Proceedings of the 1st European Workshop on Awareness and Reflection in Learning Networks

In conjunction with the 6th European Conference on Technology Enhanced Learning: Towards Ubiquitous Learning

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Awareness and Reflection in Learning Networks

Knowledge is an important resource in today's economy, and significant efforts are being invested in the design and development of learning resources, as well as learning software. Today, computer-mediated networking, exchanging of ideas and research tools be it on the Web, within organisations, learning communities, communities of practice etc. - what we consider a computer-mediated **networked learning environment** - are often essential parts of learning practice. While learners are to a certain degree aware about relations and resources, both of which have a potential to support learning, in these networks, technology can make explicit related resources and activities beyond the individual focus of attention. Additionally, technology can help learners bring knowledge and knowledge needs from their individual learning space into networked environments. For instance, technology can show learners the availability of peers with who to work together on a learning goal, or experts who can be asked in case of need.

Learning in such a networked learning environment has the advantage that learning analytics on artefacts with which the learner has interacted, like communications, topics on which searches have been executed, etc. can be used to create **awareness** on the learner's side of his own activities, social networks, and learning progress, and subsequently the learner is enabled to **reflect** on the basis own memory and perception as well as on collected data. **Learning Networks** (LNs), the online communities in networked learning environments can additionally help participants to develop their skills and competences in often non-formal, unplanned and ad-hoc learning situations and educational contexts.

Traditionally the concept of **awareness** is used in the research field of CSCW to reestablish awareness conditions of face-to-face situations with visual cues showing for example, who is online or working on a document. In the field of perception psychology, awareness is the state or ability to focus on certain stimuli of the environment while ignoring others. Here, being aware of something does not necessarily mean to understand it. In marketing, awareness usually relates to the degree consumers knows about a certain product. Generating public awareness is deemed as a task of the media to establish topics the public should know about.

Also **reflection** has several context-dependent meanings. In educational science, reflection could be seen as a critical, rigorous, and evidence based thinking, often activated by a puzzling (new) situation, involving (re-)thinking and a learning of a new understanding. Here, successful reflection leads to learning. Reflection can be also seen as a psychological process, a way of self-reflection, to inspect a way of thinking and may lead to a deeper understanding of one's learning strengths and weaknesses. In computer science, reflection can refer to the ability of programs to inspect its behaviour to adapt accordingly. The relation between awareness and reflection is that awareness of something may lead to reflection, or inversely, without being aware of something one cannot reflect on it. Especially in our fast-paced, ever dynamic world, where knowledge is a valuable (economic) asset, self-directed and lifelong learning are very important for learners, and for organisations it is important to have members who are able to do that. Through becoming aware of a certain fact, learners can reflect on it and eventually learn something new.

Considering the multitude of views on awareness and reflection one of the questions is what does it mean for Technology Enhanced Learning and how does it relate to Learning Networks? Whilst there are many standards and technical approaches to overcome silo-boundaries of leaning services and tools in terms of re-usability and interoperability, there are hardly any working solutions to enhance awareness and support reflection processes in heterogenous networked learning environments, and to foster participation in learning networks. Furthermore, most of the tools applied were not designed to engage persons in active participation but to consume and absorb information provided. There is a pressing **need to directly support the instrumentation of awareness, and the activation of reflection processes**.

Figure 1: Impression from the workshop

More and more companies, (educational) institutions and research projects in which knowledge and knowledge transfer are the core of the daily business are implementing social media in their organizations. Explicating knowledge and their carrier are key features for learning in networks. With the rise of mobile small screen devices, the prerequisites to be aware of the different dimensions of the context of artefacts, like time, location, environment and relations between artefacts would be available. As Social Media, learning services and mobile Internet grow together, those will be one of the main resources for informal learning. Awareness support for lifelong learners in networked learning environments will help to make sense of the footprints of the usage of social media and mobile environments and will support the reflection about the fast changing dynamics in open research environments. Awareness support about learning activities in general will help

learners identify knowledge that can be integrated in such learning networks, and knowledge needs that can be addressed in such learning networks.

We received 17 submissions, of which 11 were accepted as full papers.

The workshop was held on September 21, 2011. The workshop was organised in four sessions, where in the first three sessions papers were presented and discussed, and in the final session a discussion was held in the plenum.

Theory Papers

The first block of the workshop consisted of papers that consider learning by reflection from a theoretical viewpoint. All papers, coincidentally, focus especially on learning by reflection in the workplace, albeit from very different perspectives.

The first paper, Balzert et al., Enhancement of traditional Business Process Management with reflection - a new perspective for Organisational Learning?, investigates, how an organisation can fulfill the requirement and necessity to continuously "learn", i.e. to further professional development of their employees and adapt their business processes. The authors work by relating the existing body of literature in the fields of business process management, reflection and reflective learning, and organisational learning. Based on this analysis, the authors identify the potential of learning by reflection in all phases of business process management. Especially, they identify the potential of learning by reflection in both top-down driven phases like designing and implementing business processes and in bottom-up driven phases like executing and improving business processes[1].

The second paper, Kump et al., The Role of Reflection in Maturing Organizational Know-how, starts off from the premise that both individual and collaborative reflection are necessary for organisational learning. In contrast to the previous paper, the authors thus focus on bottom-up driven processes of organisational learning. The analysis is based on an explorative interview study, as well as on existing models of knowledge maturing and of learning by reflection. As one of the outcomes, the authors postulate that in dependance of the level of maturity of the topic of reflection, reflection has the potential to rather create shared knowledge (e.g., best practices) or to modify existing knowledge (e.g., standardised processes)[2].

The third paper, Pammer et al., Reflective Learning at Work - A Position and Discussion Paper, collects state-of-the-art of existing literature on learning by reflection in the light of work-related learning, postulates addendums and identifies open issues for future work. In particular, the authors discuss the reflection process, the scope of reflection, the context of reflection, and the role of tools for reflection. They identify the areas of making reflection theory applicable in work context, investigating the interrelationship between individual, collaborative and organisational learning by reflection, and providing technical support for learning by reflection as focal points for future research.

[1] A recording of the talk can be found at `http://minus.com/mq2oAiYKx`
[2] A recording of the talk can be found at `http://minus.com/miUiqbw3e`

The fourth paper, Prilla et al., Computer Support for Collaborative Reflection on Captured Teamwork Data, delves into the question of which technological support is required for collaborative reflection on teamwork. The authors base their analysis on existing literature and illustrate the potential of collaborative reflection at work by means of an observed team learning scenario. The authors conclude that technical systems that strive to support collaborative reflection at work need to provide articulation support, scaffolding and reflection guidance, and synergy support for deriving meaningful insights from experiences[3].

Empirical Papers

The last block of the workshop consisted of papers that deal particularly with self reflection in online learning networks. They presented, from an empirical point of view, new tools or approaches to support self reflection and some (initial) experience with the tools.

In the opening paper of this block, Fetter, Berlanga & Sloep in their contribution Ad hoc transient groups: Instruments for Awareness in Learning Networks, argue that Learning Networks need to be have mechanisms to support awareness, so participants can better share and jointly develop new knowledge. The authors propose a peer-support mechanism called Ad Hoc Transient Groups (AHTGs), through which participants who have a question can be connected to and helped by other members with relevant experience in the area. In the authors' view this mechanisms has the potential to improve collaboration, sense of connectedness and social capital of the participants in the Learning Network. Authors present an initial version of an AHTG tool, and results from its validation with stakeholders. Finally, authors argue that new areas of research in Learning Networks should include new ways of encourage people to recognize the value of their Personal Learning Networks for their professional activities and development[4].

Verpoorten, Westera & Specht in their contribution Annotations as reflection amplifiers in formal online learning, argue that reflection triggers offer opportunities for learners to examine and evaluate their own learning. They report results from a controlled experiment in an online course about the effects of three types of triggers: (1) learners receive information of their performance against to a yardstick (e.g., peer); (2) learners rate their mastering of the content, and (3) learners are asked to write down their learning experience. Results show that experimental groups reported significantly more reflective prompting and more intensive reflection than those participants in the control group. In contrast, however, no positive effects on learner performance and retention could be established. The authors, consequently, recommend that empirical studies document the nature of the thoughts and of the learning context induced by reflection triggers.

Finally, Krajagopal, Verjans, Van Bruggen & Sloep in their paper, Stimulating reflection through engagement in social relationships, argue that reflection on one's own behaviour and practice is triggered by social interactions. To engage in these social interactions there are skills, such as professional networking and intercultural literacy, that are needed but

[3] A recording of the talk can be found at `http://minus.com/m4NxiLAVB`
[4] A recording of the talk can be found at `http://minus.com/mH3u4XUSr`

often not considered. Then the authors describe the prerequisites of learning from these social interactions and the possibilities of technological support. Finally, they present a tool which supports intercultural communicative competence building. The tool combines individual performance, individual refection together with guided and controlled social feedback on an individual's performance[5].

Application Papers

Reinhardt, Messerschmidt, & Nelkner present a mobile tool for awareness enhancements in the context of Research 2.0. In their paper "Awareness support in Scientific Events with SETapp". SETapp stands for the Scientific Event Tracker Application, which makes use of Near Field Communication (NFC) technology. The tool targets researchers to support them during a scientific event in sharing profile data, publication data, and past and future event information[6].

Affective Metacognitive Scaffolding for the Enhancement of Experiential Training for Adult Learners by Moore et al. explores the challenge of connecting simulated learning experiences, such as job interview simulators, to real world practice. This connection will provide the learner with an augmented learning experience that exercises their metacognitive skills and informs their affective state. Through scaffolding and supporting the learner's metacognition and providing affective feedback this work aims to offer a scrutable, contextually aware and knowledge-enhanced experience that will give the learner the best opportunity to apply what they have learned effectively[7].

The "ART (Analogical ReflectionTool): using analogies to promote reflection in science education" contribution by Kritikos and Dimitracopoulou, presents a tool which aims to support analogical reasoning and to help students to reflect on these analogies. Therefore, the tool scaffolds users with their reflections on the source domain to enable them a better understanding of the unfamiliar target domain.

Ullmann's paper on "An Architecture for the Automated Detection of Textual Indicators of Reflection" presents a software architecture for the automated detection of reflection cues in written texts. The papers outlines facets of reflection and demonstrates on three elements of reflection - reflective keywords, premise and conclusion argumentation, and though provoking questions - the automated detection of reflection indicators[8].

You can find more information about the workshop and related workshops at the "Awareness and Reflection in Technology-Enhanced Learning" group on TELeurope.eu:
`http://teleurope.eu/artel`

We want to use this opportunity to thank the authors for their contributions and the program committee for their support and reviewing activity.

[5] A recording of the talk can be found at `http://minus.com/mbi65h2NNQ`
[6] A recording of the talk can be found at `http://minus.com/mSmssmeZ9`
[7] A recording of the talk can be found at `http://minus.com/mwaFc0W0I`
[8] A recording of the talk can be found at `http://minus.com/mWzoOPMwY`

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Figure 2: Parts of the organizing committee of the #ARNets11workshop (from the left to the right: Thomas Ullmann, Adriana Berlanga, Wolfgang Reinhardt, Owen Conlan)

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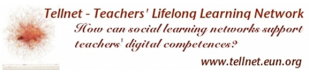

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Theory

Enhancement of traditional Business Process Management with reflection – a new perspective for Organisational Learning?

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Abstract. The successful management of learning and knowledge has become a critical success factor for organisations in today's knowledge-intensive business world. However, the question remains how an organisation should act and react in order to fulfill this management task. A common answer to the question is that organisations need employees who have the experience and knowledge to perform their work productively. A prerequisite for such employees is a continuous professional development however. In this context, formal learning methods alone are insufficient because of their long preparation time and their separation from daily working routines. What is needed is a kind of "real-time-learning", enabling individuals and also organisations to react on changing requirements and conditions in an adequate manner. In order to converge to such a "real-time" organisational learning, this paper proposes a model, enhancing traditional, top-down focused Business Process Management approaches with insights from reflection and reflective learning theory respectively.

Keywords: Business Process Management, reflection, reflective learning, organisational learning

1 Introduction

Triggered by a continuously changing business environment and major technological developments, an intensive discussion of process-oriented management approaches takes place in academic literature as well as in practice for almost 20 years now. Based on fundamental contributions of Davenport [1], Hammer and Champy [2] and Scheer [3], a variety of articles and books dealing with the topic of Business Process Management (BPM) have been published in the meantime. However, this literature holds a very "mechanistic" view, focusing on top-down specified business processes and the resources needed for their execution. Such a perspective disregards the

contribution of the individual employee, whose skills, experiences and knowledge influence the value added through a business process significantly.

In general, the successful management of learning and knowledge has become a critical success factor for organisations in today's knowledge-intensive business world. Back in 1996 already, Argyris and Schön precisely described some requirements for (learning) organisations, which are still up-to-date nowadays: "it is conventional wisdom that business firms […] need to adapt to changing environments, draw lessons from past successes and failures, detect and correct the errors of the past, anticipate and respond to impeding threats, […] build and realize images of a desirable future." [4] However, the question remains how an organisation should act and react in order to fulfill these requirements.

A common answer to this question is that organisations need employees who have the experience and knowledge to cope with such requirements and perform their work productively. Nonetheless, a continuous professional development including learning processes to acquire knowledge [5] is needed to maintain such capabilities over time. In these situations, formal learning methods alone are insufficient because of their long preparation time and their separation from daily working routines. What is needed is a kind of "real-time-learning" to enable individuals and also organisations to react on changing requirements and conditions in time and in an adequate manner.

