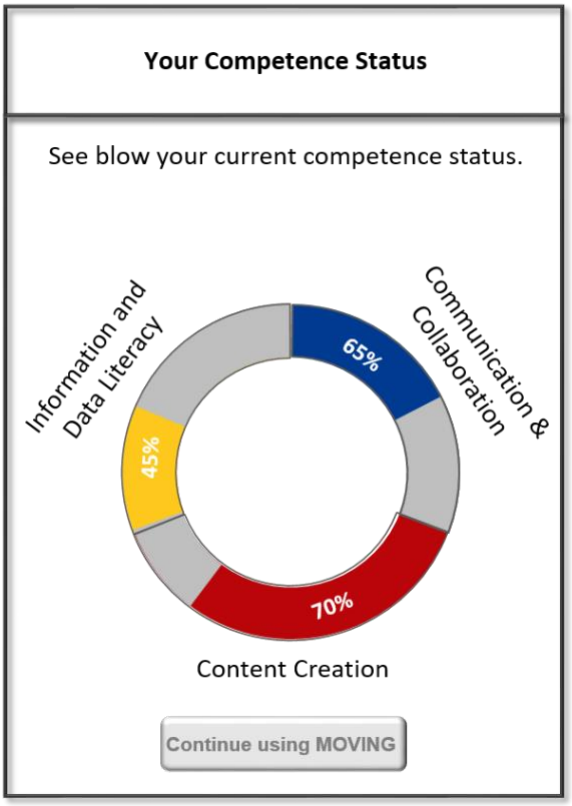

Figure 11: Curriculum Reflection Widget: Module Overview

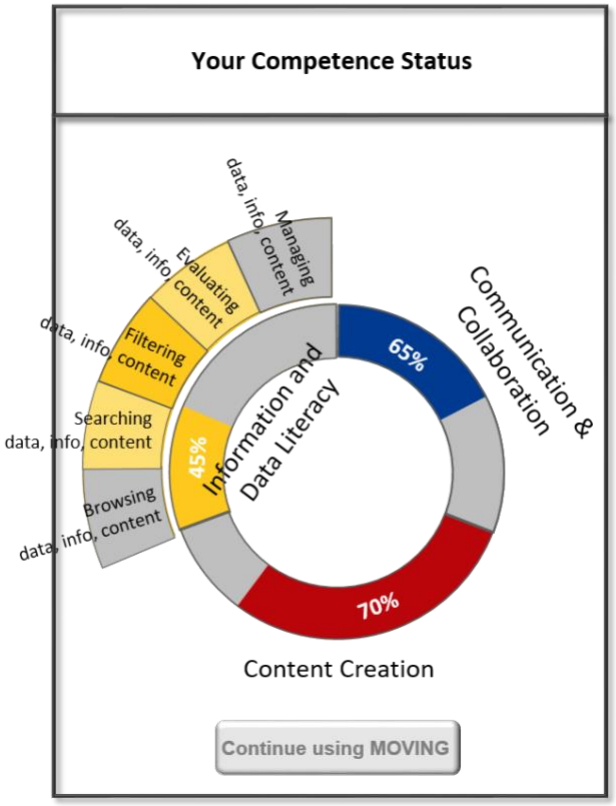

Figure 12: Curriculum Reflection: Modules and Competence Overview

The "Curriculum Reflection" widget will be integrated at the same place as the "Learning-how-to-search" widget as depicted in Figure 13

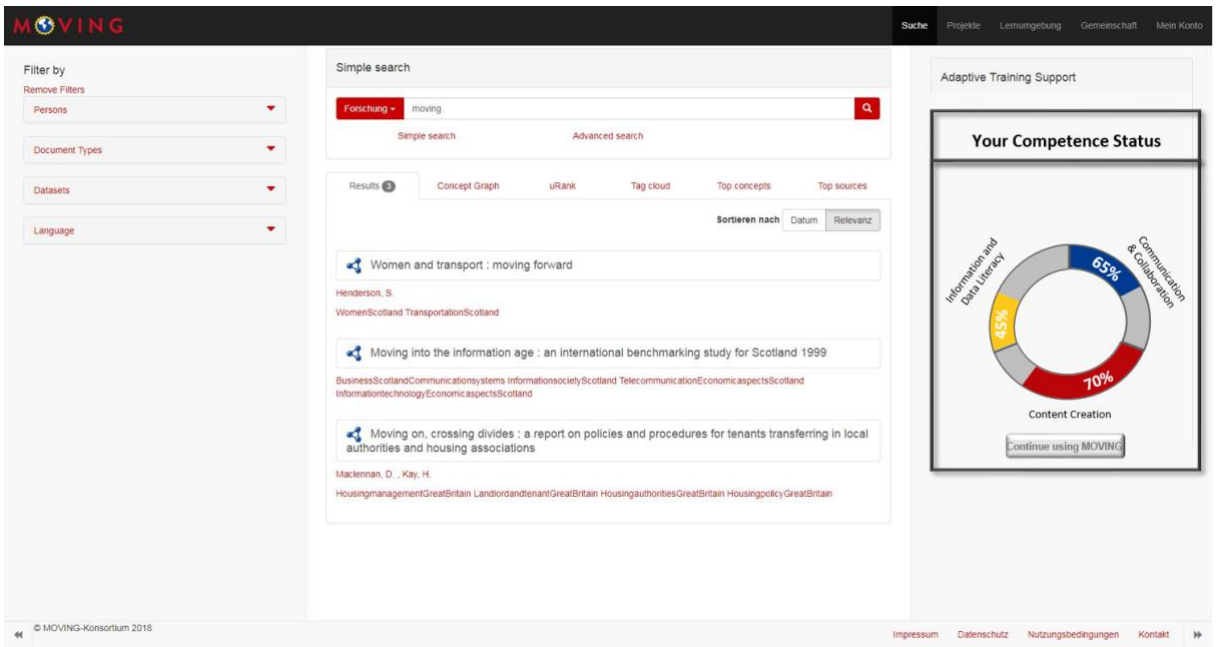

Figure 13: Curriculum Reflection Widget in the MOVING platform

The Curriculum Reflection widget strongly depends on the current user context, thus, in specific on the location the user is currently in on the MOVING platform. The Curriculum Reflection widget will adapt accordingly to the user's location, namely the Search area ("Suche"), the Community ("Gemeinschaft"), or Learning environment ("Lernumgebung"). So, if, for example, the user has entered the "Learning Environment" of the MOVING Platform as depicted in Figure 14, the Curriculum Reflection widget will refer to the module Content Creation and to the corresponding competencies. If the current user is in the "Community" area of the MOVING platform, the Curriculum Reflection widget will present the module Communication and Collaboration and refer to the corresponding competencies. It has to be mentioned, that in these two areas, only the Curriculum Reflection widget will be the available and that the Learning-how-to-search widget will not be shown there.

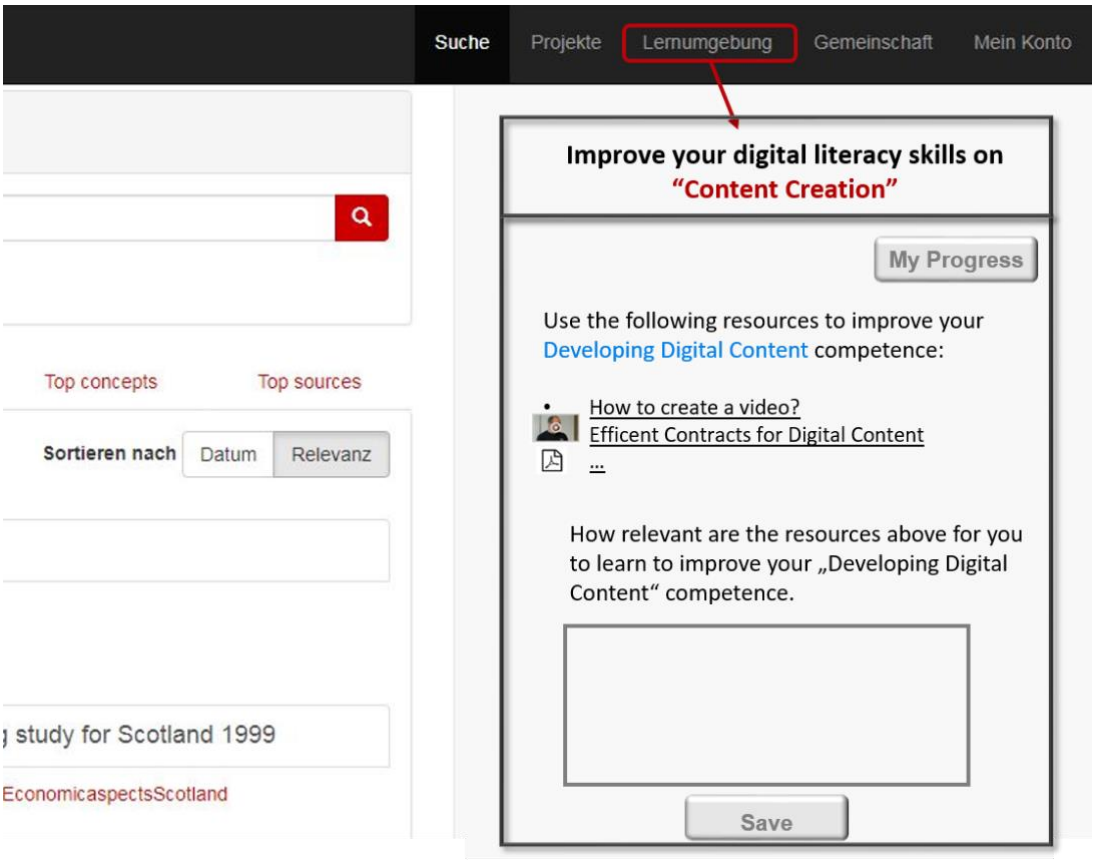

Figure 14: Curriculum Reflection Widget adapted to the Learning Environment

In contrast, if the user is in the Search area, then the Learning-how-to-search widget as well as the Curriculum Reflection widget will be available to support the user. Therefore, when entering the MOVING platform for the first time, a welcome message will be presented at the widget's place, shortly explaining what the widgets are all about and how to access them. The two icons presented above the welcome message will always be shown, when a user is in the Search area. By clicking on the icon, the user can change the widget and if a widget has some new or relevant information for the user the corresponding icon will inform him/her via a silent notification as depicted in Figure 15 on the left icon.

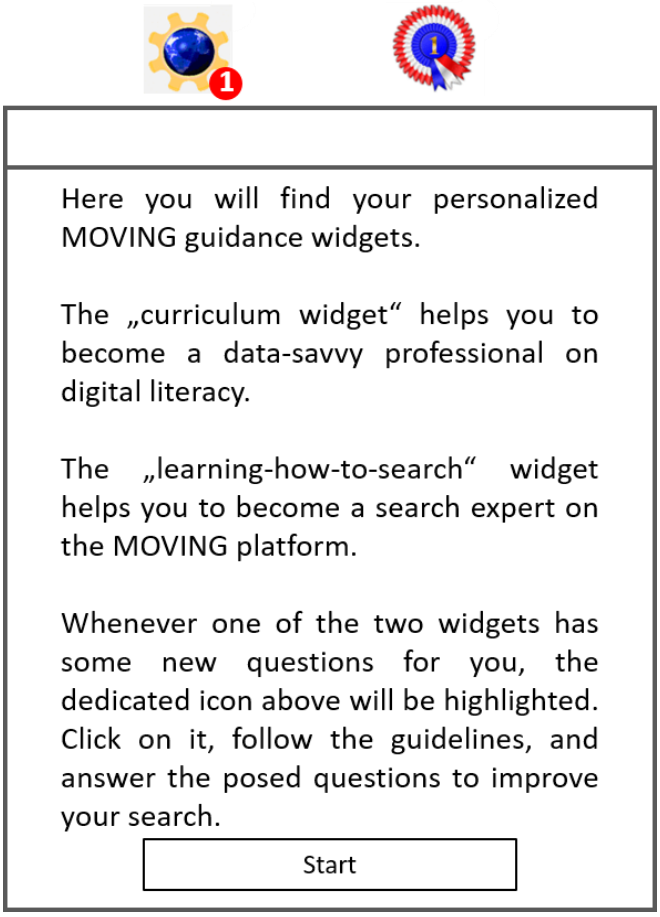

Figure 15: Widget Welcome Message

Curriculum Reflection widget architecture

The architecture of the Curriculum Reflection widget will be based on the architecture that we have already implemented for the Learning-how-to-search widget, which is a typical client-server architecture.

On the client-side, the "Curriculum Reflection" widget will be integrated into the web interface of the MOVING platform. For the client, we use HTML 5, JavaScript and CSS to represent the widget's visualisations and prompts.

On the server-side, we will use the same server-side service as implemented for the Learning-how-to-search widget and enhance it where necessary. These enhancements will especially focus on the access of the user profile, in order to be able to read and store the user's curriculum status, and the access to the curriculum itself. Details on the previously implemented client-server architecture of the Learning-how-to-search widget can be found in deliverables D2.1, D4.1 as well as D4.2. A detailed description of how the widget was finally implemented will be described in D4.3.

5.2.6 Outlook for year 3

In year 3, the Curriculum Reflection widget will be implement and integrated in the MOVING platform until September 2018. Afterwards, the Curriculum Reflection widget will be evaluated in terms of usability and correctness (automatic activity tracking leads to correct inference of competencies in relation to curricular learning goals).

5.3 Prior Knowledge Assessment

In order to establish individual learning paths for users within the MOVING curriculum for information literacy, we created a short survey to assess learners' previous knowledge on information literacy and digital competences a part of the MOVING on-boarding process. When registering to the platform every new user is asked to determine his or her skills and competences in a short self-assessment survey (see Appendix I) that is based on the learning goals described above and is informed by the digital competence assessment standards of DigComp 2.0 (Vuorikari et al. 2016). The results of this assessment are stored as individual score in the user data and determine at which level (basic, intermediate, advanced) the learning path for the three main learning units of the curriculum starts for each individual user. The section below shows the detailed description of the self-assessment tests for each learning unit. Figure 16 shows a screenshot of the implemented survey in the MOVING platform.

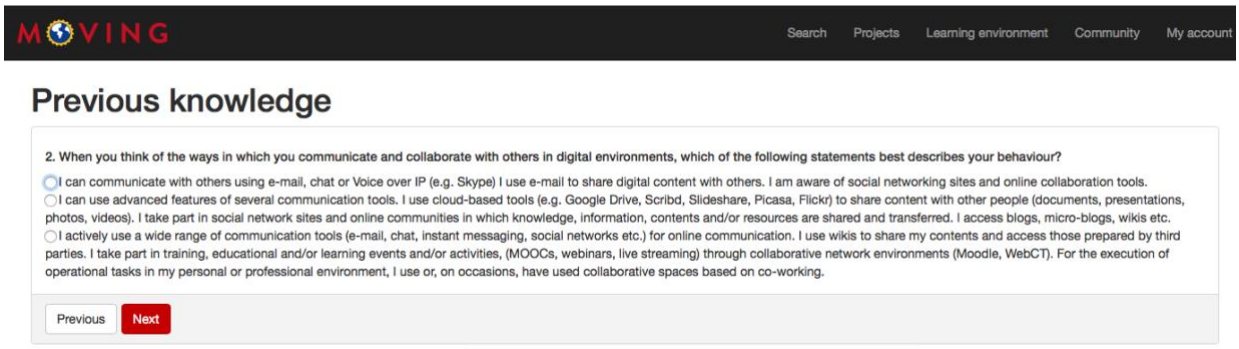

Figure 16: Previous knowledge assessment survey implemented on the MOVING platform

5.4 Case Study: A qualitative exploration of virtualising traditional face-2-face training at EY

Adaptive training support is inherently (learning-)domain-agnostic. We are therefore also exploring how the adaptive training support principles of a developed in-app reflection guidance concept can support learning in general. In specific, we investigate how the adaptive training support can support general trainings within EY all four levels of Kirkpatrick's (Kirkpatrick, 2006) model; in particular of course in virtual trainings.

We are therefore conducting a study which

- qualitatively and quantitatively compares the differences between mediating communication within a training with computer technology in terms of learning;
- explores design options for virtualising trainings, including the usefulness of inserting adaptive training support into such technical-didactical concepts.

5.4.1 Goal

Traditionally, professional learning is organised around face-2-face trainings. Especially in global companies, costs may be significant due to travel costs and personnel time spent on travelling. Virtual trainings seem to offer a solution. By virtual trainings we here understand trainings in which communication between training participants (trainees and trainers) is mediated by computer technology.

Thus, we present an explorative case study that aims to identify how the medium of communication impacts learning; and prepares a larger qualitative exploration of the identified themes, as well as a quantitative field study.

We designed the study in order to explore in particular the impact of learning setting/computer-mediation of communication in training on

- Interaction amongst trainees.
- Interaction between trainees and trainers.
- Immersion in learning / interruptions.

5.4.2 Case: Training mid-level financial auditors at EY

Our study is set in the context of EY, in particularly in the German-speaking region (Germany, Austria, and Switzerland – DACH region).

Learning cohort

The trainees in our case study are mid-level financial auditors who are expected to make the next step in their career within the next year. The next step is to take the official exam in Austria, Germany, and Switzerland, which will allow them to officially sign a financial audit. These junior auditors in their current career stage supervise junior staff who collect and analyse data at clients and typically work on site of a client. Every client/mandate is however assigned a manager, who is

the ultimately responsible person and also officially allowed in the respective country to sign financial audits.

Learning subject

The training we are looking at concerns the treatment of misstatements in financial reports, i.e. financial statements made by customers of the financial auditors which are not correctly made. Such misstatements constitute the core issue for financial auditors: Typically, in a financial audit, misstatements are first collected by junior staff and junior auditors (learning cohort for our study). Overall lists of misstatements are then discussed amongst junior auditors, responsible managers and clients. Identifying and deciding on the impact of single misstatements and required follow-up actions are complex knowledge work activities, which require regulatory, statistical and mathematical, legal, organisational (organisational guidelines) knowledge as well as good communication skills (mostly: towards the client). The learning subject of the trainings we are investigating in our study is, therefore, of key professional interest to the trainees and the employer organisation; at the same time it is also a complex subject.

Didactical setup of training

Trainings in the global company are globally designed and adapted locally. This means, learning goals, learning content, and examples are designed globally; but local trainers may adapt content, and especially examples used in trainings; and of course trainings may be held in the local language despite material being in English. The training set-up consists of a preparatory phase before the training, and the training itself.

Preparatory phase. A motivational video is sent to trainees before a training, in addition to web-based content that explains the learning subject. The content, including the video, is designed to take three hours to go through (but participants overall tend to estimate they need more time for that).

Training. The trainings first starts with an introductory part including a reflection session on the content of the web based training course. The training then consists of three blocks, each consisting of theory input from the trainers (typically: two per training), interleaved with polls (which even in physical face-2-face trainings are done via an online form so as to guarantee anonymity in case of wrong answers) and concluded by group-work (three group exercises). The training is scheduled for a full day.

5.4.3 Methodology

The present study is explorative and qualitative.

We report on observations of three trainings, group discussions and bilateral interviews we made with trainees and trainers at these three trainings.

Three Training Settings

Error! Not a valid bookmark self-reference. gives an overview of the three settings, the number of trainees and the corresponding trainers.

Table 12: Overview numbers of three trainings from which we report observations, discussions and interviews.

Training Setting	#Trainees	Trainers
Virtual Training V1	9	• A and B
Physical Training	13	• B and C
Virtual Training V2	3	• A and B

The *virtual training v1* used WebEx to mediate communication between training session participants (trainers and trainees). All participants were spatially distributed. In contrast, *virtual training v2* used WebEx to mediate communication between training session participants, but all trainees were co-located in one room at one company site. Trainer A was located in another room at the same company site to facilitate a joint reflection after the training, and trainer B was located at a different company site. The rationale for co-locating trainees in one office is twofold: First, this is a meaningful setting from the point of view of the employer organisation, in that trainers are experts in high demand, and there are not that many trainers; on the other hand, there are many junior auditors in different sites. So, while the junior auditors (=trainees) may be able to be brought together at one site, it may make sense to save on the expensive worktime (=travel time) of trainers. Secondly, from a didactical perspective, it may make sense to co-locate trainees in order to facilitate social exchange amongst trainees. In the virtual trainings, group work was mediated by WebEx in break-out sessions (separate virtual discussion spaces which were open for trainers to follow virtually).

The *physical training* was a traditional classroom training in a room reserved at one company site to which all study participants travelled. However, the majority of trainees didn't have far to travel (distance by car: less than an hour); whilst both trainers had to come a long distance (flight/fast train). In the physical training, group work was organised by physically putting different groups to work on different tables in the room.