In order to converge to such a "real-time" organisational learning, the authors of this paper propose a model to enhance traditional, top-down focused BPM approaches with insights from reflection and reflective learning theory respectively (section 3). This model is based on theoretical results from the research areas of BPM, reflection and reflective learning as well as organisational learning as presented in section 2. The paper closes with a discussion of the conceptual model (section 4) and a conclusion of the work presented herein (section 5).

2 Theoretical background

2.1 Business Process Management

A process oriented design of organisations has been discussed in research and practice since the mid-nineties. Triggered by a rapidly changing business environment and technical innovations, organisations are forced to reconsider their own market position and the related business operations continually [6]. In such business environments, competitive advantages can only be achieved by those companies which are able to adapt their business operations to their own growth and changing conditions in a fast and flexible manner. In this context, BPM is seen as a key concept to provide the necessary flexibility and adaptability [7].

In general, two main concepts of BPM can be distinguished, (1) the concept of Business Process Reengineering (BPR), which postulates a radical redesign of business processes [2] and (2) the concept of Continuous Process Improvement (CPI), focussing on more sustainable, evolutionary improvement of business processes over time. Meanwhile, the continuous improvement of business processes

is often seen as a more promising approach for the implementation of a successful and sustainable business strategy [8], because existing structures in organisations can not be simply changed or dismissed without further implications. Typically, the CPI approach is conceptualized in a BPM lifecycle, consisting of several phases. The classification and description of these phases can vary depending on the respective author. However, Houy, Fettke and Loos [9] subsume a set of aspects, which are generally incorporated in the different BPM lifecycle concepts. These aspects are visualized as different phases of a BPM-Lifecycle in Fig. 1. In compliance with these aspects and according to a definition provided by van der Aalst, Hofstede and Weske [10], BPM in this paper is understood as a set of methods, techniques and software tools which support the design, implementation, execution, control and analysis of business processes aiming to enable an optimized value creation. According to Scheer [11], a business process is defined as a sequence of executions in a business context in order to create goods or services.

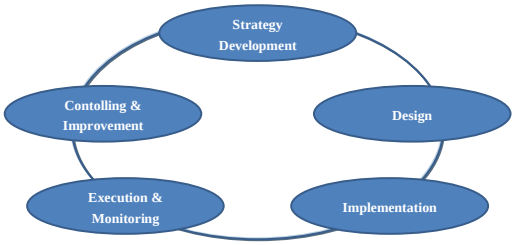

Fig. 1: BPM-Lifecycle (adapted from [9])

Current literature in the area of BPM predominantly holds a very "mechanistic" view, focusing on top-down specified business processes and the resources needed for their execution. As Vanderhaeghen, Fettke and Loos [12] point out however, human task managers usually have a certain scope of discretion while dealing with specific tasks which is not fully representable in predefined business process models. As a consequence, such a "traditional" BPM perspective neglects the contribution of the individual employee, whose skills, experience and knowledge influence the value added through a business process significantly.

2.2 Reflection and Reflective Learning

While studying the literature about reflection, it becomes obvious that this term is an interdisciplinary topic. Accordingly, many sources emanating from partially different disciplines like philosophy, psychology and education exist, with little integration of the respective concepts. As a consequence, reflection can be seen as a generic term, incorporating many ideas [14] and therefore needs to be defined in relation to the respective scope of its use.

In 1933, John Dewey [15] presented his view of reflection which strongly influenced the work of many other authors and determined their ideas and approaches of reflection [14]. He associated reflection with thinking by considering

the skills necessary to manipulate knowledge in order to revise it for a certain purpose. The starting point for the reflective activity he described is a state of doubt or uncertainty guiding the reflective process [13]. According to Dewey, reflective thinking is an "active, persistent, and careful consideration of any belief or supposed form of knowledge in the light of the grounds that support it, and the further conclusions to which it tends"[15].

In management development, experiential learning is considered the dominant theory nowadays [16]. L*earning* in this context is defined as a *process of knowledge creation through transformation of experience* [18]. The development of experiential learning theory was stimulated by a publication of Kolb [13], where he introduced a model well-known as the experiential learning cycle [19]. "Immediate or concrete experiences are the basis for observations and reflections. These reflections are assimilated and distilled into abstract concepts from which new implications for action can be drawn" [18]. Although Kolb identified reflection as an important component of learning from experience, he did not discuss in detail what is meant by this component he called "Reflective Observation" [14].

In contrast to Kolb's work, other authors focus more precisely on the process of reflection in experiential learning (for examples see [13]). The theoretical assumptions guiding the understanding of the reflective process in this paper can be traced back to a model introduced by Boud, Keogh and Walker in 1985 [20]. This model is focused on experience-based, deliberate learning, *presuming a learner* who *intends to learn* in order to *achieve a specific goal*. Reflection in this context "is an important human activity in which people recapture their experience, think about it, mull it over and evaluate it."[20] Fig. 2 indicates the three main elements of the Boud, Keogh and Walker reflection model. The left circle represents the total *experience* of a learner as the subject of reflection. The *reflective process* indicated in the central circle can be composed of three main elements. (1) Returning to experience means remembering outstanding events, repeating the initial experience in the learner's mind and sharing characteristics of the experience with others. (2) Attending to feelings is divided into the utilization of positive feelings, which means to focus on successful learning situations as well as positive experiences, and removing obstructive feelings in order to enable a more rational examination of events. The most important part of the reflective process is the (3) re-evaluation of experiences however. The learner reconsiders the experience according to the specific intention, combines new and already processed knowledge and finally integrates this knowledge into his conceptual frame of reference. The possible *outcomes* of this reflective process may include new perspectives on experience, a change in behavior, the readiness for application or a commitment to action.

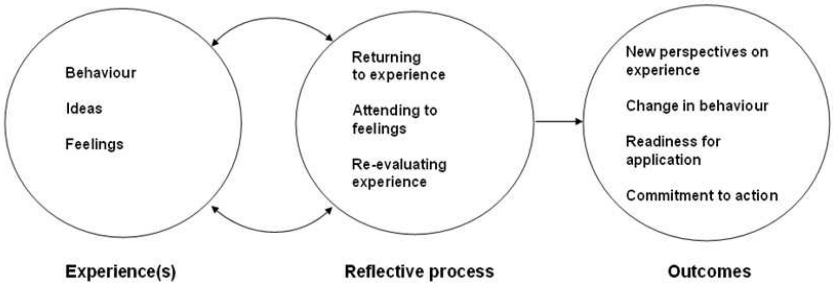

Fig. 2: The reflection process in context (based on [20])

2.3 Organisational Learning

Since its emergence, the concept of organisational learning (and the related concept of the learning organisation) has been widely discussed and studied by various academic disciplines like psychology, organisation theory or management sciences. As a consequence, many different approaches exist in the meantime with little integration of the corresponding concepts or models [21].

Lehner [22] provides a sound overview on important representatives and approaches of organisational learning, highlighting three main concepts which strongly influenced existing theory in this research area. The first one is an organisational learning cycle proposed by March and Olson [23], aiming at the explanation of learning deficiencies. The second one is a conceptualisation of organisational learning processes provided by Argyris and Schön [24], identifying two elementary forms of organisational learning processes: (1) the so-called single-loop learning, consisting in problem-solving without changing the underlying basic assumptions (so-called theory-in-use) and (2) double-loop learning including a critical analysis of these basic assumptions. Last but not least, Senge [25] developed five fundamental requirements (which he called disciplines[1]) necessary for the development of a learning organisation.

Further insights in this multifaceted topic can be gained by falling back on existing literature reviews. In 1993, Dodgson [26] examined some literature in order to gain insights in (1) the goals of organisational learning, (2) the learning process in organisations and (3) ways to facilitate or impede organisational learning. Relating to the goals (1), Dodgson concludes that organisational learning is just an attempt of adjustment to a competitive and fast-changing environment (i.e. the business world) in order to ensure the survival of the organisation. In summary, this author came to the conclusion that organisational learning aims at adequately dealing with situations of uncertainty and that "learning occurs throughout the activities of the firm" [26] in this context.

Based on very similar questions, Lähteenmäki, Toivonen and Mattila [21] presented the results of their extensive literature review in the British Journal of Management in 2001. However, their work was focused primarily on the

[1] These disciplines are personal mastery, mental models, shared visions, team learning and systems thinking.

identification of several gaps in existing research and the introduction of a set of measures for organisational learning derived from a single case study. The first gap identified was that existing research emphasizes the learning of individuals too much instead of concentrating on the learning of organisations. Apart from this learning subject viewpoint, these authors also conclude a lack of conceptualization concerning the actual translation of learning by individuals into the learning of organisations. After their literature review, they came to the conclusion that existing research is insufficient to develop a holistic model for organisational learning and that despite of many similarities between the two perspectives, existing models ignore the change management theory almost completely. Vice versa, in change management literature, the concept of organisational learning is often included implicitly but not really defined.

In 2003, Wang and Ahmed [27] introduced five focuses of the organisational learning concept[2] which were also identified through an extensive literature review. Of special interest for this paper are the second, fourth and fifth focus. The second one "Process or System" is emanating from the information processing perspective which declares organisations as systems for information processing. The process to manage the experiences of an organisation is interpreted as organisational learning in this context. In recent literature, the fourth focus of "Knowledge Management" became very popular, understanding organisational learning as a change in the state of knowledge. In this context, Nonaka and Takeuchi [29] provided a link between organisational learning and knowledge creation through their well-known model, describing the process to transfer knowledge among different levels. The fifth focus, called "Continuous improvement and incremental innovation" has the intention to correlate process improvement and organisational learning, assuming that incremental innovation composes the learning organisation. Wang and Ahmed [27] conclude from their literature review that current organisational learning approaches are focussed on system thinking, problem-solving and information-processing which results in a mere incremental improvement. "In hyperdynamic business contexts, organisation learning is the process by which the organisation constantly questions existing product, process and system […] to achieve sustained competitive advantage" [27]. However, these authors do not describe, how their idea could be operationalised.

Actually, an organisation learns on a number of levels, ranging from the individual over the team to a company-wide level, and in addition to this internal point of view, also to an inter-organisational level [28]. The question remains however, how to distinguish this learning from mere individual or team-based learning without further implications for the organisation (for a similar argumentation see Argyris and Schön [4], p. 17-18 for example). In this paper we follow the approach of Argyris and Schön, understanding organisational learning as "an organization's improvement of its task performance over time" including the "learning to change the values that define 'improvement'" [4]. In this context "organisational learning occurs when individuals within an organisation experience a problematic situation and inquire into

[2] These focuses are called Collectivity of individual learning, Process or System, Culture and Metaphor, Knowledge Management and Continuous improvement and incremental innovation

it on the organization's behalf. […] In order to become organisational, the learning that results from organisational inquiry must become embedded in the images of organization held in its members' minds and/or in epistemological artefacts (the maps, memories, and programs) embedded in the organisational environment" [4].

3 "Real-time" Organisational Learning – a conceptual model to intertwine BPM and Reflective Learning theory

3.1 The conceptual model – two different perspectives

As already mentioned in the introduction, organisations have to cope with a rapidly changing business environment nowadays. Therefore, it is very important to constantly enable and support the development and proficiency of their employees. The question is however, how this task can be performed by and for the benefit of an organisation. In general, two different approaches to answer these questions do exist in literature [30]. On the one hand, the problem is regarded from a management perspective, stressing the importance of activities like strategic planning and controlling as well as competence management in order to provide a kind of framework for the daily working environment of the individual employee. On the other hand, there is the perspective of early literature on organisational learning (e.g. [23]), building on the understanding that only individuals can acquire specific skills and knowledge. In this context, organisational learning does occur if the individual is learning and acting on behalf of the organisation [31].

Accordingly, we distinguish in our conceptual model (see Fig. 3), if reflection in the context of BPM leads to a top-down process or a bottom-up process of organisational learning. The bottom-up approach is characterized through the (self-) development of the individual employee, assuming that enhanced individual performance contributes to a better mode of operation within the organisation [32]. However, the experiences concerning the individual performance enhancement must also be communicated within the organisation to contribute to the organisational knowledge base. Accordingly, the learning results have to be embedded into employee's minds and/or in organisational artifacts to become organisational. From our point of view, this embedment takes place through the integration of the learning results into daily business processes and the enclosed working routines and tasks.

However, this bottom-up (individual) perspective is insufficient to explain a target-oriented development of an organisation over time. What is missing are reference functions guiding private adjustments, for example if comparing individual performance and its contribution to the favored performance of the organisation. "Such reference functions are fulfilled by organisational maps, memories and programs" [4], which incorporate work flow diagrams, data bases and procedural specifications of organisational routines for example. Due to the fact that such organisation-wide references can only be created or adapted if harmonized with top-management directives, the authors consider this kind of organisational learning as a top-down approach. The interrelation of these two approaches and the contribution of reflection theory to this model will be explained in the next subsections.