Themes for observation and interviews/discussions

Based on our overall research questions we were looking to observe:

1. Interaction between trainees (=trainees).
2. Interaction between trainers and trainees.
3. Immersion in learning activities / interruptions.

In interviews and group discussions we were looking again for these topics, but in addition asked

1. How did/would you decide between face-2-face and virtual training?
2. Did you actively participate in the preparatory phase – if yes, when and where?
3. What would be your ideal learning set-up?
4. What kind of experience do you have with virtual work/collaboration/home office?

Analysis

The *virtual training v1* was observed by three of the researchers whereby one also acted as trainer, the *physical training* was observed also by three researchers, and the *virtual training v2* was observed by all four researchers involved in the study, whereby one also acted as trainer.

Researchers discussed and compared observations and results from interviews directly after each training, in order to complete notes and impressions with the training still in fresh memory. In addition, observations and notes were reflected by the researchers in relation to prior assumptions and literature review following an informed grounded theory approach (Thornberg, 2012). This means, that below we first discuss the results along the three major themes we aimed to explore (interaction amongst trainees, interaction between trainees and trainers, immersion/interruptions) and then discuss themes that emerged directly from observations, group discussions and interviews.

5.4.4 Discussion of results

Interaction amongst trainees

In the *physical training*, we observed frequent side-channel discussions amongst trainees, shared laughter, support for each other when one participant was asked a question by trainers. In group work, participants "huddled" in front of a shared laptop display or piece of paper.

In the *virtual training v1*, where all participants were spatially distributed, such side-channel communications were not observed, but also not observable. There was no observable trainee-to-trainee discussion in the main group channel and also not in the chat.

In the *virtual training v2*, where all participants were spatially co-located, we observed very little interaction amongst trainees. In the warm-up exercise, some joint discussion took place, in the spirit also of getting to know how WebEx works. Throughout the rest of the day, however, we observed that in a way, the laptop screens, via which the communication with trainees was mediated, captured the near-to-full attention of trainees. One expression of this is that in discussions, the focus of the trainees is on the screen, and not on the physically present other trainees.

Immersion / interruptions

In the *physical training*, participants felt much immersed in training: Most participants had organised this day to be free of working obligations. Some participants were still communicating with colleagues via Skype, and two participants at least also took phone calls. Participants felt that this was necessary due to work-related deadlines that were close to the date of the training (upcoming in a few days). One participant stated that "*I also was personally interested in how things are going at the client, as the final report on the client will be sent out [in three days]… but of course one can organise such disruptions*" (such that they fall into breaks or group work time).

Date of training

Across both settings, trainees brought up the issue that the training fell into a bad season (into the busy season around the end of the year). In multiple rounds we then discussed what would be a good season to organise trainings, but none was found. In the busy season, everyone is busy, but in

the not-so-busy season everyone is also busy and in the summer everyone tends to be on holiday and would equally be loath to commit to training days. This issue is closely related with the next one on organisational learning culture.

General preferences for physical or virtual training

Participants in both settings were very open in terms of personally preferring physical or virtual trainings. One participant in *the virtual training v2* would have a very strong preference for virtual trainings that are timewise flexible, and which he could also do at his own speed. One participant in the *physical training* said that "*I lost my general preference for physical trainings in the 2-hour traffic jam this morning*".

Organisational learning culture

In particular, the learning culture within this company very strongly *prioritises working over learning, and penalises virtual trainings* by having no culture of remote/virtual work and collaboration or home office. Consequently, if a person is not at the client's site, (s)he cannot be productively working in the management's and colleague's perception; and vice versa if a person is at the client's site, (s)he needs to be available for interruptions throughout the day. In addition, virtual trainings are not perceived within the organisation to be on equal par with physical trainings: one participant said "*If I told my manager that I blocked a full day for a virtual training, he would think I'd gone crazy*".

Secondly, time pressure is high; to the extent that no trainee in our study reported to have seriously worked through the learning material of the preparatory phase: trainees did everything they did in the evenings in their spare time; reported that the stated time necessary for completion was much too low; and many trainees used their evenings for more operational work activities.

One of the underlying organisational issues seems to be that *learning activities are not systematically planned* (staffed), and *non-attendance to trainings is hardly penalised* – mostly, the responsible manager is being made aware of non-attendance, but as responsible managers put the operative pressure on their junior auditors to be productive in relationship to clients this is hardly a severe penalty. In principle, the learning department could request financial retribution out of the budget of a mandate, but this is rarely executed.

Design implications for virtual training technology

Finally, one stream of emerging issues centres on functionality and design of technology used for virtual trainings, and of course also the socio-technical design of virtual training.

Firstly, of course there were "simple" technological problems like connectivity, access management, and the technical necessity to install a WebEx plugin.

Secondly, the technology used (WebEx) is very much centred on presenting content rather than representing participants (no pictures or videos shown of participants). This makes concentration for a full day very hard and opened up discussions and speculations across trainees and trainers that such a setup could be more useful for shorter trainings of around two hours. On the other hand, this

focus on content rather than participants limits the communicative nature of virtual trainings, even whilst virtual trainings are essentially set up to be synchronous and collaborative learning settings.

5.4.5 Conclusion

In terms of our original research questions, we see that face-2-face trainings provide learners with a more focused, more immersive, and less disrupted learning environment; and that interactions amongst trainees and trainers are perceived as more fruitful. We also see however that the organisational learning and working culture strongly influences the perception of the value of virtual trainings (negatively in this case); and that changing the organisational learning and working culture would be a key lever when aiming to design for effective virtual trainings.

5.4.6 Outlook for year 3

We are now working in three directions:

Qualitative: So far, the *virtual trainings* used Web-Ex. This is not particularly immersive, especially for an extended period of time (a full day). We aim to also explore video-conferencing technology. In contrast to Web-Ex, this could create more the perception of interacting with other people than with a system.

Quantitative: It is completely unclear at time of writing whether any such qualitative differences impact the performance of trainees on knowledge tests administered after the training: We are therefore in the progress of implementing a study in which in both settings (classroom, virtual) trainees receive a knowledge test directly after the training and six months to a year after the training.

Design Exploration: Finally, we aim to set up a co-design workshop that uses the findings from the qualitative and quantitative studies as a basis for co-designing adaptive training support based on the in-app reflection guidance and the levels of Kirkpatrick's (Kirkpatrick, 2006) model that integrates with such general trainings. First ideas are integrating adaptive training support in the preparatory phase for physical classroom trainings. Integrating adaptive training support within the training itself will depend on the study results outcome in terms of what we can see as efficient training strategy.

6 Semantic Profiling and Recommender System

6.1 Recommender System

In this section, we focus on the implementation and integration of the HCF-IDF approach proposed into deliverable D2.1, Section 4, which can be directly applied to scientific papers. It provides recommendations of scientific papers based on the users' profiles. Its integration in the platform is currently in progress. Further details on this method are available in deliverable D2.1, while additional implementation details will be provided in the upcoming deliverable D4.3.

To build the user profiles, we exploit the previous search history of a user. We take into account both how recent a search is and how often it has been performed. The idea is that user interests may vary over time and a user tends to perform several related searches on a topic. This is particularly true in exploratory search tasks such as learning or topic investigation. Based on such profile, the HCF-IDF algorithm generates the recommendations by returning a ranked list of documents that match the user profile. The top recommendations are shown to the user as displayed in Figure 17. For new users a certain number of searches are required before recommendations are provided.

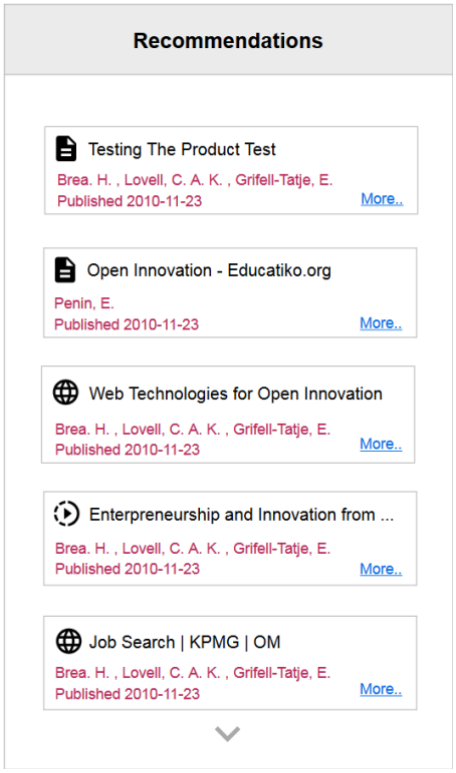

Figure 17: Recommendation widget

As the provided recommendations are worth being shown together with the "Learning-how-to-search" widget, Figure 18 presents how the Recommendation widget will be implemented in the MOVING platform.

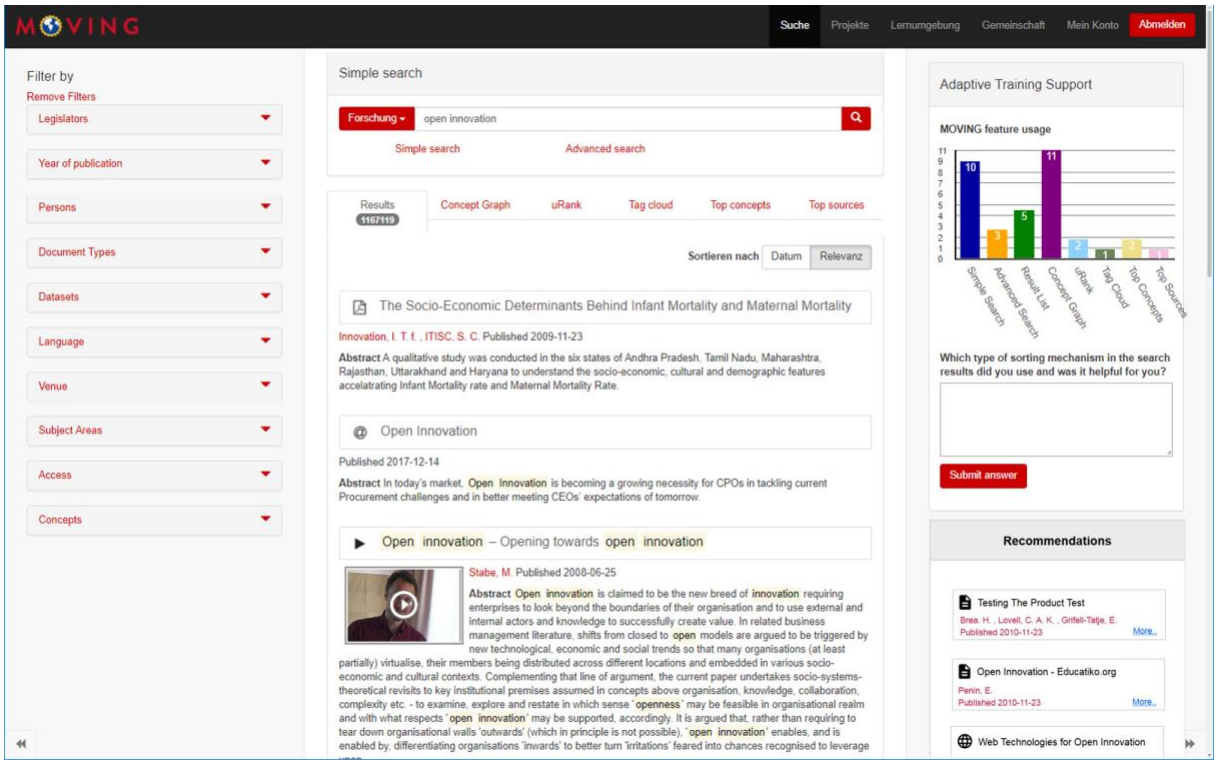

Figure 18: Learning-how-to-search and recommendation widget in the MOVING platform.

6.2 User Reviews and Linked Data for Content Recommendation

6.2.1 Problem statement

The Web has evolved from an information space to share textual documents into a medium to distribute structured data. Linked Data[28] is a set of best practices for publishing and interlinking data on the Web and it is the base of the Web of Data, an interconnected global knowledge graph. Because of the increased amount of machine-readable knowledge freely available on the Web, there is a high interest in investigating how such information can be used to improve recommender systems.

Currently, most recommender systems exploit ratings to infer user preferences, although the growing popularity of social and e-commerce websites has encouraged users to write reviews. These reviews enable recommender systems to represent the multi-faceted nature of users' opinions and build a fine-grained preference model, which cannot be obtained from overall ratings (Chen et al. 2015). Additionally, recommender systems may take advantage of reviews because they are harder to fake than ratings, are richer of information, and users may struggle to express their preference as ratings (Leung et al. 2006). Some studies have also documented the positive influence of product reviews on the decision processes of new users (Chatterjee, 2001; Kim & Srivastava, 2007).

[28] http://linkeddata.org

We address the issue of mining reviews and show how the extracted information, combined with Linked Data, can be exploited in recommendation tasks. On the one hand, Linked Data can provide a rich representation of the items to be recommended since they include interesting features. For example, movies represented in DBpedia[29] contain classical information such as cast and director, but also some unexpected relations, e. g. both Braveheart and Saving Private Ryan won the Best Sound Editing Academy Award. On the other hand, reviews may reveal additional connections among items. For instance, various reviews of Interstellar mention Stanley Kubrick, although in DBpedia there is not a direct link between these two resources.

We propose a new recommendation approach that semantically annotates reviews to extract useful information from them. The annotated entities and the knowledge freely available in the Web of Data are then combined to discover additional resources and generate recommendations. Our method can exploit any dataset available in the Web of Data to provide recommendations, although we rely on DBpedia and Wikidata[30] in our implementation.

More precisely, we conducted an offline study to find the best configuration of our technique for these two datasets and comparatively evaluate our approach against a Linked Data based and some traditional algorithms based on ratings. We performed the study in the movie, book, and music domains, and the evaluation took into account different properties of recommender systems, i. e. prediction accuracy (both in terms of ratings and ranking), diversity, and novelty. In fact, not only accuracy is important: recommendations all known to users or all of the same kind (e. g., all movies already watched or all movies of the same genre or with the same actor) may not satisfy them, although they match their taste (users expect to discover new movies to watch and may be bored of dramas, although they generally like it). The results showed that our method achieved the highest diversity, provided a better accuracy than the method based on Linked Data, and increased the novelty of recommendations with respect to traditional techniques.

The method proposed can be applied to documents hosted in the MOVING platform, such as scientific papers and books. Instead of user reviews, the abstracts can be exploited to annotate entities. The same holds for the transcripts of videos (when available). Additionally, annotating directly metadata such as the authors is possible as well. In some cases, document metadata provide authors and concepts that are already represented as Linked Data which can be used in the discovery phase as done for the annotated resources. However further experiments are needed to verify the effectiveness of the approach in the MOVING platform.

[29] http://dbpedia.org

[30] https://www.wikidata.org

6.2.2 Literature review

In this section, we distinguish among works that exploit user reviews for recommendation tasks and studies which discuss Linked Data based recommender systems. In the best of our knowledge, we are the first to combine the use of reviews and Linked Data.

Review-based Recommender Systems.

The exploitation of user reviews in recommender systems is a well-known research topic. Some techniques try to tackle the problem of building the profile of users by analyzing their reviews, while others focus on the identification of the main features of the items to recommend by mining their reviews (e.g. for a hotel breakfast, room comfort and location can be mentioned), as Cheng et al. (2015) summarised in their survey. Different strategies have been proposed in the relevant literature to address the latter problem. Some researchers have suggested methods able to identify the sentiment associated with the features of an item exploiting a domain-specific ontology (Aciar et al., 2007) or its technical description (Yates et al., 2008). A common aspect of these techniques is that the possible features are already available before performing the analysis. However, there are also approaches for unsupervised extraction of product features and sentiment from reviews (Qiu et al. 2011; Somprasertsri & Lalitrojwong, 2010). Since we use Knowledge Graphs to extract and expand features from the reviews, we do not apply those unsupervised extraction techniques. Nevertheless, it may be interesting in the future to combine both approaches and first conduct an unsupervised extraction of item features and sentiment from reviews and subsequently perform an expansion via knowledge graphs.

Another possibility is to identify the main characteristics of an item with the help of natural language processing methods, without any previous knowledge of the context. For example, a popular technique considers bigrams that frequently occur in reviews and that are associated with a word expressing an emotion (Dong et al., 2013). In this case, the goal of the recommender system is suggesting items with the same features of the ones liked by the target user, but with a better global sentiment. In the best of our knowledge, there is only one attempt to exploit user reviews for recommendation tasks using semantic annotation. Dzikowski et al. (2012) applied semantic annotation to reviews while users are editing them. Their goal was to produce annotated reviews of restaurants through Linked Data in order to generate tags to be associated with the reviewed items. In contrast, we apply semantic annotation to find related items.

Linked Data based Recommender Systems.

In the past, some studies reviewed different Linked Data based recommender systems that were proposed in the literature (Di Noia & Ostuni, 2015; Figueroa et al., 2015). Typically, these recommender systems consider the relationships among resources by taking into account the existing links in the Web of Data and use these relationships to measure the semantic similarity of resources. Such relationships can be direct links or paths between the items to recommend. In the following, we summarise the main works, although none of these exploit reviews. Damljanovic et al. (2012) suggested domain experts in an open innovation scenario. Their approach generates

recommendations by discovering related resources through hierarchical or transversal relationships in DBpedia. Passant (2010) presented dbrec, a music recommender system, which mainly relies on a measure named Linked Data Semantic Distance (LDSD). This measure is based on the number of direct and indirect links between two resources. Heitmann and Hayes (2010) also proposed a recommender system which exploited Linked Data to mitigate the new-user, new-item and sparsity problems of collaborative recommender systems. More recently, Musto et al. (2016) studied the impact of the knowledge available in the Web of Data on the overall performance of a graph-based recommendation algorithm. Vagliano et al. (2016) presented a recommendation algorithm based on Linked Data which exploits existing relationships between resources by dynamically analyzing both their categories and their explicit references to other resources. Di Noia et al. (2012) described a model-based approach to provide content-based recommendations with Linked Data. Ostuni et al. (2014) defined a neighbourhood- based graph kernel for matching graph-based item representations. Di Noia et al. (2016) introduced SPrank, a hybrid algorithm which extracts semantic path-based features from DBpedia and computes recommendations using Learning to Rank.

6.2.3 Method description

SemRevRec process user reviews to identify entities to recommend through semantic annotation. Then further entities are discovered relying on Linked Data. Every time a new review is submitted, the system executes the semantic annotation step and possibly adds new entities through discovery. More specifically, the system annotates some entities in the text as shown in Figure 19. Given the review of Interstellar, Stanley Kubrick and his movie *2001 A space odyssey* are annotated, i.e. linked with corresponding entity, which is also a resource in the Web of Data. Through, exploiting the links among resources, further entities can be discovered, e.g. others Kubrick´s movies, such as *A clockwork orange* and *Full metal jacket*. These entities can then be recommended to users. The recommendation process can start when the user provides an initial item, e.g. a movie he/she liked.

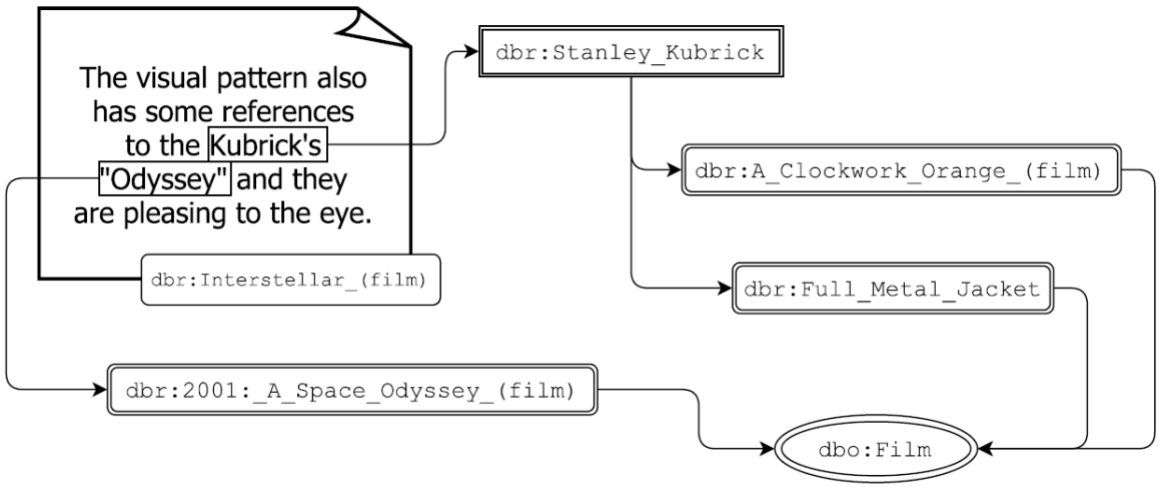

Figure 19: An example of semantic annotation and discovery for a movie review

The architecture of SemRevRec is depicted in Figure 20. The system consists of two main modules which are highlighted with different colors: semantic annotation and discovery, and recommendation. The former is responsible for feeding the recommender system with semantically annotated entities and Linked Data through the knowledge base, while the latter provides recommendations to users. The recommendation module works online, while the semantic annotation and discovery are done offline. Initially, some reviews are annotated and the resulting entities are used to discover additional entities through Linked Data. Each of these two modules is made up of the submodules depicted, which are responsible for specific steps of the whole process: annotation, discovery, generation of recommendations, and their ranking. The storage of entities is not a step, but the corresponding database is a transversal submodule used by all the others.