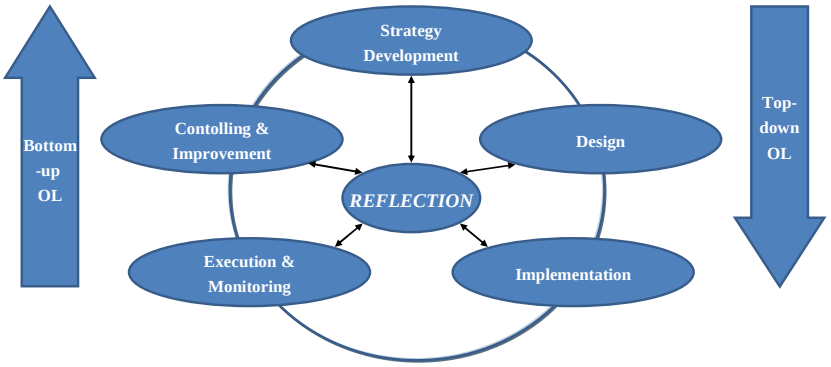

Fig. 3: A conceptual model to intertwine BPM and reflective learning theory

3.2 Top-down Organisational Learning - from Strategy Development to the Implementation of business processes

The challenge in the *Strategy Development* phase of the BPM-Lifecycle (cp. section 2.1) is to align the defined corporate strategy with the (core) business processes of the organisation. Strategy definition is generally top management responsibility. In this context, the management board can reflect systematically on own or others' experiences in order to attain new perspectives or the readiness for strategic decision making (cp. the reflection process as indicated in section 2.2). Reflective learning in this context is initially restricted to the members of the management board. However, the results and implications of the reflection and strategic decision making process need to be established on all levels of an organisation, because the implementation of the defined corporate strategy will fail on the operational level otherwise.

The *Design* phase incorporates two main tasks, the identification and documentation of already existing business processes (as-is-analysis) [33] and the design of favored, future business process models (target processes to-be) [34]. The process of model design is an appropriate activity for reflection. The model designer can re-evaluate systematically his own and others' experiences in order to find new perspectives on and improvement potentials for the respective business process. Furthermore, it is also possible that the model designer starts to reflect while designing a business process, because s/he is confronted with an unexpected situation or problem incidentally. In this context, reflective learning occurs on the individual level of the process designer initially. However, if the improved business processes are implemented in the organisation, every employee contributing work tasks to these business processes as well as the whole organisation can benefit from these improved models. With regard to the concrete work tasks of employees, the improved process models can be seen as a top-down specification of individual working procedures.

After the design of business processes is finished, these processes need to be *implemented* within the organisation in order to execute them in day-to-day business. Reflection in this context can help the organisation to prepare for a smooth integration of the designed business processes into daily working routines. By re-evaluating past experiences systematically, e.g. about already occurred problems

while transforming process models into more technical models executable in information systems, some implementation obstacles may be prevented. Furthermore, it could also be very beneficial to anticipate possible future circumstances which might influence or even prohibit the implementation of business processes (e.g. restrictions due to laws, etc.). *The implementation* of business processes is the continuation of the *Design phase* activities, assuring the actual incorporation of the top-down specified working procedures into the organisation. Therefore, also these activities conducted during the Implementation phase of the BPM lifecycle contribute to a top-down approach of organisational learning.

3.3 Bottom-up Organisational Learning – from process Execution to process Improvement

Once the business processes are implemented into the organisation, they can be *executed* in daily business. Depending on the available IT systems and the respective level of automation, this execution can be monitored, for example by examining the work progress regularly. Concerning the execution of business processes, two possibilities for reflection can be identified. On the one hand, an employee can reflect on his everyday thinking and acting while executing business processes in order to evaluate and improve the daily working routines. On the other hand, it is also possible to re-evaluate others' experiences systematically, aiming to improve the own way of executing business processes. As mentioned above, it is also possible to monitor current business processes in progress. In this context, deviations from normal conditions and exceptional circumstances should be disclosed as soon as possible in order to enable the employee executing or monitoring the respective business process to react directly and in an adequate manner. Reflection on this current (maybe incidental) experience can help an employee to cope with such incidents and unexpected events by evaluating appropriate reactions. From a learning point of view, the reflective processes described above lead primarily to a learning of the individual employee. However, by communicating concrete results and improvement potentials concerning specific business processes, this individual learning can be transferred to the organisational level. Accordingly, the described learning activities in the Execution & Monitoring phase of the BPM lifecycle can be classified as bottom-up organisational learning.

The *Controlling & Improvement* phase of the BPM-lifecycle deals with the analysis of aggregated data about multiple, already completed process instances [35]. For this analysis, it is necessary to gather and aggregate information about the respective processes. Afterwards, deviations between actual and favored performance parameters can be analyzed in order to identify improvement potentials. While analysing and interpreting aggregated process data, a process manager or owner can reflect systematically about these past experiences in order to gain new insights on current working routines and develop some alternatives to change organisational business processes and behaviour subsequently. Graphical representations of relevant information about the finished business processes (e.g. diagrams and dashboards) can support the reflective process reasonably. Organisational learning in this context occurs on an individual level (process owner or manager) initially, based on the

experiences from many executed process instances and the respective employees involved in these business processes. However, this individual learning can be transferred to the organisational level while discussing and considering the underlying improvement potentials in the next *Strategy Development* and *Design* phase of the BPM lifecycle respectively, thereby closing the loop between the bottom-up and the top-down approach of organisational learning.

4 Discussion of the model

The authors consider BPM and its possible interrelation with reflective learning theory as a very promising approach to support organisational learning for several reasons. As already outlined in section 2.3, organisational learning in this paper is defined as the improvement of an organisation's task performance over time, including the learning to change the values that define 'improvement'. The tasks within an organisation can be broken down to individual work steps which, in their collectivity constitute the business processes of this organisation. Thus, every work step can be interpreted as a part of a business process since it has a specific output. Learning processes in this context occur, if individuals, teams or whole organisations - represented by their decision-makers - reflect about single and several work steps respectively as well as whole business processes and their interdependencies in order to improve them. Improvement in this context means an optimized value creation in accordance with the organisations' objectives. Accordingly, the BPM approach is seen as key concept to provide the necessary flexibility and adaptability to achieve competitive advantages which are required to adjust to a competitive and fast-changing environment in order to ensure the survival of the organisation, which is the main idea behind the concept of organisational learning (cp. section 2.3)
Another shortcoming mentioned in the context of existing organisational learning theory was that it emphasizes the learning of individuals instead of concentrating on the learning of organisations. Most approaches just transfer methods and concepts of individual learning to the organisational level. Accordingly, there is a lack of conceptualization stated concerning the actual translation of learning by individuals into the learning of organisations (cp. section 2.3). The conceptual model presented in this paper is based on solid results of BPM research. BPM as a management approach is strongly focussed on an organisational point of view. However, "traditional" BPM approaches often neglect the contribution of the individual employee, whose skills, experience and knowledge influence the value added through a business process significantly (cp. Section 2.1). Accordingly, the authors propose to support also the so-called bottom-up organisational learning approach in order to utilize the innovation potential of the individual employee thereby complementing the 'traditional' top-down approach of BPM. Furthermore, this view also fits to another implication derived from organisational learning research, stating that there is a constant interaction between individual and organisational learning processes. The learning process at an organisational level can be seen as structural changes which in turn affect the individual level and the subsequent individual learning processes. These structural changes are implemented via the Design and

Implementation phase of the BPM lifecycle into the organisation through modified business processes as explained in section 3.2.

Furthermore, it was mentioned that continuous improvement is a prerequisite for organisational learning and that incremental changes need to be complemented by more radical innovations in order to achieve sustained competitive advantage of an organisation over time (cp. section 2.3). By constantly questioning products, processes and systems, such innovations should be enabled. The conceptual model presented in this paper enables such a continuous improvement of (business) processes and systems over time by repeatedly passing through the BPM lifecycle and utilizing the concept of reflection to re-evaluate (”questioning”) own and others experiences in the different phases. Furthermore, the CPI approach does not exclude the BPR approach (cp. section 2.1) which can be used to implement more radical changes in an organisation if feasible and necessary.

Last but not least, it was stated in section 2.3 that learning results have to be embedded into its member’s minds and/or in organisational artifacts in order to become organisational. From our point of view, this embedment takes place through the integration of the learning results into daily business processes and the enclosed working routines and tasks. Due to the fact that such organisation-wide references can only be created or adapted if harmonized with top-management directives, this point of view is defined as top-down approach of organisational learning in the conceptual model presented - the documented business process models are such organisational artifacts actually.

5 Summary and Conclusion

In this paper, a conceptual model to enhance traditional, top-down focused BPM approaches with insights from reflection and reflective learning theory is presented in order to converge to a kind of “real-time” organisational learning. Based on theoretical findings from the respective research areas, possibilities for reflective learning with regard to different phases of a BPM-lifecycle are discussed. Furthermore it is explained how these reflective activities can contribute to organisational learning – either from a top-down or from a bottom-up perspective.

The authors consider BPM and its possible interrelation with reflective learning theory as a very promising approach to support organisational learning, because re-evaluating (”questioning”) own and others experiences with regard to business processes facilitates innovations in as well as a continuous improvement of organisations. While traditional BPM literature holds a more “mechanistic” view, focusing on top-down specified business processes and the resources needed for their execution thereby disregarding the contribution of the individual employee, the model proposed in this paper explicitly addresses also the bottom-up perspective of organisational learning, trying to utilize individual skills, experiences and knowledge to influence the value added through a business process.

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The Role of Reflection in Maturing Organizational Know-how

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Abstract. The Knowledge Maturing Phase Model has been presented as a model aligning knowledge management and organizational learning. The core argument underlying the present paper is that maturing organizational know-how requires individual and collaborative reflection at work. We present an explorative interview study that analyzes reflection at the workplace in four organizations in different European countries. Our qualitative findings suggest that reflection is not equally self-evident in different settings. A deeper analysis of the findings leads to the hypothesis that different levels of maturity of processes come along with different expectations towards the workers with regard to compliance and flexibility, and to different ways of how learning at work takes place. Furthermore, reflection in situations where the processes are in early maturing phases seems to lead to consolidation of best practice, while reflection in situations where processes are highly standardized may lead to a modification of these standard processes. Therefore, in order to support the maturing of organizational know-how by providing reflection support, one should take into account the degree of standardisation of the processes in the target group.

Keywords: reflection, knowledge maturing, organizational learning

1 Introduction

Organizational learning has been investigated in various disciplines (e.g., [1]), and from various angles (for overviews see [2], [3]). Researchers from the field of cognitive psychology have provided conceptualizations of the complex interplay between individual and collaborative knowledge creation and learning, putting different concepts in the centre of attention such as the conversion between tacit and explicit knowledge [4], the mutual dependencies between individual and shared mental models [5], and the co-evolution of individual and organizational knowledge mediated through shared artefacts [6]. A more recent theory of organizational learning and knowledge evolution that strongly focuses on socio-technical interactions is the Knowledge Maturing Model suggested by Schmidt [7] and further developed in the course of the MATURE Project (e.g. [8]). Knowledge Maturing is defined as goal-oriented learning on a collective level, emphasizing that it is always purposeful.

When we consider that an organization's knowledge stock is 'mirrored' in its work practice, and organizational practice is one of the main knowledge repositories of an organization, organizational learning might then be understood as any *change in organizational work practice* (including change of existing work practices or the development of new work practices respectively). While the Knowledge Maturing Model also relates to the evolution of conceptual or factual knowledge, we will focus on knowledge maturing related to change of 'know-how' (i.e. procedural knowledge) [9]. This process shall be called *task-centred organizational knowledge maturing*.

Creation of new knowledge is often triggered by changes in an organization's environment that puts new demands. However, it is stressed in the literature that organizational learning is more than just the adaptation to environmental changes but includes *deliberate reflection* on daily work practice and transformation of organizational routines (e.g., [3]). In line with Hoyrup [10] and Järvinen & Poikela [11], we argue that reflection is one of the major mechanisms that lead to maturing of organizational know-how. While the Knowledge Maturing Model implicitly covers aspects of reflection, it does not provide a comprehensive theoretical rationale on how reflection and knowledge maturing are interrelated. The aim of this paper is to examine the relationship of reflection at work and its role for task-centred organizational knowledge maturing. Moreover, we will examine reflection in settings with different levels of maturity of organizational know-how based on data from an interview study in four European organizations. This will be the first step to integrate work from two large-scale EU projects in the TEL community, namely MATURE and MIRROR.

In the following, we outline the Knowledge Maturing Model developed within the context of MATURE, before explaining the specific role of reflection for organizational learning. We then present the major findings from our interview study that examined the interrelationship of reflection and knowledge maturing. Finally, we present our integrative model linking knowledge maturing and reflection.

2 The Knowledge Maturing Model of Organisational Learning

The development of the Knowledge Maturing Model of organizational learning started several years ago by the joint interpretation of empirical evidence gained in several applied research projects; the first version of the model [7] was refined in [8] by incorporating results from a large empirical study (described in [12]) as well as further experience gained in projects on implementing tools for knowledge management and organizational learning. The model was then subjected to a series of three empirical studies, an ethnographically-informed study, a representative empirical study, and an in-depth study conducted within the MATURE project. A comprehensive description of the Knowledge Maturing Model can be found in [13].

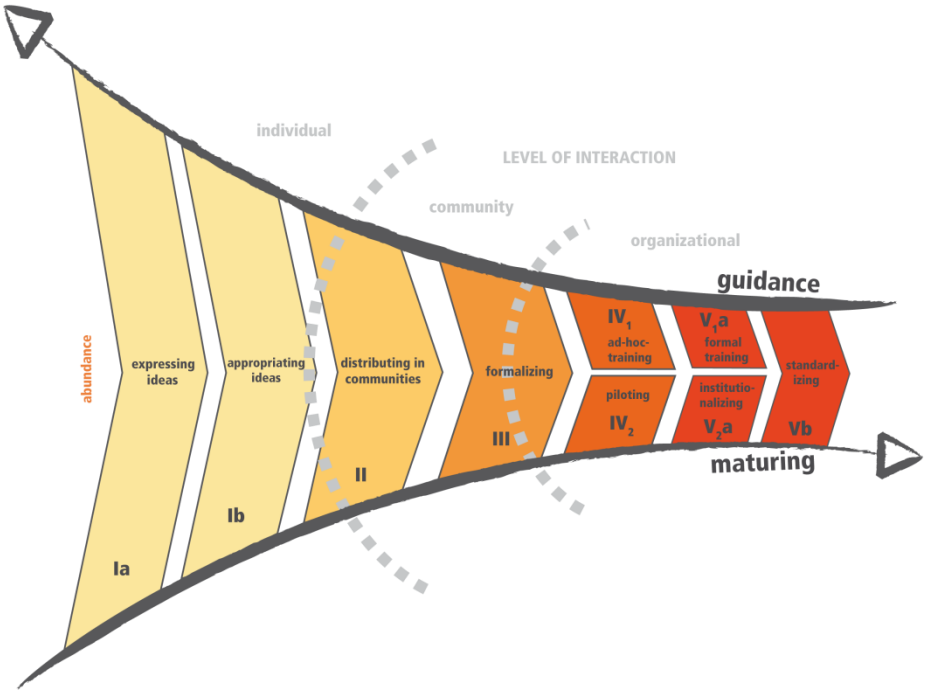

Fig. 1: Knowledge Maturing Model v.3, [14]

The Knowledge Maturing Model outlines the following phases (see Fig.1):

Ia. Expressing ideas (investigation): New ideas are developed by individuals either in informal discussions or by 'browsing' the knowledge available within the organization and beyond. Extensive search and retrieval activities result in loads of materials facilitating idea generation. Knowledge at this stage is subjective, deeply embedded in the originator's context, and the vocabulary used for communication might be vague and restricted to the originator.

Ib. Appropriating ideas (individuation): New ideas that have been enriched, refined, or otherwise contextualized with respect to their use are now duly

appropriated by the individual. Contributions are 'bookmarked' so that an individual can benefit from its future (re-)use.

II. Distributing in communities (community interaction): This phase is driven by social motives such as belonging to a preferred social group or the expectation of reciprocal knowledge exchange within the community. A common terminology for individual contributions is developed and shared among community members.

III. Formalising (information): Artefacts created in the preceding phases are often unstructured and still embedded in the community context. They are only comprehensible for people in this community as shared knowledge is still needed for interpretation. In Phase III, structured documents are created in which knowledge is de-subjectified, and context is explicated with the purpose to ease the transfer to collectives other than the originating community.

From Phase IV on, there are two alternative paths of knowledge maturing:

IV_1. Ad-hoc training (instruction): Activities related to creating training materials out of documents that are typically not suited as learning material as they lack didactical considerations. Topics are refined to ease teaching, consumption, or re-use. Learning objects are arranged to cover a broader subject area. Tests help assess the knowledge level and select learning objects or paths. Knowledge can be used for formal training in Phase *V (*V_1*a. Formal training (instruction))*. The subject area becomes teachable to novices. A curriculum integrates learning content into a sequence using sophisticated didactical concepts to guide learners in their learning process. Learning modules and courses can be combined into programs used to prepare for taking over a new role, for example.

IV_2. Piloting (implementation): Experiences are deliberately collected with a test case stressing pragmatic action trying a solution before a larger roll-out of a product or service to an external target community, or new rules, procedures, or processes to an internal target community such as project teams or other organizational units. Know-how can be institutionalized at the beginning of Phase *V*.

V_2a. Institutionalising (introduction): In the organization-internal case, formalized documents that have been learned by knowledge workers are solidified and implemented into the organizational infrastructure in the form of business rules, processes or standard operating procedures. In the organization-external case, products or services are launched on the market.

Vb. Standardising (incorporation): This latest phase covers standardization or certification. Certificates confirm that participants of formal trainings achieved a certain degree of proficiency or justify compliance with a set of rules that organizations have agreed to fulfil. Standards also help connecting products or services or showing that they fulfil laws or recommendations before being offered on a certain market.

To summarize, so far we have explained (1) the Knowledge Maturing Model that describes how knowledge is becoming more 'mature', i.e. more justified, understandable, committed, legitimated, teachable, or even standardized. Furthermore, in our view, (2) knowledge maturing was introduced as a type of organizational learning, and (3) task-centred knowledge maturing is considered to be a process leading to more justified, understood, committed, legitimated, or even standardized organizational processes. In the following, we argue that reflection on work practice is an effective mechanism for maturing organizational know-how.

3 Reflection Processes in Task-centred Knowledge Maturing

Reflection on one's own work practice is crucial for learning at work as it leads to a better understanding of own work practice and can guide future behaviour [11], [15]. Thus, reflecting on past experiences is an effective mechanism for individual and collaborative learning [16], [17] and knowledge maturing in the early phases of the Knowledge Maturing Model.

Theoretical work in the field of reflection can be traced back to Dewey's 'reflective thinking' [16], defined as "active, persistent, and careful consideration of any belief or supposed form of knowledge in the light of the grounds that support it and the further conclusions to which it tends [that] includes a conscious and voluntary effort to establish belief upon a firm basis of evidence and rationality." (p. 118). We further base our work on Boud et al. ([18], p.19) who extend Dewey's conceptualization adding the notion of *learning* through reflection: "Reflection in the context of learning is a generic term for those intellectual and affective activities in which individuals engage to explore their experiences in order to lead to new understandings and appreciations."

We argue that reflection does not occur automatically during the course of daily work but is triggered by either an external event or critical incidents or by an internal cue such as a negative affective state, feelings of uncertainty etc. We surveyed empirical studies examining the initiation of reflection and found that in general, all known triggers for reflection (such as disturbances, errors, negative feedback, unexpected success etc.) have in common that they elicit a state of *discrepancy*. The awareness of discrepancy leads to instability or dissonance in the cognitive system [19]. It is experienced as psychological discomfort that leads to a general arousal of the individual cognitive and affective system. This can be considered to be a fundamentally motivational state as people aim at minimizing the dissonance to alleviate psychological discomfort [20] [21]. Reflection is one means to do so by critical analysis of the experience.

The outcome of reflection can be individual learning, team learning, and/or organizational learning. In this paper, we focus on the significance of reflection for organizational learning, i.e. for changing the explicit (i.e. standard procedures, working routines) or implicit (i.e. best practices, organizational culture) knowledge base of an organization. Thus, in the following, we present findings from an interview study that we conducted with the goal to understand individual and collaborative reflection and how reflection leads to organizational learning. The findings will be discussed before the background of the Knowledge Maturing Model in Section 5.

4 Knowledge Maturing through Reflection: An Interview Study

4.1 Method

The interview study took place in the context of the MIRROR Project (see Acknowledgement). During our first visits at four application partner sites, we had the opportunity to talk to several staff members of each organization. In order to best possibly seize this opportunity during the site visits, we decided to carry out group

interviews to learn when and how staff reflects about their daily work and what impact this reflection has on their work practice. Therefore, the interview was focused on specific examples and personal experiences. In addition, the purpose of the group interviews was to acquire a deeper understanding of current work practices and current practices of learning within the organization.

The group discussions were guided by questions tackling the following topics:

- Daily work practice, job demands, role of standards and routines ("Could you please describe a typical work day?", "When is your boss satisfied with your work?")
- Learning at work (including formal and informal learning) ("Do you have opportunities for further education at your workplace?", "How do you acquire new knowledge at work?")
- Triggers, content, and outcome of reflection on daily work practice ("Could you give an example for a situation you reflected on?"; "What was the outcome of your reflection - what was your lesson learned?")
- Organizational learning through reflection ("After a project has been finished, do you discuss what went well and what should be improved?")

During the group interviews, one interviewer asked open questions, another person observed and took notes. The interviewer encouraged the participants to discuss their points of view in order to find similarities and differences between individuals. The group interview took 90 minutes approximately. The participants agreed to audio recording of the group discussion.

4.2 Sample

Four interviews were carried out in four organizations which are partners in the MIRROR Project. Prior to the site visits, we asked the management to provide contact to 2-5 staff members, interdisciplinary participants whenever possible, and with varying degree of professional expertise. Three of the interviews were actual group interviews with two, three, and four participants respectively; one of them was an individual interview due to unexpected time constraints of other participants.

Neurological Clinic.

The neurological clinic is a large, modern hospital in Germany with approximately 400 full-bodied employees dealing with approximately 1000 strokes a year (app. 2000 emergencies all together, including other severe neurological emergencies than stroke). The staff work in interdisciplinary teams of doctors, care staff, and therapists (physio therapists, ergo therapists, logo therapists etc.). Work is organized in shifts, and there are regular well-structured handovers.

The clinic is DIN EN ISO certified, i.e. quality assurance is taken as of paramount importance: Practically every task is documented in detail in the Quality Management (QM) Handbook, and practically every task of daily work is standardized. Regular QM Circles are implemented to continuously evaluate and improve work processes.

We interviewed four employees, all belonging to the stroke unit. The sample included one assistant doctor (currently in her specialist training, three years of professional experience), two therapists with five and ten years of experience, and one head nurse with about twenty years of experience, thereof six years in management.

Nursing Home.

The nursing home where the interview was taking place is a privately run and managed care home in Great Britain with approximately 43 staff and 70 residents.

Most of the care staff, except for recently qualified nurses, are not educated to degree level and only have National Vocational Qualifications. This means, staff without formal training/qualifications is asked to tackle complex situations. Care staff have a number of tasks that they need to do each day (e.g. waking, bathing, feeding, etc.) and are often more concerned with getting the task done than accommodating individual residents' moods and behaviour. Work is organized in day and night-shifts with handovers; protocols document every treatment and activity.

We had the opportunity to talk to three female carers having more than ten years of professional experience. They all hold a professional exam in caring. Two of them are also concerned with administrative issues.

Telecommunication Company.

Work at the global telecommunication company (head quarter in Great Britain) is entirely different: Most employees work from home as teleworkers. They communicate via Emails, phone conferences, or Instant Messenger. The choice of media is depending on the content ('simple' or 'complex' topics) and the number of participants (two or many). Teams are dispersed all over the country, and they are managed virtually. Work is highly standardized on the project level, i.e. there is a standard business process for contract management. There is a huge range of formal training opportunities, many of them available in the company's e-learning system. Performance management is implemented to ensure the quality of work.

Due to time constraints, we could talk to one of the contract managers only. She had 5 years of experience in her current position and a higher education background. She works full-time, mostly from home. Her job duties include managing an interdisciplinary 'contract management team' of three and more people.

Software Consultancy.

At the German software consultancy, a medium-sized Full Service Customer Relationship Management Provider, people work in small teams of two to three people. Altogether, the company holds about 60 employees, most of them based in the head quarter. However, they have a lot of customer meetings at the customers' site which require internal preparation and post-processing. Daily work is heavily focused on customers' needs and requirements which requires some flexibility. However, there are several standard business consulting processes. Regular job appraisal interviews allow for continuous evaluation of job performance based on predefined criteria (business-related criteria mainly).

We interviewed two employees, a sales consultant and a software consultant, both with about two years of professional experience as consultant.

4.3 Results

Individual and Collaborative Reflection.

The original purpose of the study was to find out whether and how reflection takes place in the different organizations, what typically is the content of reflection, and how reflection contributes to organizational learning.

We found three different types of situations which typically trigger reflection:

1. Critical Incidents: Spontaneous reflection may be triggered by a critical incident, such as a contract being lost, or a patient showing unintended reactions to a certain treatment. At the nursing home, for example, reflection typically happens "if care is not delivered how it should be, e.g. [...] in a hurry". This kind of reflection is also often shared within a team of nurses whenever a single staff member could not find a solution to a challenging situation: "We had a female checking the windows every day around four, five o'clock in the evening [...]; it turned out that she was a head mistress in a big school and one of her jobs, once everyone had left school was to lock all the windows; So once we found this out, went with her; she was quite happy then". While of course also positive incidents (e.g., unexpected success) are conceivable as triggers, the need for reflection typically was bigger in case of negative incidents.
2. Performance and Team Evaluation: Reflection was also triggered by performance or team evaluation sessions where finished (project post mortem) or running projects (project monitoring) are being discussed. For instance, during the interview at the telecommunication company the participant said that "if we lose a contract, it may be the case that we have internally a big workshop trying to analyze why we lost the business". Similarly, supervision sessions with a coach or mentor are settings that most likely provoke reflection on own performance. Typical triggers for reflection include regular performance appraisal interviews with a line manager, where "personal development goals are defined together with the supervisor", and "after one year, it is tested whether the goals were achieved". In general, the participants reported that they perceive it as "helpful and interesting to have the opinion of the supervisor" on their work performance. These situations have in common that they are regular occasions that typically include evaluation of recent task performance.
3. Regular Team Meetings: Regular team meetings provide a further opportunity for reflection but rather 'on demand'. Such meetings happen frequently at the neurological clinic, for instance: Three times a week they have x-ray meetings; the chief physician shows MRT/CT images, the neurologist presents patients' history, the radiologist shows x-rays; unclear medical evidence is discussed, the process of diagnosis is reflected upon, and alternative ways of diagnosis are being elaborated together. Similarly, at the software consultancy, "in the weekly team meeting, the supervisors are informed about things which work well, or not so well with customers", and the team discusses how to proceed in the future. There are also "best practice meetings" to discuss different approaches to handle projects in order to develop a shared best practice - "but it depends on the team how this is handled". These team meetings are the occasion to "share success stories within the organization".