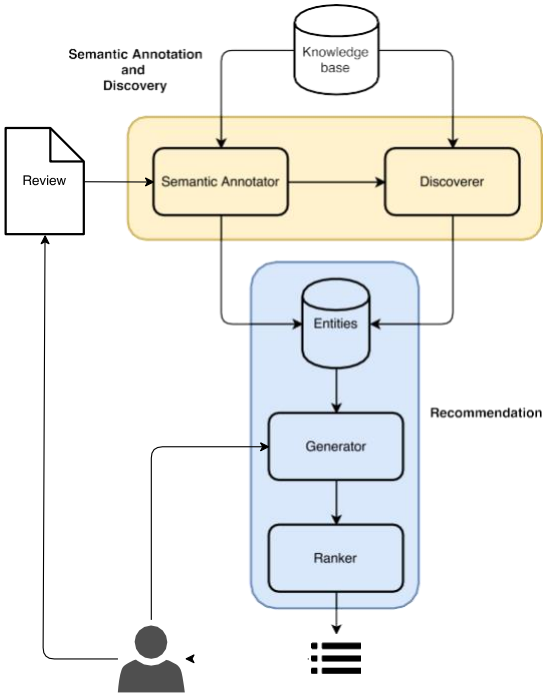

Figure 20: SemRevRec architecture

SemRevRec deals with the annotated or discovered entities and the items to recommend. We consider the items a particular type of entities since SemRevRec recommends items which may be annotated or discovered entities, although an item may not appear as an entity in the system, e. g., a movie is reviewed but was never annotated or discovered. However, this does not mean that an entity corresponding to such film does not exist in the considered knowledge base. Semantic annotation and discovery are explained in Section 6.2.3.1, while recommendation is presented in Section 6.2.3.2.

Although our approach is not bounded to a particular domain or knowledge base available in the Web of Data, in our implementation, we focus on movies, books, and music, while we rely on DBpedia and Wikidata to identify possible differences between these two knowledge bases. We

chose them for annotation and discovery because they are two of the main datasets in the Web of Data and have a vast amount of resources represented which belongs to a variety of domains. We used reviews from IMDb[31] for movies, LibraryThing[32] for books, and Amazon[33] for music.

6.2.3.1 Semantic Annotation and Discovery

Semantic annotation allows SemRevRec to exploit Linked Data for retrieving additional entities. This is possible because the annotated entities are also resources in the Web of Data. Thus, the discoverer can find resources which are related to the annotated entities in order to enable our system to recommend more items. Reviews are a source of non-trivial relations: for example, in a movie recommendation scenario, a user can mention a movie which reminds him of the reviewed one because of the colors, the setting, or the atmosphere, and these features are hardly available as Linked Data (see Figure 19). At the same time, Linked Data can enrich information coming from users. For instance, they enable the discoverer to obtain other movies in which an actor mentioned in a review played or additional movies of a director (as in Figure 19). In order to do so, the discovery can take into account various properties, from more traditional, such as the genre, the director, or the actors of the movie reviewed, to more unexpected ones, such as other movies shot in the same country.

Semantic annotation is the process of annotating textual or multimedia contents with semantic tags to add information about their meaning (Saathoff & Scherp, 2010). In written text, this can be done by associating an URI to the recognized entities. We considered two popular semantic annotators that rely on Wikipedia: AIDA (Hoffart et al., 2011) and DBpedia Spotlight (Daiber et al., 2013). They are both capable of disambiguating entities according to the surrounding context: this is useful because users frequently write acronyms and abbreviations. We finally selected AIDA because it is more accurate according to an independent comparison (Gangemi, 2013).

The module of semantic annotation and discovery analyses the text of the reviews and stores the identified entities in a relational database. The URI of each annotated entity is associated with the URI of the reviewed item and with the occurrence of that entity in all the reviews of that item. In effect, the same entity may appear again in reviews regarding another item. AIDA is capable of identifying and disambiguating the entities mentioned in the review considering, by default, the ones available in YAGO[34]. The latter is one of the main knowledge bases in the Web of Data.

The AIDA resources are mapped with the equivalent ones available in DBpedia exploiting the similar structure of the URIs. For example, `yago-res:The_Matrix` corresponds to `dbr:The_Matrix` because their URIs where generated starting from the title of the same Wikipedia article. In contrast, the

[31] http://www.imdb.com

[32] https://www.librarything.com

[33] https://www.amazon.com

[34] http://www.yago-knowledge.org

mapping between DBpedia and Wikidata relies on the `owl:sameAs` predicate available in DBpedia. If the same entity corresponds to more than one in the other knowledge base, it is ignored in order to avoid probable inconsistencies. The same holds true if there is no `owl:sameAs` property, although DBpedia is well linked to Wikidata. In principle, it is also possible to perform the semantic annotation phase relying on a custom knowledge base, but AIDA is provided with a precomputed database that includes all the necessary information for annotating with YAGO. In our case, since DBpedia and Wikidata are both well interlinked with YAGO, it was less time-consuming computing the mapping than the information needed by the annotator for these two knowledge bases.

Finally, the types of each entity are obtained from the target knowledge base, optionally considering only a subset of them (e. g. only the DBpedia ontology types, such as `dbo:Film`). This is done in order to minimize the amount of information retrieved and to reduce the time required for this operation. The types are stored locally because they are not expected to change often and reading them from a relational database is more efficient than querying the original knowledge base.

Given the annotated entities, the discoverer retrieves from the knowledge base other relevant entities through SPARQL queries. It relies on some properties which can be configured and depend on the domain and on the dataset considered. The discovery is not bounded to a particular knowledge base or domain. On the contrary, this approach is fairly general since it relies only on RDF and SPARQL. In our implementation, we considered DBpedia and Wikidata, and we focused on movie, book, and music recommendations. Table 13 summarizes the properties that we selected for discovering further items to recommend starting from the entities available in the reviews.

Table 13: Properties considered for discovery

Domain	DBpedia	Wikidata
Movie	`dbo:starring`	`wdt:P161`
Movie	`dbo:director`	`wdt:P57`
Book	`dbo:author`	`wdt:P50`
Music	`dbo:artist`	`wdt:P175`
Music	`dbo:writer`	`wdt:P676`

More specifically, the discoverer reads the annotated entities stored during the semantic annotation phase. The discoverer is able to obtain all the resources which have the given entities as an object of the selected properties. For example, in the movie domain, we selected `dbo:starring` and `dbo:director` in the case of DBpedia because most of the annotated properties, when not movies, were actors and directors. This allows the system to discover other movies from the same director or actor named in a given review. Sometimes directors or actors not involved in the movie were also mentioned for comparison. The discoverer can retrieve other movies from these entities, which are relevant for the user who wrote the review, thus can also be of interest for other users. Similarly to movies, we selected `dbo:author` for books as well as `dbo:artist` and `dbo:writer` for music because most of the annotated entities were authors, artists or writers when not books and songs, respectively. It is possible to exploit both direct and inverse properties in the discovery.

The discoverer stores the discovered entities in a relational database for efficiency reasons. The URI of each discovered entity is associated with the URI of the annotated entity through which it was discovered, and, optionally, with the LDSD measure (Passant, 2010) between them. This measure is inversely proportional to the number of links between two resources: more links result in a lower distance. Each discovered entity may be found through more than a single annotated entity. The LDSD can be exploited in the ranking phase, which is described in Section 6.2.3.3. However, since its computation is expensive due to the various SPARQL queries involved, it may be optionally skipped to speed up the discovery step. Obviously, in this case, the LDSD measure does not contribute to the ranking.

6.2.3.2 Recommendation

The recommendation process consists of two main steps: the generation of the candidate recommendations and their ranking. Given an initial item, SemRevRec retrieves all the entities which are related to the initial item and then ranks them.

Firstly, the system selects the annotated entities which were mentioned in the reviews of the initial item. Afterwards, it obtains the entities which mention the initial item, i. e., entities whose reviews generated an annotated entity that corresponds to the initial item. For example, if the initial item is *Interstellar* and a review of *2001: A Space Odyssey* mention Interstellar, then *2001: A Space Odyssey* is considered as a candidate recommendation. SemRevRec optionally retrieves the discovered entities. They may include entities discovered through the initial item. For instance, if the initial item is *Interstellar* and *The Dark Knight* was previously discovered because both these movies have been directed by Christopher Nolan, *The Dark Knight* is selected. The same holds if *Interstellar* was discovered from *The Dark Knight*, i. e., Christopher Nolan was annotated in the reviews of the latter. Similarly, the entities discovered through other entities which were annotated in the reviews of the initial item are relevant. For example, if *Interstellar* is the initial item, Stanley Kubrick was annotated in one of its reviews, and *2001: A Space Odyssey* was discovered through Stanley Kubrick, then *2001: A Space Odyssey* is a candidate recommendation. It is possible to configure the generator to include in the candidate recommendations the discovered entities or not. It is also possible to specify the minimum occurrence required for entities to be included in the candidate recommendation set, which is expressed as a percentage of the maximum occurrence of entities in the reviews of the item considered.