Furthermore, we found that reflective thinking often occurs 'spontaneously', e.g., after interaction with a client. One person from the software consultancy reported: "If two of us have been at a customer, we are discussing on our way back what went well, how we did things, how the other saw things; The other one serves as a mirror". At the neurological clinic, recreation time with colleagues is also a typical occasion to share experiences and to reflect on work practice: "We talk with our colleagues about our work during lunchtime". There, the participants reported that "even at private meetings, we do 'doctors blathering'".

Strong triggers for reflection are evoked in situations where comparisons take place on an individual or collaborative level ("The monthly company meeting is a very formal meeting to exchange news and to compare with others", software consultancy), or on an organizational level ("There are comparisons with other hospitals; e.g., if they have a low holding time, we also should reduce our holding time; these comparisons trigger further improvement of our own processes", neurological clinic).

Comparing our interviews, we realized that in these organizations, there are strong differences in how readily the answers were given by the participants during the interview: While with participants from the software consultancy and the telecommunication company, we had no difficulties to explain what we mean by 'reflection', and the participants readily gave answers that fit our concept of reflection, participants at the neurological clinic seemed to be irritated by the term 'reflection', and stated that they would not reflect a lot due to lack of time and as they were "happy not to think about their work too much because there are not many success stories". When participants from the nursing home spoke of reflection, they mostly meant thinking about 'challenging behaviour' of residents; reflection about their own work practice was not reported to happen regularly.

Factors Related to Reflection and Reflective Learning within Organizations.

The observation that reflection on own work practice was not a concept that was readily tangible for all participants, and that reflection was nothing to take place in each organization to the same extent led us to a further analysis of factors that may influence whether reflection takes place within a company. We could identify a couple of characteristics that are candidates for explaining the variance with regard to organizational knowledge maturing through reflection.

Flexibility vs. Standardization of Work Processes.

Analyzing the differences between the four organizations we realized that one aspect in which the organizations in our study differed strongly was the degree of standardization of the work tasks: On one end of the continuum, we have highly standardized work tasks where every step needs to adhere to quality assurance regulations or other standards, and must be documented comprehensively. This is the case at the neurological clinic where "everything is very structured", and "there are many standard forms that have to be filled". This is similar at the nursing home, however, the care staff seems to have more flexibility in their procedures: "From 8 o' clock in the morning, it's basically helping people sit up for breakfast; if they do not want to get up, they do not have to. […] Then, we bring them down to the hall where we have activities going on; everyone is encouraged to join in". Obviously, there are

standard procedures but the care staff can adapt to a resident's needs in order to deliver good care.

On the other end of the continuum, workers have quite a lot of flexibility in doing their work. This is the case, for example, at the software consultancy, where "a typical work day is an untypical work day". Clearly, there is some structure (procedures, meetings, content management systems), but the employees have a lot of freedom in deciding how to do their jobs. Projects are very much driven by the needs of their customers and thus, each project is somewhat unique. At the telecommunication company, there are standard business processes pre-defined ("everything is very much standardized"), however, the daily work requires a lot of flexibility ("If I ever had a typical work day"), and days differ much depending on meetings and customer interaction. The staff can basically decide how and when to carry out their work. The interviewee at the telecommunication company stated further that she should "not even need to think about what the team is doing, because it should just happen in the background; it's a standard process".

According to the degree to which daily work is standardized the requirements for high work performance differ, too. During the interviews, we examined what kind of behaviour is expected and rewarded within the company and what would constitute a 'good day' or a 'bad day'. The answers illustrate the different job demands very nicely: According to the interviewees at the neurological clinic, a good day is "when the day plan is working, when I have the feeling that I had time for the patients". Asked for performance criteria, the interviewees stated "if we stick to structure and process; [...] if we adhere to instructions". Similarly, at the nursing home, employees are expected to follow the quality standards of care. One of the interviewees with management responsibility explained: "If we have new policies, I print them out, and I will ask every staff member to sign a form to say that they have read it, and I put that policy into their file with that form." These answers indicate that at the neurological clinic and the nursing home, the expectation is to show full compliance to regulations in order to ensure efficiency and high quality.

However, at the nursing home, residents may show 'challenging behaviour', due to dementia. Then, the care staff is expected to find out the reason for this behaviour and to identify a way to deal with the situation, reacting appropriately to the patients' needs thereby still adhering to quality regulations.

At the telecommunication company, the staff is expected to carry out pre-defined business processes. Any disturbances have to be avoided (as they cost time, and "any additional time needed reduces the margin of a contract"). The interviewee stated that her team had a really good day "if the processes worked without any intervention from them". Nonetheless, the regulations are at a much lower granularity than e.g. in the neurological clinic (i.e. business process steps are defined, daily task execution is not regulated), and the staff is expected to solve issues once they occur.

Of the organizations participating in the interview, the software consultancy is the company where most creativity and creative problem solving is expected from the employees: "Our customers are changing; thus, we have to move into new topics; our consulting techniques improve and develop further; we refine what we have, and we include new topics".

These observations led us to the hypothesis that jobs with a high degree of standardization mainly require compliance (adhering to standards) whereas jobs with low degree of standardization require creative problem solving.

Formal Training vs. Informal Learning

Further analysing the situation in the different organisations, we realized that they also differed with regard to how learning takes place. In the interviews, we found four ways of how learning and knowledge transfer take place in these organizations:

- Courses/eLearning (e.g., MS Excel eLearning course)
- On-the-job training (e.g., 'shadowing' more experienced peers, mentoring)
- Learning through Communication (e.g., project monitoring meetings)
- Learning by doing (e.g., creative problem solving, dealing with mistakes and disturbances)

Courses are useful if standard procedures exist that need to be known by many persons. Such courses have been mentioned by the neurological clinic ("We have a lot of courses; we can also suggest courses; for example we wanted to have a seminar on 'clusters of symptoms' – this was then arranged for us"), by interviewees at the nursing home ("We have many courses, e.g., on dementia, palliative care, end of life, medication course etc."), and also by the telecommunication company ("You go to the training pages on the intranet, see what training is available, see if it is of interest to you and then you have to apply to go on it").

On the job training needs to take place where physical activities are dominant: At the nursing home, typically novices accompany more experienced colleagues for one day and observe what they are doing ('shadowing'). Then, on the next day, the novices try to do it on their own.

Another way of learning is through communication, e.g. in meetings: In the neurological clinic, they "have a lot of informative meetings. If there are exceptional events, [they] discuss them. Sometimes also studies are presented". At the nursing home, information is shared during the ward meeting or handover. At the software consultancy, "everyone could talk about everything in the company meeting".

Learning by doing was named as a way of learning at the software consultancy. According to the interviewees, acquiring new knowledge and learning sometimes happens through customer relations. Reflection plays a crucial role here.

Obviously, the more standardized the work processes, and the more compliance is expected from the workforce, the more formalized is the professional further education that is offered to the staff. On one side of the informal-formal learning continuum are courses that teach standard procedures. Here, reflection is not crucial as a means to learn. Instead, the staff should be able to carry out the standardized procedure without deviation. On the other side of the continuum, when learning by doing, reflection about one's own experience is essential to transfer learning from one concrete experience to other similar situations.

5 Discussion: Linking Reflection and Knowledge Maturing

The observation that reflection seems not to occur self-evidently in different organizations raised an important question: Are there factors that determine whether or not reflective learning is likely to be experienced by persons within an organizational context? We took a closer look at the interview data and identified a number of factors according to which the organizations differed and that are strongly related: The degree of standardization of work tasks (flexibility vs. standardization), and related job demands for the staff (compliance vs. creativity), and established learning practice within an organization. These findings shall now be mapped to the ideas of the Knowledge Maturing Model. It shall be emphasized at this point that while our interview study has triggered some interesting thoughts about the role of reflection in different maturing stages, due to methodological constraints (small sample size, the way how samples were created and composed, heterogeneity of participants, etc.), the study is only a first step into the direction of combining theories of reflection and knowledge maturing.

By definition, maturing organizational know-how – if taken to the last phase of knowledge maturing – by definition results in shared 'best practice' or even standardized processes. Standardization typically has the goal to ensure high efficiency and high quality. We argue that performing 'mature' processes requires highly specific knowledge. Vice versa, performing (non-trivial) unstandardized tasks requires creativity and problem solving capacities, and thus more general skills and knowledge. As in standardized processes, the associated knowledge is more 'mature', i.e., typically more justified, understood, committed, legitimated, and teachable, formal trainings can be provided to train their workforce which then can rely on this knowledge in performing their tasks in a compliant way.

As we stated in Section 3, in general, reflection is triggered by the perception of *discrepancy*. We argue that in case of performing work tasks, the discrepancy is a deviation of the employee's actual performance from the expected performance. As we have found, the expectation may range from creatively solving a task to carrying out a task exactly as foreseen by the process standard. In the case of high standardization, discrepancy may occur if the standard process could not be carried out as expected, or if the outcome did not occur even though the process had been carried out as prescribed. One of the outcomes of reflection may be in this case that the employee has to learn an exception of how to carry out a task in a specific situation; organizational learning may take place as an outcome of the reflection, too, if the process standardization is modified or extended based on an individual's reflection process. In non-standardized tasks where creative problem solving is expected, discrepancy may occur if they do not meet performance criteria. In this case, reflection either may lead to individual learning, or – in case of organizational knowledge maturing through reflection – towards sharing experiences and joint development of best practice.

To put these considerations in a nutshell, in case of low maturity (i.e. high variability of practices), reflection can be one means to consolidate shared best practice and to develop standard processes, whereas in case of high maturity (i.e. high standardization), reflection leads to modification of institutionalized practices and innovation with regard to processes and routines. Fig. 2 integrates these assumptions.

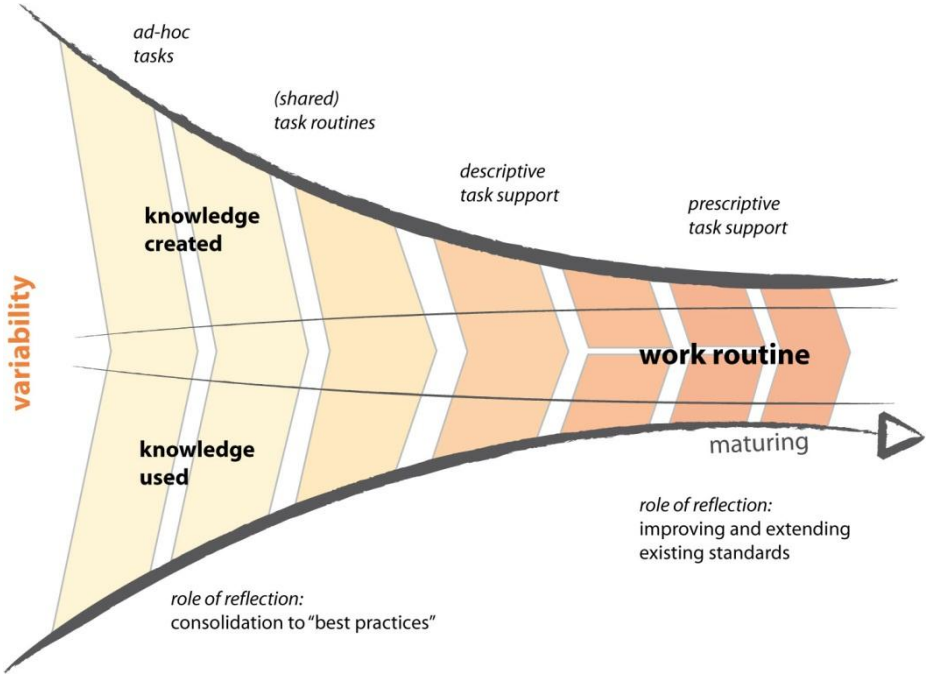

Fig. 2: Reflection in maturing organizational know-how

The figure shows a simplified version of the Knowledge Maturing Model focusing on maturing know-how, combined with the characteristics of task support typically available from [22]. These range from no support (ad-hoc tasks) via informally shared practices and more formal descriptive task support to prescriptive standards. Carrying out *fully* standardized processes (right side of the spectrum in Fig. 2) with pre-defined outcome may lead to creating new knowledge only if the process cannot be carried out as described for some reason, if the expected outcome does not occur, or the standardized process does not cover the situation encountered. Then, reflection may lead to a modification of the standard process on a fine-grained level: In other words, there is a strong stable core ('sedimented knowledge', [23]), and new knowledge is created around this core, which may result in a further detailed standard procedure. On the other end of the spectrum, broad and divergent knowledge is needed for carrying out *un-standardized* tasks. Here, learning typically 'just happens' in a self-directed manner through actively searching for information, experimentation, or learning-by-doing. Thus, carrying out un-standardized tasks might lead to the creation of new know-how, and even to new standard processes. Reflection in this case leads to maturing on a more coarse grained level as not so much 'sedimented knowledge' exists.

6 Discussion

We have started the analysis of our data with the question of what may be the reasons for differences between organizations with regard to the prevalence of reflection. Our findings revealed that these companies differ strongly with regard to the degree of 'maturity' of their know-how. This difference, as explained above, may have an impact on the kind of discrepancy that is experienced – 'complying with a standard does not lead to the expected result' vs. 'own expectations are not met by carrying out a task'. This alone, however, does not mean that more or less reflection occurs in these different contexts, but it implies that reflection has different characteristics.

One explanation why the participants in the neurological clinic and the nursing home stated that reflection does not play a major role in their work may be that in the more standardized settings, (reflective) feedback loops are built into the standards to ensure continuous improvement. For example, there is a clear process to whom a deviation from the standard should be reported, or how feedback on standard procedures can be given. That way, reflection becomes part of standardized work practice and may not be perceived as 'separate' activity.

Also, the health care staff's answers may have been biased by 'social desirability': Persons in jobs that require creative problem solving may find it natural to reflect about their work; persons that are expected to follow standard procedures, when asked about reflection, may be irritated because good performance in their case would mean 'do as the process prescribes'. Clearly, our study has the limitation that we only have subjective answers but no measure of how often reflection actually took place.

The question if the differences that we found are purely due to varying degrees of 'process maturity' or if the different institutions or branches (health vs. technology) also have an impact on whether reflection is perceived to take place remains open to future work. An alternative explanation may even be that health care staff in general tends to experience less reflection than technical staff. In our view, however, how reflection is perceived is not determined by the organization (or branch) but rather by the level of maturity of their processes. This implies for example that in the same company different professions may have different perceptions of reflection.

7 Conclusion and Outlook

Reflection is a means to improve 'maturity' of organizational processes as it contributes to the development of shared know-how, organizational best practice, and standardization of work processes. Thus, supporting reflection implies supporting organizational knowledge maturing.

However, findings from our exploratory interview study led to the hypothesis that the role of reflection changes throughout the different maturing phases: In early phases, reflection seems to lead to the implementation and consolidation of shared work practice; in later phases, reflection may trigger revision and refinement of described, prescribed, or even standardized processes. Moreover, different causes of discrepancy seem to trigger reflection in the different phases, ranging from not meeting own (or a supervisor's) expectations to deviating from a standard process. As

a consequence, reflection support in early maturing phases should raise awareness of own work practice and stimulate re-evaluation of own experiences. Sharing of individual reflection outcomes should be supported to enable the development of shared work practice. Reflection support in later maturing phases should make deviations from standardized processes and outcomes more visible. Feedback loops to refine established standards should be implemented to enable continuous improvement of standard processes. Clearly, future work needs to be directed towards testing these propositions and analyzing which maturing phase requires which kind of reflection support.

Furthermore, other factors as the ones explained above may have an impact on the prevalence of reflection. Kelloway & Barling [24] suggest that three different factors determine whether workers engage in 'knowledge work': *motivation*, *ability,* and *opportunity*. We argue that these factors can also explain whether reflection (as a specific type of knowledge work) takes place. 'Opportunity' could mean the opportunity to experience discrepancy. Fully standardized processes may only offer the opportunity to reflect on these processes if they do not lead to the desired outcome, while situations where persons are invited to experiment may provide plenty of opportunities for reflection. Time pressure may reduce the opportunity to reflect and thus constitutes a barrier to reflection at work. 'Ability' means that persons need to have the mental capabilities to abstract from their actual experience and draw conclusions for future behaviour–this ability cannot be taken for granted for every person. 'Motivation' means the motivation of a worker to reflect. Clearly, the motivation to reflect may be low if the worker does not see the benefit of reflection or if staff does not have the possibility to improve their work practice on their own. Moreover, there may be interindividual differences with regard to the need to reflect. These factors will also be considered in future studies.

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Reflective Learning at Work - A Position and Discussion Paper

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Abstract. The relevance of reflection for learning has long been recognised, and there is a substantial body of theoretical work on reflection. However, many questions regarding reflection at the workplace are still open, especially regarding the actual occurrence of reflection in different workplaces, and the efficient support for reflection.
In our ongoing work to examine the relevance of reflective learning at work in various organisations and to design technological support, we have collected and discussed existing literature on reflective learning. Within this paper, we discuss relevant and open issues in four major topical areas that are relevant to the above research goal, namely (i) the reflection process , (ii) the various scopes of reflection such as individual and organisational learning, (iii) the context or setting in which reflection might take place and (iv) how we can facilitate and scaffold reflection by means of technology. We aim to provide a basis for discussion and to illustrate that research on reflection, especially in the context of work, is far from finished.

1 Introduction

The relevance of reflection for learning has long been recognised, and there is a substantial body of theoretical work on reflection. Within the project *MIRROR - Reflective Learning at Work*[6], our goal is to facilitate learning by reflection at the workplace using state-of-the-art information technology. However, many questions regarding reflection at the workplace are still open, especially regarding the actual occurrence of reflection in different workplaces, and the efficient support for reflection.
Within this paper we discuss four major topics that need to be considered from a theoretical viewpoint when tackling the challenge of providing technological support for reflective learning at work. These are (i) the reflection process itself, (ii) the various scopes of reflection such as individual and organisational learning, (iii) the context or setting in which reflection might take place and (iv) how

[6] http://www.mirror-project.eu

we can facilitate and scaffold reflection by means of technology. These topics also provide the structure of the present paper. For each topic we will explain our current understanding and present issues for discussion.

2 The Reflection Process: Triggers, Object, Process, and Outcomes of Reflection

Daudelin defines reflection as "the process of stepping back from an experience to ponder, carefully and persistently, its meaning to the self through the development of inferences; learning is the creation of meaning from past or current events that serves as a guide for future behavior" [3]. Reflection has the potential to lead to a better understanding of ones own work practice and work-related experiences and can guide future behaviour [10]. For our purposes, we thus consider reflection and reflective learning to be the same thing.
We start our discussion of the reflection process with the input-output-oriented model of reflective learning proposed by Boud et al. [2], see Fig. 1. This model outlines a three-step process of reflective learning: The learner re-evaluates past experience by attending to its various aspects such as feelings and ideas, thereby producing outcomes such as a better undertstanding of an experience or behavioural change. However, it does not specify the content of reflection, the triggers for reflection, the reflection process itself, and the outcome of reflection. These aspects need to be better understood, in order to design efficient support, both technological and non-technological, for learning by reflection at work, and in order to illustrate clearly the benefits of learning by reflection for individual learners and teams in organisations, and the organisation itself.

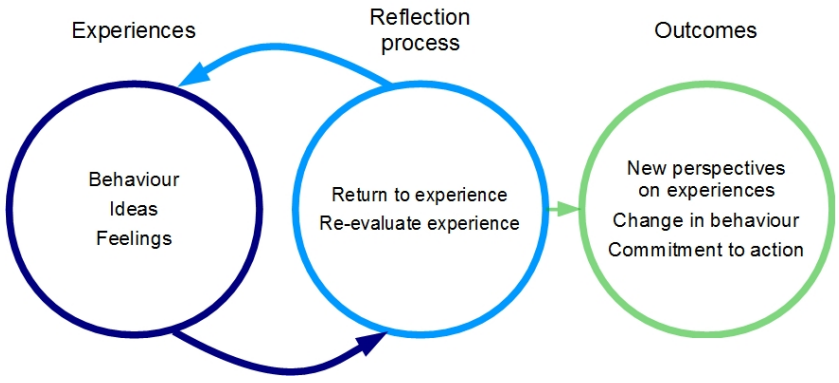

Fig. 1. The process of reflective learning [2]. Note that this illustration redrawn following the original drawing.

The Content of Reflection: Experience(s) In Boud's reflective learning process (illustrated in Fig. 1) we can consider the experience returned to as a single experience or as a conglomeration of single experiences. We follow [2] in defining a single experience as "the total response of a person to a situation, including behavior, ideas and feelings". In everyday as well as academic language "experience" refers both to a single experience within the context of a specific event or situation and general experience in the sense of (tacit) knowledge, skills or attitudes that have been developed over time. In workplace learning, we can thus specify work-related experience as the content of reflection: The subject matter of reflection is likely to be ones own work practice. Reflection in a team context might be based on shared experience instead of individual experience. It is still an empirical question, which aspects of work practice are typically reflected upon, for instance whether it is on task performance, on communication with clients or colleagues, or on one's own reaction to experiences.

Triggers for Reflection Reflective learning does not automatically occur during the course of daily working routines. Reflection arises from the flow of experience prompted by some kind of cue that draws attention to a concrete instance of experience. All typical occasions for reflection that we have found in the literature have in common that they elicit a state of discrepancy. This discrepancy can arise from experiencing a knowledge or skill gap, the mismatch of an individual's expectation and the actual environment, experiencing contradicting information, difference in individual understanding, involvement in social conflicts, a positive change in work processes, improvement in productivity, etc. From a psychological viewpoint, we can thus understand *discrepancy between reality and expectation* as the trigger for reflection. This discrepancy leads to inner discomfort; reflection is one possible, and highly benefical, strategy for dealing with such discomfort. For practical reasons, we would like to have a more fine-grained distinction between triggers. A practically applicable categorization of triggers is therefore one of our ongoing research endeavours.

Personal and Situational Factors that Influence Whether and How Reflection Takes Place The same situation may make one person reflect wheras another person does not experience a need for reflection at all. We can safely assume that this is influenced by a complex interplay between situational factors and personal factors. On an abstract level, it is reasonable to assume that a person's need, (cognitive) ability and opportunity as well as characteristics of the situation in which reflection takes place influence whether and how reflection takes place. In our future work, we want to identify this interrelationship more precisely. This is the pre-requisite for designing a work environment that fosters learning by reflection, such as establishing reflective practice or tweaking organisational culture so that it holds reflective learning in higher regard.

Reflection and Learning Based on the re-evaluation of a past experience, reflection leads to a new and better understanding of the experience and allows for

deriving implications, conclusions, or 'lessons learned'. Reflection thus includes processes of drawing conclusions with regard to future situations. This, in turn, requires the generalization and abstraction from the concrete experience. The outcome of reflective learning can be cognitive, affective, and/or behavioural (in line with [2]). A resolution or lesson learned is a core part of the reflective process; this constructive element of reflection differentiates it from repetitive thought and rumination (cp. Martin & Tesser [9, 8] for research into rumination), although the outcome does not necessarily have an immediate and/or observable impact on work practice. Thus, following our definition of reflection, reflection always leads to learning.
We aim at a comprehensive categorisation of reflection outcomes that are measurable. This is an essential pre-requisite to evaluate any interventions.

Indicators for the Occurrence of Reflection In general, reflection is considered to be the conscious re-evaluation of one's own experience. Reflection is "a form of mental processing with a purpose and/or an anticipated outcome that is applied to relatively complicated or unstructured ideas for which there is not an obvious solution" [10, p98]. The reflective process is deliberate/careful (active, purposeful), rational (systematic, situated sense-making) with an affective side (attending to feelings, values and attitudes), and includes the rational evaluation of knowledge and beliefs.
Unfortunately, most models of reflection do not specifiy the concrete mental operations, which would be necessary to assess reflection. However, identifying whether reflection occurs or not will be crucial for any research purposes that involve evaluation of interventions. Our goal is therefore to identify indicators of the reflective process such as perspective taking, counterfactual thinking, and generation of behavioural intentions. Addditionally, available models of reflection focus on individual reflection and thus neglect communcation activities that become relevant in collaborative settings. Hence, we need to further consider indicators for reflection in collaborative settings. Relevant indcators might be the ones proposed by van Woerkom & Croon [13] such as questioning groupthink, giving and receiving feedback etc.

Reflection and Task Performance The work of Schön [12] explains how knowledge, experience and reflection at the workplace are linked. According to Schön, there are several steps involved in reflective work practice: Knowing-in-action, surprise, reflection-in-action, experimentation, and reflection-on-action. Knowing-in-action refers to the kind of knowledge we can only reveal in the way we carry out tasks and approach problems, e.g., tacit knowledge. Reflection-in-action happens as an integral aspect of work, triggered by situations that challenge knowing-in-action. Solutions to these challenges emerge as an outcome of reflection and are tried out, e.g., enacted in practice (experimentation). This experimentation is re-evaluated through reflection-on-action taking place after the event. The result of reflection is improved knowing-in-action. Although, Schöns model sheds light on the connection between reflection and the task performance

process, we believe that time and opportunity to reflect is essential. Some emotional and cognitive distance to an experience seems also to be necessary for generalization and abstraction from a single experience, e.g., "the role of emotions as possible barriers to reflection" are explicitly mentioned in [2].
We thus think it is difficult to link Schön's reflection-in-action to the reflection process that we assume based on Boud's model of reflection. Reflection-in-action in the sense of Schön's defintion seems to be related to problem solving during task performance instead. Dealing with disturbances or challenges during task completion should, in our opinion, not be regarded as reflection as long as there are no lessons learned that guides future behavior. This is, however, an issue for discussion as there is some disagreement in available literature with regard to the relationship of reflection and problem solving during daily work.