6.2.3.3 Ranking Functions

Finally, SemRevRec ranks the candidate recommendations. We defined three different ranking functions, which corresponds to different ranking approaches. In Section 6.2.4, we investigate which of these functions is more effective. The first is presented in Equation 1 and takes into account only the occurrence $occur(i, i_{in})$ of the entities available in the reviews. $Occur(i, i_{in})$ is equal to the number of reviews of an initial item i_{in} where an entity i is annotated, plus the number of reviews of i where i_{in} is annotated (if any). However, the entity i can be annotated or discovered. For the latter, the occurrence of the entity through which it was discovered is used. The α coefficient is 1 if i is an

annotated entity. Otherwise, it can be configured to a custom value (the default is 0.5) to weight the contribution of a discovered entity to the ranking. To obtain a value between 0 and 1, R1 is normalised to the maximum occurrence of entities j which belong to the candidate recommendation set CR.

$$R1(i) = \frac{\alpha \cdot occur(i, i_{in})}{max_{j \in CR}(occur(j, i_{in}))} \quad (1)$$

The second ranking function (Equation 2) also considers the Linked Data Semantic Distance (LDSD) measure between each discovered entity and the entity through which it was discovered. This avoids assigning the same value to all the entities discovered through the same annotated entity as R1 does. Like for R1, the entity i can be annotated or discovered. The β coefficient is 1 if i is an annotated entity, 0.5 otherwise. The γ coefficient is 0.5 for discovered entities, 0 otherwise. In this way, R2 returns a number between 0 and 1, which is equal to R1 for the annotated entities, while, for the discovered entities, it is the average of R1 and LDSD(i, i_o), where i_o is the entity through which i was discovered.

$$R2(i) = \beta \cdot R1(i) + \gamma \cdot (1 - LDSD(i, i_o)) \quad (2)$$

The third ranking function (Equation 3) considers the LDSD measure between an entity i and the initial item i_{in}. The coefficients η and κ can be set to custom values and they allow the ranker to weight differently the contribution of the occurrence in the review (given by R2) and Linked Data (through the LDSD measure). With these coefficients, it is possible to customise the ranking for different application scenarios. Sometimes reviews provide a lot of entities, thus may be convenient exploit these annotated entities as this information is directly related to users. In other cases, reviews could contain few annotated entities does it is important rely on the discovered entities. LDSD measures between discovered entities and the entities through which they were discovered need to be precomputed at discovery time (see Section 6.2.3.1) to enable SemRevRec to exploit R2, LDSD measures between entities in CR and the initial item need to be computed while ranking. In the latter case, the ranking time is increased.

$$R3(i) = \eta \cdot R2(i) + \kappa \cdot (1 - LDSD(i, i_{in})) \quad (3)$$

6.2.4 Experimental evaluation and comparison

We evaluated the performance of SemRevRec with two offline experiments conducted in the movie, book, and music domains. The purpose of the first experiment is to compare the three different ranking functions defined and understand the impact of the discovery, the occurrence threshold, and the coefficients of R3. Furthermore, we performed the first experiment two times, first relying on DBpedia and then on Wikidata, to assess the effect of the exploited knowledge base on the quality of the recommended items. The aim of the second experiment is to compare our proposal with traditional recommendation techniques that rely on ratings and a recommender system based on Linked Data.

In order to conduct both experiments, we obtained from IMDb, LibraryThing, and Amazon the user reviews regarding all the items included in the MovieLens 1M[35], the LibraryThing[36] and the HotRec 2011 LastFM[37] datasets of user ratings.

The items of such rating datasets were mapped with the corresponding entities available in DBpedia relying on the work of Di Noia et al. (2016). Moreover, their equivalent entities in Wikidata were obtained from DBpedia itself, as described in Section 6.2.3.1. For the purpose of retrieving the user reviews, Wikidata was exploited in order to discover the IMDb identifiers of the movies available in the MovieLens 1M dataset. On the contrary, the LibraryThing dataset already contained the references useful for obtaining the reviews. Regarding the musical artists present in the HotRec 2011 LastFM dataset, we relied on the search feature of Amazon for identifying their most reviewed musical work.

Table 14 lists several statistics regarding the exploited rating datasets and the analyzed reviews in the three domains considered. It is worth noting that the HotRec 2011 LastFM dataset contains a limited number of ratings with respect to the other datasets and, for this reason, it is the most sparse one.

Table 14: Datasets and reviews statistics

	Movie	Book	Music
Users	6,040	7,279	1,892
Items	3,706	37,232	17,632
Ratings	1,000,209	2,056,487	92,834
Reviews	559,858	363,791	669,978
Distinct entities	107,468	77,120	70,762
Total entities	574,435	303,705	296,777

The LibraryThing dataset includes a considerable number of items, even if fewer reviews are available in the book domain. Regarding the outcome of the semantic annotation, the number of distinct and total entities identified in user reviews is reported. The ratio between these two values may be considered a measure of the variety of the mentioned topics. According to this measure, the reviews about movies are the most varied ones in terms of entities.

Figure 21 displays the boxplots representing the distributions of the number of annotated entities per each item according to the domain, excluding the outliers for graphical reasons. Given the interquartile range $IQR = Q3 - Q1$, all data points not belonging to the interval $(Q1 - 1.5 \cdot IQR;\ Q3 + 1.5 \cdot IQR)$ are considered outliers.

[35] http://grouplens.org/datasets/movielens/1m/

[36] http://www.macle.nl/tud/LT/

[37] http://ir.ii.uam.es/hetrec2011/datasets/lastfm/readme.txt

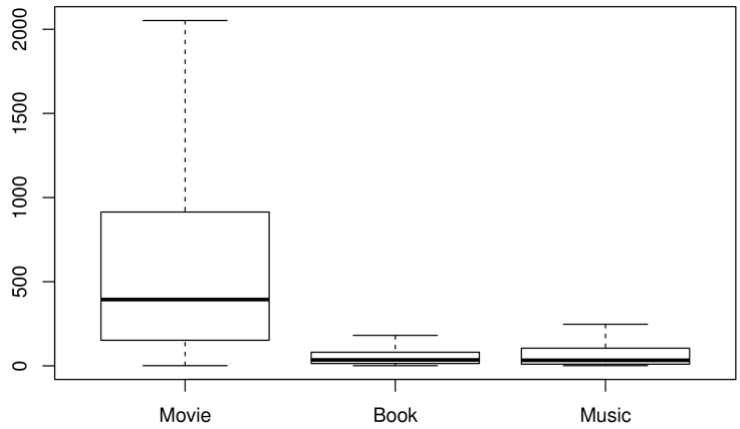

Figure 21: Distribution of entities extracted from the reviews of the items per domain

It is clear that movie reviews are fairly different from the other ones. This may be related to the higher ratio between reviews and items in the movie domain.

In order to perform the evaluations, a 5-fold cross-validation was executed. Here, we considered ratings as positive if their score was greater than 3 on a scale from 1 to 5 for MovieLens, greater than 6 on a scale from 1 to 10 for LibraryThing, and greater than 0 for HotRec 2011 LastFM. In effect, the latter dataset represents implicit feedback, in this case given by the number of times a user listened to a particular artist, while the others are examples of explicit feedback. Exploiting the lists of the top-10 recommendations for each user, we computed the measures of precision, recall, nDCG (Järvelin & Kekäläinen, 2002), Entropy Based Novelty (EBN, Bellogìn et al., 2010), and diversity (Zhang & Hurley, 2008).

For the implementation, we rely on the LibRec library[38]. It computes measures according to the all unrated items protocol (Steck, 2013). More specifically, it creates a top-N recommendation list for each user by predicting a score for every item not rated by that particular user, whether that item appears in the user test set or not. All the non-rated items are considered to be irrelevant for the user. This explains the low values for the measures (e. g., precision and recall) as the quality of recommendations tend to be underestimated. However, Steck (Steck 2013) suggests relying on this protocol rather than the rated test-items, which includes only rated test items in the top-N list, as the user satisfaction regarding top-N recommendations depends on the ranking of all items.

6.2.4.1 Results

We firstly report the results of the first experiment on optimising the parameters of our SemRevRec system. Then, we document the results of comparing our approach with baselines from related work.

6.2.4.1.1 Optimising the SemRevRec parameters

[38] http://ir.ii.uam.es/hetrec2011/datasets/lastfm/readme.txt

In this experiment, we evaluated the impact of the ranking function, the discovery, the occurrence threshold, and the coefficients of R3 on the performance of our algorithm. We executed SemRevRec in three domains with different ranking functions and with and without the discovery phase. We also varied the configuration parameters η and κ of the ranking function R3, in order to identify possible relationships between the occurrence and the LDSD measure. Moreover, we considered how the percentage of the minimum occurrence required for entities to be included in the candidate recommendation set impacts on the results. The main configurations tested are listed in Tables 15, 16, 17, and 18 summarise the results obtained with the DBpedia knowledge base in the movie, book, and music domain, respectively. For all the measures but EBN, higher values mean better results, while the lower is EBN, the higher is the novelty. The best values and configurations are highlighted with a bold font.[39] In order to decide if the difference between two measures was statistically significant, we relied on the Welch's t-test (or unequal variances t-test), which is an adaptation of the Student's t-test more reliable when the two samples have unequal variances and unequal sample sizes (Ruxton, 2006). We considered $p < 0.001$ because we applied the Bonferroni correction as we performed pairwise comparisons.

Table 15: Configuration of SemRevRec

Conf.	Ranking	Discovered	Occurrence	η	κ
C1	R1	False	0.05	–	–
C2	R1	True	0.05	–	–
C3	R2	False	0.05	–	–
C4	R2	True	0.05	–	–
C5	R3	False	0.05	0.50	0.50
C6	R3	True	0.05	0.50	0.50
C7	R3	True	0.05	0.75	0.25
C8	R3	True	0.05	0.25	0.75

Table 16: Results with MovieLens and DBpedia

Conf.	Precis.	Recall	nDCG	EBN	Divers.
C1	0.0604	0.0399	0.0412	1.2804	**0.2431**
C2	0.0529	0.0327	0.0343	1.2776	0.1629
C3	0.0604	0.0399	0.0412	1.2804	**0.2431**
C4	0.0276	0.0178	0.0197	**0.7820**	0.1716
C5	**0.0683**	0.0424	0.0491	1.0047	0.1795
C6	0.0460	0.0255	0.0320	0.9354	0.1794
C7	0.0344	0.0191	0.0243	0.8248	0.1464
C8	**0.0711**	**0.0478**	**0.0524**	1.0163	0.2114

Table 17: Results with LibraryThing and DBpedia

Conf.	Precis.	Recall	nDCG	EBN	Divers.
C1	0.0396	0.0350	0.0341	0.4081	0.7701
C2	**0.0506**	**0.0497**	**0.0465**	0.2771	0.7780
C3	0.0396	0.0350	0.0341	0.4081	0.7701
C4	0.0357	0.0340	0.0353	**0.1946**	0.8919
C5	0.0462	0.0373	**0.0462**	0.2809	0.8663
C6	0.0356	0.0331	0.0366	0.2280	0.9039
C7	0.0306	0.0269	0.0317	0.2444	0.8932
C8	0.0421	0.0418	**0.0429**	0.2077	**0.9118**

Table 18: Results with LastFM and DBpedia

Conf.	Precis.	Recall	nDCG	EBN	Divers.
C1	**0.0495**	**0.0504**	**0.0486**	0.7894	0.5654
C2	**0.0504**	**0.0515**	**0.0473**	0.6640	0.6021
C3	**0.0495**	**0.0504**	**0.0486**	0.7894	0.5654
C4	**0.0504**	**0.0515**	**0.0473**	0.6640	0.6022
C5	0.0363	0.0371	0.0378	0.2619	0.9238
C6	0.0360	0.0370	0.0378	**0.2422**	**0.9325**
C7	0.0361	0.0369	0.0378	**0.2425**	**0.9325**
C8	0.0360	0.0368	0.0378	**0.2411**	**0.9329**

The obtained results suggest that the discovery of additional entities through Linked Data is useful for improving the precision of the recommended items. In fact, the best configurations in all the domains but music (C8 for movies, C2 for books) rely on it. In the music domain there is not a

[39] More values are highlighted for the same measure if the differences among them are not statistically significant.

significant difference in the measures when relying on the discovery phase. This may be related to the fact that we considered reviews about musical works in order to recommend musical artists.