3 The Scope of Reflective Learning: Individual, Collaborative, and Organisational Learning

Especially in the context of organisational learning, reflection should not only be considered as an individual cognitive process. Since most business organisations strive to implement teams to successfully face the rapid changes and challenges in business life, we argue that also collaborative reflection should be considered more comprehensively [6]. However, there is little literature that collects how and when transitions between individual and collaborative reflection, or from individual and collaborative reflection to organisational learning and vice versa happen (exceptions include [4, 5]). Rather, existing literature often deals with one single aspect only, such as developing self-reflective capabilities and supervised reflection in educational settings (i.e. individual reflection), with team learning and reflection in work settings (i.e. collaborative reflection), or with organisational learning from a quality management perspective. On the other hand it is highly relevant in the context of workrelated learning to investigate which paths are "travelled" in the real world, in order to efficiently support existing reflection and transfer best practices to other workplaces. Established paths are necessary so that results of reflection by individuals can be shared with a team or the whole organization.

Individual and Collaborative Reflection We suggest a reciprocal relation between reflection within a group and the individual reflection processes: For reflection to be collaborative, participants share experiences. With regard to the outcome of reflection, we need to further specifiy who learns from reflection: Besides individual learning, reflection may also lead to team learning. Team learning through reflection leads to team development for the purpose of improving team performance in the future. We would like to point out here, however, that team learning is not only the result of a whole team reflecting collaboratively together, but implications for team work practice might, of course, be also derived by a single team member or perhaps by the team lead while reflecting solitarily on his/her personal understanding of team work. Outcomes of collaborative

learning can be, e.g., social norms, implicit or explicit rules for communication, coordination or cooperation, etc.

Reflection and Organisational Learning Reflective learning can also be viewed in an organizational scope. Organizational learning, an organizations improvement of its performance over time [1], can be seen as a consequence of the learning taking place within the context of daily work. Learning includes both individual and team learning. We consider this kind of organisational learning to result from staff's learning experiences as a bottom-up process. For bottom-up organisational learning, continuous evolution of best practice must be stimulated by regular review of organizational routines and practices. Sharing of individual work practice should be encouraged so that others can profit from individual good practice. On the other hand, organisational learning can also be initiated in a top-down approach, when work processes are reflected on at a managerial level. Management responsibles may reflect on the organisation's overall performance as well as specific organisational standards and routines on the basis of performance data. This data may originate from work processes directly, or may stem from from reflection processes of single staff members or teams.

4 The Context of Reflection at the Workplace: The Reflection Session

By reflection session we refer to a time-limited activity framing and supporting reflection. Reflection sessions range from individual and spontaneous pauses in between work tasks to scheduled and facilitated reflection meetings in teams. By using the term "reflection session", we distinguish the mental process of reflection within a single learner or the social process of reflection within a team respectively ("reflection"), from the setting in which reflection happens ("reflection session").

Following-up on our earlier discussion of different aspects of learning by reflection, we propose five sets of characteristics (aspects) for a reflection session. The five sets of characteristics include the three elements in Boud's model[2], but add characteristics of the learner and contextual information about the reflection session. Such aspects are necessary to compare reflection sessions, study commonalities and differences between reflection sessions, and subsequently build appropriate support for different reflection settings. We have already begun testing the usefulness of the conceptualisation below on existing empircial data [11, p22ff], but future, continued validation is needed.

Content Characteristics By content we refer to the object of reflection, the past experiences.

- Does the reflection address a single experience or a conglomeration of experience?
- Who owns, or "made", the experience?
- Which work process(es) are in focus?

  - Which aspect of the experience is reflected on?

Characteristics of Reflection Process This refers to the question how and by whom the activities in the reflection session are being conducted.
  - Who participates in the reflection process? Is the process individual or collaborative? What are the participants' roles in this process?
  - Which data is accessed to support reflection?
  - Are there specific reflection techniques to facilitate reflection?

Outcome Characteristics Outcomes are any results of reflection sessions. They target both what the learners have actually learned, as well as the tangible artefacts that have been produced.
  - What is the scope of reflection? Which actors must ideally learn and change?
  - Which (kind of) knowledge is constructed?
  - Which tangible artifacts are produced?
  - How are outcomes sustained?
  - What actual changes in work practice result from reflection?

Learner Characteristics Learner characteristics describe the learning actor(s), which may be a single person, a team or group of people, or an organisation. Naturally there are different characteristics for all these "kinds" of learner. For example:
  - Personal disposition, such as need or ability to reflect.
  - Group dynamics, e.g., culture of giving respectful feedback.
  - Organisational culture.

Characteristics of Reflection Situation The reflection situation encompasses concrete situational factors of the reflection session, such as time and place where the reflection process takes place.
  - When does the reflection happen?
  - Was the reflection session planned?
  - How long does the reflection session take?
  - Where does the reflection session take place?

Organisational and Technical Support for a Reflection Session Facilitation and "design" of reflection sessions require knowledge about the specific effects of the above discussed characteristics. Although we have already identified these characteristics of a reflection session, we do not know exactly which options are adequate for which purpose. In some cases, for example, it might be good to have an individual reflection opportunity before the team comes together and shares individual pre-understandings - in other cases, sharing individual experiences and discussion interpretations might be useful in a team context from the beginning (e.g., when single individuals do not have access to information relevant or knowledge applicable). Involvement of a line manager might be useful if she can provide objective feedback but it might hinder a thorough analysis of a specific situation. Some incidents might require an immediate analysis, while in other cases it might be more helpful to wait until emotions have calmed down.

5 The Role of Tools in Reflection At Work

Tools may have different roles in supporting reflection at work. Two broad categories of tool use for workrelated reflection have been identified as (i) gathering data from the work process and (ii) providing support for the reflection session in [7]. From this starting point, we go on to expand the conceptualisation of different roles of tools along the model of reflection of Boud et al. [2] considering the experiences, the reflection process, and the outcomes:

Experiences Here, we can consider technology that captures data about a learner's experiences, which can be used as a basis for reflection in a reflection session. Such technology may or may not support the work tasks, e.g., a subversion repository supports a developer's work and also produces log data whilst a video camera does not support the a fireman's work but produces log data that can be used as a basis for reflection. Finally there are manual data capture tools, e.g., note-taking tools, which serve not only to capture experiences but also serve as a first step in a reflection process since they require an explicit engagement on the learner's part with an experience.

Reflection Process Technology can also be used to support the reflection process itself. Given the current technological state-of-the-art, the following ideas come to mind:

- Data analysis tools: Data analysis technology can help making sense of complex data that describe the experience that is the object of reflection.
- Reflection recommendation: Assuming that it is possible to automatically identify triggers for reflection, e.g., by detecting emotions, or discrepancies between an actual work process and the prescribed work process, it is possible to recommend a learner to reflect on an experience.
- Scaffolding / reflection guides: Tool support for the reflection session may take the form of process guidance, i.e. scaffold each reflection step. For example, tools may scaffold articulation of individual pre-understandings for the purpose of collaborative reflection. Tools may highlight disagreement and conflicts among individual understandings of an experience. Finally, tools can support the generation of reflection outcomes.

Outcomes In a successful reflection process, returning to an experience and abstracting from it is followed by integrating the extracted findings into existing knowledge. This integration can be viewed as knowledge construction, and thus as learning. Technology can support such knowledge integration, for instance by pro-actively searching for artefacts that contain related knowledge and providing them to the learner. Technologies for knowledge sharing foster the transition from individual learning to team learning.

Challenges for Developing Technological Support for Reflection at Work Some of the described technologies for supporting reflection present technical challenges, such as gathering meaningful data about work experiences, or identifying triggers and recommending users to reflect. Other technologies, such as technologies for knowledge sharing, are technologically well-established.

However, with all envisioned technologies, we face the challenge that little research exists concerning technological support for reflection. A lot of literature deals with how manual note-taking, such as diary-writing, supports reflection. Other work deals with life-logging, which is becoming increasingly popular because of the availability of life-logging consumer goods, such as smartphones, pulse meters, pedometers, etc. Emphasis is often placed on the technical possibility of logging data, but less on which data is actual meaningful for learning. Additionally, we are faced with the challenge of supporting not only scheduled reflection sessions, but to also provide suppport for spontaneous reflection. We can only assume that scheduled and spontaneous reflection sessions follow different processes and hence require differently shaped support.

6 Summary

To summarise briefly, we see open issues for future research on learning by reflection in the workplace mostly in (i) making theory more applicable which will be done by studying more closely the content of reflection, triggers for reflection, personal and situational factors that influence reflection and by developing methods to identify and assess reflection that occurs at work, (ii) widening the perspective to investigate the interrelationship between individual, collaborative and organisational learning by reflection, and (iii) developing appropriate technological support for reflection. Additionally, fitting reflection into already tight schedules of workers, and identifying clearly the benefits of learning by reflection are two overarching challenges for reflective practice in workplaces. Organizational culture often does not give reflection the time and space it deserves in the work processes. By facilitating reflection however, organisations can use these powerful learning opportunities in everyday work for individual, collaborative and organizational benefit.

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Computer Support for Collaborative Reflection on Captured Teamwork Data

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Abstract. This paper introduces collaborative reflection for the purpose of team learning at the workplace and describes requirements for its support by IT tools. In particular, we identify three processes to be supported and discuss solutions necessary for collaborative knowledge construction and meaning making based on captured teamwork data. This includes support for articulation work, transfer of established scaffolding and guidance concepts to reflection at the work place, and strategies of convergence for collaborative knowledge construction. The paper also sketches potential technical solutions embedded into organizational procedures to facilitate collaborative reflection and team learning.

Keywords: Reflection, collaborative reflection, collaborative knowledge creation, team learning, workplace learning

1 Introduction

Employees learn far more from experience than through formal training ([1], [2]): while they can be prepared for their job in formal learning scenarios and may receive vocational training, adopting and adapting work routines or cooperation structures are subject to informal learning and experience. Consequently, reflection on work practice has been identified as a central learning mechanism ([3], [4]) leading to a better understanding of work and guiding future behavior ([5], [6]). Since in most organizations people work in teams, research should also consider *team learning by collaborative reflection*. This paper describes methods and tools to support such learning at the workplace, explaining the usage of data on work practice. The work described here is part of the project *MIRROR - Reflective Learning at Work*[1].

2 The Significance of Collaborative Reflection for Team Learning

Most models of reflection have a strong individual focus (e.g. [3], [7], [8]). The social dimension of reflection has only recently been described by [9], who highlights the

1 MIRROR is funded under the FP7 of the European Commission (project number 257617). Further information can be found at http://www.mirror-project.eu.

role of sharing experiences for the purpose of learning (see also [10]). In this context, the discussion of experience can stimulate and deepen individual reflection. Other social activities such as asking for feedback on work and social comparison are also important aspects of reflection ([11], [12]) and serve as *indicators* for the occurrence of (team) reflection. In this context, it is important to understand that reflection in teams includes both learning done individually by team members and team learning.

Many definitions of team learning explicitly include reflection, defining it "an ongoing process of reflection and action" ([13]). Understanding learning as co-construction of knowledge ([14]), "team learning occurs when individuals share their experiences thus, contributing their unique contextual knowledge to the team" ([15]). Thus, the explication of individual experiences and understandings during team reflection can lead to a deeper insight into shared work practice. This is illustrated by a team learning scenario we observed at a SMB IT consulting company in Germany:

> In a company selling software for customer relationship management, sales consultants regularly visit trade fairs to present their products. There, they meet with their customers and get in touch with interested parties.
> Some days after visiting another fair, the consultants met to review the trade fair at the headquarters. This meeting started with a reporting session, where every participant described her personal impressions of the fair. The team discussed about customer meetings, topics encountered and feedback received. Other consultants asked further questions such as whether talks worked out as planned, whether they achieved their goals, or how the fair will affect the upcoming contracts.
> In addition, more general questions were raised by the head consultant. He also made notes about any reports and stimulated discussions about similar experiences with customers. Once, for example, he asked whether and how cloud computing had been discussed with customers. During a lively discussion, some consultants contributed various stories about their experiences on this. Others reported on articles about the topic they had read and offered to send them around. The team also discussed the perceived relevance of cloud computing on the market, and whether it is a market trend or hype. After some discussion, they concluded that the topic is indeed relevant for their company and has to be discussed further. When they started planning the upcoming trade fair and again discussed cloud computing. They decided to use it as an eye catcher at their booth next time. Thereby they hope to get into deeper discussion about cloud computing with customers and offer assessments of suitability for cloud products in the customers' environment.

As the story illustrates, potentials of collaborative reflection include learning from peers about their experiences, reciprocal sense making, explication of individual understanding and integration of perspectives. It also shows the complexity of establishing a shared understanding in teams and the important role of shared material and experiences for this process. Our work aims at reducing this complexity and supporting the usage of data for reflection by computer tools.

3 Computer Support for Reflective Team Learning

As stated above, designing computer support for collaborative reflection is of vital interest for many organizations. Recent accounts for collaborative *learning* and

knowledge construction might be helpful for collaborative *reflection* as well: There are many approaches supporting collaborative learning, including prompts for elaborated explanations, external representations for co-constructing ideas and means to make cognitive conflicts salient. Additionally, wikis (e.g. [16]), collaborative tagging systems (e.g. [17]), concept maps or systems for group discussions (e.g. [18]) have been applied successfully to support collaborative learning. Additional, there are concepts supporting discursive learning by contextual annotations of material ([19]), the coupling of chat and graphical data ([20]), guidance and scaffolding of knowledge building ([21], [22]) or negotiations ([23], [24]). However, while these approaches work well in educational settings, their value for collaborative reflection and workplace learning has yet to be analyzed as this context raises additional challenges.