The best ranking function depends instead on the domain. For movies, R3 outperformed the other rankers (C8), while, for book and music recommendations, R1 accounts for the best results (C2), although in the music domain the values obtained with R1 and R2 were equivalent (C4). This suggests that a simpler ranker may be more effective on sparse data, and it could be better to rely on information from reviews than on Linked Data. Additionally, the coefficients η and κ of R3 may have a high impact on the results as shown by C6, C7, and C8 in Table 15, even if, in the music domain, the measures do not vary. In particular, C8 improves significantly the precision and recall measures with respect to other configurations of R3 in the movie and book domains.

Figure 22 illustrates the performance in terms of nDCG of the three ranking functions available in SemRevRec when the number of entities considered for the recommendation process varies. The occurrence represents the minimum number of times an entity needs to be annotated in the reviews of a certain item in order to be included in the candidate recommendation set. It is expressed as a percentage of the most annotated entity for an item. The plot is based on the results obtained in the movie domain with the Wikidata knowledge base, as this can be considered the most representative case. Unsurprisingly, all rankers tend to converge, as the number of entities available decreases. However, it is important to notice that the nDCG is monotonically decreasing. This fact happens in the majority of the domains with both knowledge bases and supports the hypothesis that the higher is the number of available entities, the better is the quality of the recommendations.

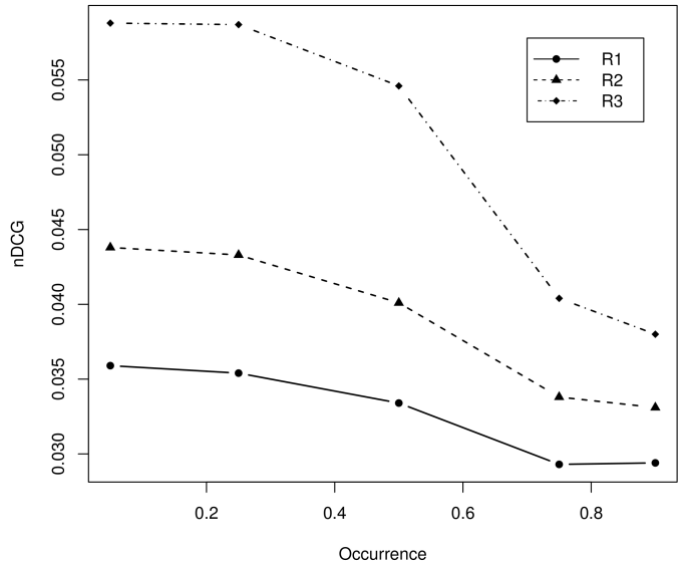

Figure 22: nDCG with MovieLens and Wikidata

Figure 23 compares the results obtained by the best configuration of our algorithm when using DBpedia and Wikidata for each domain. Although both knowledge bases are derived from Wikipedia, the results differ. In particular, Wikidata outperformed DBpedia in the vast majority of the considered measures. A possible reason may be that Wikidata provides higher data quality for the recommendation task, as it also contains knowledge manually encoded by human editors. At the

instance level, this may be primary due to the interlinking of resources since we rely on the LDSD measure which exploit direct and indirect links. At the ontology level, the properties considered in the discovery may also have a high impact. We should investigate which features of a knowledge base are well suited for a Linked Data based recommender system, although they can also depend on the particular domain considered.

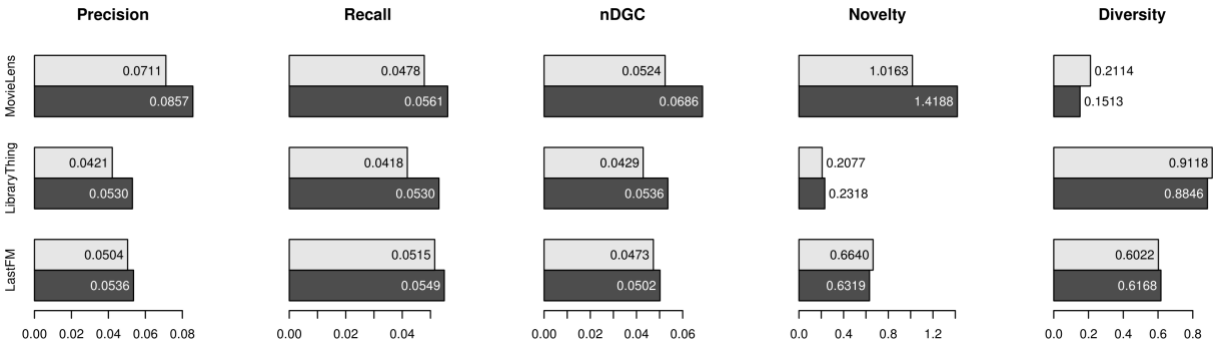

Figure 23: Comparison between DBpedia and Wikidata. Light grey is DBpedia, dark grey Wikidata

Table 19 lists the results obtained with Wikidata. They vary significantly when the η and κ weights of the ranking function R3 are changed. Thus, we decided to include in this deliverable only the results related to the configurations C4, C6, C7, and C8, although we tested all the ones listed in Table 19. The complete evaluation is available on the Web.[40] In general, Wikidata provides better results with respect to DBpedia and this behavior is consistent in all domains, but differences are more significant when movies are recommended.

Table 19: Results with Wikidata

Conf.	Domain	Precis.	Recall	nDCG	EBN	Divers.
C4	Movie	0.0582	0.0368	0.0438	**1.3626**	0.1223
C6	Movie	0.0757	0.0487	0.0588	1.4284	**0.1461**
C7	Movie	0.0728	0.0459	0.0552	1.4322	**0.1423**
C8	**Movie**	**0.0857**	**0.0561**	**0.0686**	**1.4188**	**0.1513**
C4	Book	0.0392	0.0373	0.0379	0.2634	0.8455
C6	Book	0.0452	0.0443	0.0466	0.2621	0.8705
C7	Book	0.0365	0.0334	0.0380	0.2809	0.8600
C8	**Book**	**0.0530**	**0.0530**	**0.0536**	**0.2318**	**0.8846**
C4	**Music**	**0.0536**	**0.0549**	**0.0502**	**0.6319**	0.6168
C6	Music	0.0384	0.0395	0.0375	**0.3083**	**0.9314**
C7	Music	0.0390	0.0401	0.0380	**0.3062**	**0.9327**
C8	Music	0.0367	0.0377	0.0363	**0.3178**	**0.9322**

6.2.4.1.2 Comparison with Baselines

We compared our technique to the Most Popular, Random Guess, Item KNN, and Bayesian Personalized Ranking (BPR, Rendle et al. 2009) algorithms, as implemented in LibRec, and with SPrank

[40] https://doi.org/10.6084/m9.figshare.5074081

(Di Noia et al., 2016), a state-of- the-art Linked Data-based recommender. We set the neighborhood size for Item KNN to 80, while we used 100 factors for BPR, as done by Musto et al. (Musto et al., 2016). We configured SPrank to exploit LambdaMart as the ranking method and to follow in the DBpedia graph the same properties that we selected for our algorithm, as listed in Table 19.

Tables 20, 21, and 22 list the results obtained in the movie, book, and music domain, respectively. The best values are highlighted with a bold font.[41] For SemRevRec, we reported both the configuration with the best trade-off among the various measures and the best scores achieved for each measure in the experiment previously described. In all the experimental trails, SemRevRec provided the best diversity and a better accuracy (both in rating pre- diction and ranking) than SPrank, while it improved in novelty with respect to traditional techniques. BPR accounted for the highest precision, recall, and nDCG. In general, the diversity of algorithms is rather low for movies, while for music and books is above 0.6, apart for Item KNN.

Table 20: Comparison using the MovieLens dataset

Algorithm	Precis.	Recall	nDCG	EBN	Divers.
SemRevRec	0.0857	0.0561	0.0686	1.4188	0.1513
Best Scores	0.0857	0.0561	0.0686	**0.7820**	**0.2431**
SPrank	0.0445	0.0254	0.0280	0.8813	0.1612
Item KNN	0.1626	0.1105	0.1302	2.6846	0.0696
BPR	**0.2347**	**0.1737**	**0.1930**	1.8358	0.1769
Popular	0.1325	0.0840	0.0969	2.7439	0.1412
Random	0.0055	0.0028	0.0031	**0.3018**	0.1679

Table 21: Comparison using the LastFM dataset

Algorithm	Precis.	Recall	nDCG	EBN	Divers.
SemRevRec	0.0536	0.0549	0.0502	0.6319	0.6168
Best Scores	0.0536	0.0549	0.0502	0.2411	**0.9329**
SPrank	0.0156	0.0158	0.0176	**0.1834**	0.9077
Item KNN	0.1392	0.1428	0.1720	1.6023	0.4730
BPR	**0.1545**	**0.1583**	**0.1808**	0.9404	0.6547
Popular	0.0686	0.0703	0.0791	2.0360	0.6519
Random	0.0005	0.0005	0.0004	**0.0442**	**0.9946**

Table 22: Comparison using the LibraryThing dataset

Algorithm	Precis.	Recall	nDCG	EBN	Divers.
SemRevRec	0.0530	0.0530	0.0536	0.2318	0.8846
– Best Scores	0.0530	0.0530	0.0536	0.1946	**0.9118**
SPrank	0.0379	0.0346	0.0337	**0.1562**	0.8037
Item KNN	0.0620	0.0564	0.0662	1.4956	0.2259
BPR	**0.0862**	**0.0817**	**0.0895**	0.6043	0.7177
Popular	0.0423	0.0343	0.0447	1.6034	0.6483
Random	0.0004	0.0002	0.0003	**0.0382**	**0.9879**

The differences between SemRevRec and the other approaches are statistically significant according to the Welch's t-test with $p < 0.001$, except for SPrank, BRP, Most Popular, and Random Guess in the movie domain regarding the measure of diversity, SPrank in the book domain regarding the measures of precision and diversity, and Most Popular in the music domain regarding the measure of diversity.

[41] More values are highlighted for the same measure if the differences among them are not statistically significant. In the case of EBN and diversity, when Random Guess was the best, we also highlighted the second best because its precision, recall, and nDCG were close to zero. This means that the recommendations provided are completely unrelated and their novelty and diversity is not relevant.

6.2.4.2 Discussion

In general, the results obtained by our algorithm in the music and book domains are not as good as the ones reached with movie recommendations. This may be due to the characteristics of the reviews, as illustrated in Figure 21 and previously discussed. The entities annotated for each item in these two domains are much less than the entities available in movie reviews. This fact should be further studied. Moreover, it would be interesting investigating the impact of the number of reviews available and their quality with respect to the recommendation process. For example, a meaningful album review mentions the author and similar albums or artists the user liked, while a review describing the package is not very useful in our scenario. In fact, we aim to suggest other artists to listen to, although packaging may impact on the decision of buying a physical copy of that album. Finally, the significant difference in the results obtained when exploiting Wikidata or DBpedia suggests that the impact of knowledge bases, notably the selection of types and properties exploited, on the performance should be further analysed.

In this work, we relied on all the reviews available for the items present in the rating datasets used for the evaluation. However, only reviews about some items, i. e. the ones with the average rating higher than a threshold, or only some reviews for each item, i. e. only the ones which are rated positively, could be considered during the semantic annotation phase. Nevertheless, lower performance on music artists and books was expected because the available ratings were sparser than the ones regarding movies. This holds for all the algorithms and explains the general difference of scores in these domains (overall lower than for movies).

SemRevRec showed the best diversity in all the domains. Notably, in the sparse dataset of books, it achieved precision, recall, and nDCG comparable to Item KNN with a much higher diversity, although both are content based methods. However, collaborative filtering techniques are known to suffer less of the overspecialisation problem and provide better rating prediction and ranking than content-based ones as SemRevRec. For this reason, although collaborative filtering is very popular, we decided to include in the baseline only one technique among many, i. e. BPR, which is one of the newest and most promising. Nevertheless, it showed a lower diversity than our algorithm. Not surprisingly, it also accounted for the best rating prediction and ranking.

Our approach also provided a higher novelty than traditional techniques and a better rating prediction and ranking than SPrank. In the movie domain, SemRevRec accounted for the best novelty, while with music and books for the second best, with results close to SPrank. Additionally, when optimised for this measure, SemRevRec had similar (for books) or higher (for music) rating prediction and ranking than SPrank. On the contrary, when the former is optimised for rating prediction and ranking, it could be preferred to the latter to increase the novelty of recommendations, but also limiting the loss in rating prediction and ranking. Additionally, SemRevRec was evaluated considering the recommendations generated for all the previous movies a user liked since its generation approach is rather naive and takes into account only an initial item. Combining it with a machine learning technique could significantly improve its performance, but further experiments are required to prove this.

7 Conclusion and outlook

MOVING offers a platform that with its unique combination of work and training environment empowers people to become self-reflective lifelong learners. Deliverable 2.2 presents a comprehensive overview of the learning options on the MOVING platform and describes the technologies that support users to become information- and data-savvy professionals. Information literacy is key for individuals to actively participate in open and collaborative innovation processes. In this deliverable, we described in detail the process of curricula development at TUD and EY and presented a framework for teaching information and digital literacy on the MOVING platform. The next steps of this process, that are planned for year 3 of the project, encompass the development of training units for information literacy for the two use cases and the production and provision of learning material for the learning experience of the users. In addition, demos and tutorials that familiarize users with the wide range of technologies and tools for data and document analysis and collaboration in the MOVING platform will be produced at JSI.

Furthermore, in year 3 we will advance the learning environment of the platform. This process involves the implementation of learning management features that support the provision of different learning paths and training options on the MOVING platform. It also includes enhancing the platform and the user profiles with social technologies like blogs, wikis, social bookmarking features and forums with commenting functions. With these features MOVING provides the platform for a community of practice of users that are engaging in open science and open innovation practices. With the MOVING MOOC *Science 2.0 and open research methods* we engage learners on the platform in collaborative, reflective and practice-oriented learning and encourage them to be not only passive consumers of information but instead become active producers of knowledge and content. This establishes MOVING as a platform for a community of practice of information-savvy professionals from a wide range of disciplines and societal sectors.

The learning concept is complemented by the adaptive training support widgets developed at KC that offer guidance to users while they are using the platform. The “Learning-how-to-search” and “Curriculum reflection” widgets support users in improving their information and data literacy skills when working within the different platform environments. While the “Learning-how-to-search” widget is already integrated in the platform and will be evaluated in the upcoming months in Y3, the “Curriculum reflection” widget will be implement throughout the next months. Furthermore, KC will continue the collaboration with EY to further enhance the adaptive training support in face-to-face and virtual trainings.

SemRevRec, the recommender system developed by ZBW, will offer content suggestions and learning options to the users based on their individual interests and skills. The integration of the recommender system is planned for year 3 of the project. Once implemented the system will be tested and enhanced to compile content that is accurately tailored to the individual MOVING users.

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Appendix I

Prior Knowledge Self-Assessment Survey

(1) Search for Information

Learning Goal: Identify, locate, retrieve, store, organise and analyse digital information, judging its relevance and purpose

Competences:

- To articulate information needs, to search for data, information and content in digital environments, to access them and to navigate between them.
- To create and update personal search strategies.
- To adapt search strategies based on the quality of information found.
- To analyse, compare and critically evaluate the credibility and reliability of sources of data, information and digital content.
- To organise, store and retrieve data, information and content in digital environments.
- To organise and process information in a structured environment.

Prior Knowledge Assessment

Question: When you think of your ability to search, evaluate and organise data and information on the internet, which of the following statements best describes your behaviour?

☐ I can look for information online using a search engine. I know not all online information is reliable. I can save or store files or content (e.g. text, pictures, music, videos, web pages) and retrieve them once saved or stored. I keep information and files in a number of different physical supports (hard drive, USB stick, memory card).

☐ I can use different search engines to find information. I use some filters when searching (e.g. searching only images, videos, maps). I compare different sources to assess the reliability of the information I find. I classify the information in a methodical way using files and folders to locate these easier. I do backups of information or files I have stored.

☐ I can use advanced search strategies (e.g. using search operators) to find reliable information on the internet. I can use web feeds (like RSS) to be updated with content I am interested in. I can assess the validity and credibility of information using a range of criteria. I am aware of new advances in information search, storage and retrieval. I can save information found on the internet in different formats. I can use cloud information storage services.

(2) Communication & Collaboration

Learning Goal: Communicate in digital environments, share resources through online tools, link with others and collaborate through digital tools, interact with and participate in communities and networks

Competences:

- To interact through a variety of digital technologies.
- To understand appropriate digital communication means for a given context.
- To share data, information and digital content with others through appropriate digital technologies.

- To know about referencing and attribution practices.
- To use digital technologies for collaborative processes, and for co-construction and co-creation of resources and knowledge.
- To deal with the data that one produces through several digital technologies, environments and services.

Prior Knowledge Assessment

Question: When you think of the ways in which you communicate and collaborate with others in digital environments, which of the following statements best describes your behaviour?

- ☐ I can communicate with others using e-mail, chat or Voice over IP (e.g. Skype) I use e-mail to share digital content with others. I am aware of social networking sites and online collaboration tools.
- ☐ I can use advanced features of several communication tools. I use cloud-based tools (e.g. Google Drive, Scribd, Slideshare, Picasa, Flickr) to share content with other people (documents, presentations, photos, videos). I take part in social network sites and online communities in which knowledge, information, contents and/or resources are shared and transferred. I access blogs, micro-blogs, wikis etc.
- ☐ I actively use a wide range of communication tools (e-mail, chat, instant messaging, social networks etc.) for online communication. I use wikis to share my contents and access those prepared by third parties. I take part in training, educational and/or learning events and/or activities, (MOOCs, webinars, live streaming) through collaborative network environments (Moodle, WebCT). For the execution of operational tasks in my personal or professional environment, I use or, on occasions, have used collaborative spaces based on co-working

(3) Content Creation

Learning Goal: Create and edit new content (from word processing to images and video); integrate and re-elaborate previous knowledge and content; produce creative expressions, media outputs and programming; deal with and apply intellectual property rights and licences

Competences:

- To create and edit digital content in different formats.
- To express themselves through digital means.
- To modify, refine, improve and integrate information and content into an existing body of knowledge.
- To create new, original and relevant content and knowledge.
- To understand how copyright and licenses apply to data, information and digital content.

Prior Knowledge Assessment

Question: When you think of the ways in which you produce new content (word processing, images, video etc.) or integrate existing content in digital environments, which of the following statements best describes your behaviour?

- ☐ I can produce simple digital content (e.g. text, tables, images, audio files) in at least one format using digital tools. I can make basic editing to content produced by others. I know

that content can be covered by copyright. I can apply and modify simple functions and settings of software and applications that I use (e.g. change default settings).

- I can produce complex digital content in different formats (e.g. text, tables, images, audio files). I take part in social network sites and online communities in which knowledge, information, contents and/or resources are shared and transferred. I know how to reference and reuse content covered by copyright. I can apply basic formatting (e.g. insert footnotes, charts, tables) to the content I or others have produced.
- I can produce or modify complex, multimedia content in different formats, using a variety of digital platforms, tools and environments. I can create and manage content with collaboration tools (e.g. electronic calendars, project management systems, online proofing, online spreadsheets). I can use tools/editors for creating web page or blog using templates (e.g. WordPress). I have my own blog in which I generate my own content, make it accessible to others, and receive feedback about it.