4 Dimensions of Collaborative Reflection at the Workplace

Our approach transcends existing work on computer-supported collaborative learning in two ways: First, only little is known about the applicability of IT support for learning by reflection at the workplace. Second, our approach uses data representing real teamwork practice. This raises questions which data to gather, how to do this and how to facilitate interaction with huge amounts of data.

4.1 The Context Dimension: Task and Social Aspects of Teamwork

Reflection on teamwork at the workplace refers to two levels of work done. First, it is about tasks to perform. Second, it addresses social demands of coordination and communication during teamwork. For both of these levels, learning from past experiences is crucial for enhancing future performance of the team as well as individuals ([13]). Additionally, the task and social dimensions of teamwork also show the advantage of reflecting on teamwork collaboratively, justifying the extra effort stemming from collaborative reflection (cf. [11]). In this context, team reflection might occur in different settings such as pre-planned meetings, regular handover sessions and spontaneous encounters of team members.

4.2 The Data Dimension: Teamwork Data as Basis for Collaborative Reflection

While formal learning can be supported by material edited for teaching purposes, workplace reflection needs data representing real work practice. Such data can enhance a team's awareness on shared work practice and make problems or good practice visible. For this data, we need to consider a variety of different granularity and semantic levels. Table 1 shows a choice of such data, including data that might have been useful in the story described above (section 2) such as shared calendar entries to review the performance at the fair or notes consultants took during the customers talks about cloud computing. Additionally, it shows data such as mood levels of individuals, which can be used in the scenario to determine stressful phases

and thus support reflection on whether it was a challenging customer or an unknown topic that. Other data such as pictures and workflow data can be helpful in reflecting individual performance or a team's communication structure.

Table 1: Data types for reflection, with examples from the story above.

Type of data	Instance	Reflection purpose
Sensor data	Mood level measures	Spontaneous assessments
Workflow data	Duration of conversations	Analyze communication
Pictures and videos	Pictures from the fair	Recall / compare work practice
Application content	Shared library or bookmarks	Rebuild context of topic
Explicit notes	Notes from individual reflection	Explicate personal learning
Work documentation	Meeting minutes	Review conversations

Initial trials of using such data such as shown in Table 1 for collaborative reflection purposes show that workers perceive the data as a meaningful basis for reflection and that support for this not only needs means of gathering and aggregating data supporting people in interacting with this data, e.g., in identifying relevant data, relating different data pieces to each other and making meaning from this data. Additional, individual understandings of the data need to be shared explicitly and in relation to the data. In further work, this is intended to result in a continuous cycle of interpreting data, collaborative sense making and sharing individual understandings. Obviously, this process cannot be supported solely by technology, but also needs corresponding organizational procedures, as we will explain in the next section.

5 Designing Computer Support for Collaborative Reflection

Collaborative reflection involves individual reflection, sharing individual understandings, establishing a shared understanding and construction of knowledge. This is in line with Stahl's cycles of individual and collaborative learning ([25]), the co-evolution model of [16] and the conceptualization of distributed cognition by [26]. Our analysis of the challenges described above, which are taken from our empirical work with 3 companies shows that respective support will at least need to include three main activities: the explication of experiences by articulation, guidance for the reflection process and support for convergence into joint knowledge.

Articulation support. As described above, team reflection needs explication of individual experiences and understandings of work. This can be supported by means to comment on captured data. Annotations on teamwork data stemming from such articulation work (cf. [27]) can then be used for team reflection on this data material. In our story, available support for articulation could have helped team members to make their experiences from the fair explicit for discussion during and outside the meeting. For this purpose, the annotation of data by textual comments, tags, audio or video can be used. Through this, a rich base of contextualized experience is available for team reflection. For tool support of this process, multimedia-enabled wikis, in which content can be easily linked, could be used as a starting point.

Scaffolding and guidance support. As stated above, team reflection on work data needs support in using such data and structuring the reflection process. Thus, support by scaffolds ([21]) and means of facilitation ([19]) can be useful to make team reflection successful ([11]). In our story, the consultants could have used a more structured approach guided by prompts of an application and better facilitation to better make sense of their experiences at the fair. This indicated that support for guidance will be combination of facilitation and other human activities with tools such as prompts and proposals for actions.

Synergy support. In order to help teams to derive implications for future work from reflection, converging insights from reflection has to be supported, too. In the story above, convergence support might have helped to derive solutions how to go on with the cloud computing topic faster. We suggest implementing support such as means for graphically structuring the content and tools for negotiating meaning.

6 Summary and Outlook

Our work intends to provide solutions for supporting collaborative reflection on captured teamwork data for the purpose of team learning. Research on collaborative learning and reflection does not provide enough information to build proper tools for such support. For this support, we identified the articulation on shared experiences and teamwork data, the implementation of guidance for the generic scope of reflection and support for convergence to be processes of primary interest for collaborative reflection to be crucial for supporting collaborative reflection. These processes have to be supported by socio-technical solutions combining organizational processes with information technology. Moreover, means used to support such reflection will have to pose little extra effort on people, as they might not be used otherwise. In order to accomplish these goals, further work will be focused on developing prototypes for supporting and investigating collaborative reflection support in real world settings.

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Empiricism

Empiricism

Ad Hoc Transient Groups: Instruments for Awareness in Learning Networks

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Abstract. Learning Networks are online social networks through which participants share knowledge with each other and jointly develop new knowledge. The ultimate goals are to enrich the experience of formal, school-based learning as well as to form a viable setting for professional development. In order to attain these goals, however, participants should be aware of each other's existence in the first place. This paper introduces a case study of a Learning Network: eTwinning, a European network of teachers who exchange their experiences and seek collaboration. Based on multiple sources, a picture of the current state of mutual awareness and sense of connectedness in the eTwinning network is painted. The network proves to be divided. On the one hand there is a strong core group, which feels connected and is clearly aware of each other. On the other hand there are many participants who seem to be isolated. To engage this second group, this paper suggests the use of a peer-support mechanism called Ad Hoc Transient Groups (AHTGs). Through AHTGs participants who have a question can be connected to and helped by other members with relevant experience in the area. Finally the paper presents new areas of research in Learning Networks, particularly the design of a service that aims to encourage participants to grasp the value and opportunities offered by their Personal Learning Networks for their own professional activities and professional development.

Keywords. Learning Networks, social awareness, ad hoc transient groups, AHTG, Social network analyses, sense of connectedness, eTwinning, TellNet

1 Introduction

Learning Networks are technology-supported communities through which learners share knowledge with each other and jointly develop new knowledge. This way, Learning Networks enrich the experience of formal, school-based learning as well as form a viable setting for non-formal professional development and lifelong learning[1]. Examples of Learning Networks for professional development are networks of employees who want to improve customer services, lawyers who want exchange knowledge and experience, or networks of teachers who exchange their experiences and seek collaboration.

A case in point is the European project *Teacher's Lifelong Learning Networks* (Tellnet), which aims to study an existing network of teachers (eTwinning) in order to support development of their competences by managing and handling large-scale data on social networks. Furthermore, in the context of this project tools are investigated to foster peer-support and collaboration as well as increase social capital in the eTwinning network.

As part of a range of studies on fostering social capital in Learning Networks [2], in this study we follow an approach where we start from a theoretical basis and end up with a prototype tested and adjusted in an existing network. We give special attention to the view of the future users as well as the actual impact the introduction of AHTGs are expected to have. Founded on earlier reports provided by eTwinning, as well as results obtained from the Tellnet project, a picture is drawn of the current state of the network with regard to participants' awareness of each other and their sense of connectedness to each other. Based on this picture, AHTGs are introduced and their role in changing the network is explained. Finally, we reflect on future research regarding AHTGs.

2 The eTwinning Network

eTwinning* is defined as the network for schools in Europe. It promotes teacher and school collaboration through the use of Information and Communication Technologies (ICT). In other words, the eTwinning network (over 120.000 users) is a large online environment in which teachers can work with each other and learn from each other. Through this network, collaborative projects can be started on a wide variety of subjects. They range from improving teaching skills of math teachers to having multiple primary school students working together and learning about different cultures [3]. At present eTwinning undergoes a transitional phase. Since the beginning of the eTwinning action in 2005, its main purpose was the facilitation of collaborative school projects across borders in Europe, whereas since 2008, its aim has broadened towards the delivery and maintenance of a social network for teachers [4]. In parallel, the eTwinning platform has gone through major changes. New social networking features have been added to the platform to allow eTwinning teachers (eTwinners) to do projects, to socialize, to extend their professional network and to improve their teaching skills [4]. The socialization of the network is, therefore, paramount to eTwinning's future development.

In the following part, we outline a view on eTwinning using various sources. By combining different approaches and data, we can build up a meaningful current status of eTwinning. The following information is explained:

- Monitoring report of eTwinning in 2009.
- Survey measuring the sense of connectedness and general connectivity (n=795).
- Social network analyses (data from the eTwinning platform).

* www.etwinning.net

2.1 Monitoring Report eTwinning 2009

In December 2008, eTwinning conducted a survey asking eTwinners about their opinions on and actions in eTwinning. The survey was conducted online in 22 different languages. In total, 1308 eTwinners responded [5]. The 2008 survey revealed a clear distinction between primary (2/3) and secondary school teachers (1/3). Also, while many different topics are taught (e.g. Mathematics, ICT, Literature), the topic Foreign Languages clearly dominates the survey, accounting for 44.3% of the teachers. Looking at the data extracted from the eTwinning platform in June 2010, we can further define the subjects taught by eTwinners. While there are more than 20 different subjects that the teachers indicated in the data, four are most common ones, namely Foreign Languages, Language and literature, ICTs and Maths (see Table 1).

Subject taught	**N**	**%**
Foreign languages	57782	9.2%
Language and literature	19508	3.1%
Informatics/ICT	15609	2.5%
Mathematics/Geometry	13829	2.2%
Other	524272	83.1%

Table 1 – Main teaching subjects

A second classification can be based on the reason for registration as this provides insight into the different goals eTwinners have. In the 2008 survey, the four main reasons for registration were:

- Help students meet other students (main).
- Meet other European teachers.
- Find partners for projects/Comenius actions.
- Improve teaching skills.

The survey also finds that eTwinners came into contact with eTwinning initially either through colleagues, teacher training activities, or by browsing the Internet.

A third classification can be made based on whether or not an eTwinner has participated in a project yet. As explained previously, before 2008, the idea of cross-border school collaboration projects was the main driver for joining eTwinning. Out of the 1308 2008 survey participants, 1024 or 78.3% had already participated in an eTwinning project. This means that the respondents to this survey consist of the core eTwinners who are active in project collaboration among many other activities in eTwinning. The data from the platform collected in mid 2010, shows a reversed trend; a small percentage of teachers collaborate in the projects whereas the majority have no involvement in the project work (73% of the eTwinners had not yet participated in a project), while of those that did half participated in multiple projects.

Most respondents in the survey of 2008 indicate that they are satisfied about the coordination with partners and almost all participants (>95%) who were in a project were satisfied with eTwinning in general. Moreover, they report that the projects impacted their teaching practice in numerous ways, for instance:

- Making it fun.
- More interest in taking part in future projects.

- Improvement of ICT skills.
- Improving foreign languages and communication skills.
- Learning about other school systems.
- Learning new teaching techniques.
- Improving skills to work in interdisciplinary teams.

There are however challenges to overcome during a project. Such as:

- Lack of time.
- ICT problems.
- Difficult to find a partner.
- Difficult to organize the work online.
- The user friendliness of the eTwinning platform.

2.2 Sense of connectedness

Sense of connectedness (SOC) represents how well someone feels connected to others and feels he or she is part of a community [6]. As part of an ongoing experiment a survey was conducted to better understand the SOC of the eTwinners, their characteristics and online behaviour.

The survey was based on the SOC questions proposed by Rovai [6]. eTwinners were invited to participate when they taught one of the major topics as shown (see Table 1). In the end, 795 eTwinners filled in the survey. Obviously, this is only a subset of eTwinners, who can be classified as active as they have to come to their desktop to see the invitation.

The main result of the survey is that the majority of respondents feel well connected with an average of 6.65 on a 10 point scale (SD= 1.2). Interestingly, the SOC is positively correlated with the number of projects responding eTwinners were involved in $r = 0.22$, $p < 0.001$. Also, SOC was positively correlated with the number of months they had been part of eTwinning $r = 0.19$, $p < 0.001$. Unsurprisingly, the number of months and number of projects were also positively correlated with each other $r = 0.32$, $p < 0.001$.

Results also show that respondents indicate that around 50% of their eTwinning contacts are online contacts solely. In other words, many respondents have multiple contacts whom they meet face-to-face as well. This is an important result as it indicates that eTwinning should be seen more as a blended social network than a full-blown online social network. The fact that it is a blended network for a large group influences on how to interpret the visible social network. eTwinners, who might be labelled as isolates in the network based on project participation, could have a strong set of relationships based on face-to-face meetings and not be isolated at all.

A large proportion of the respondents think their amount of contact with other eTwinners is just right with a mean of 4.8 on a 9 point scale (Figure 1). Yet variation in this preference is high – it covers the whole range from 1 to 9. The majority of the respondents indicate they would like to have more contact with fellow eTwinners.

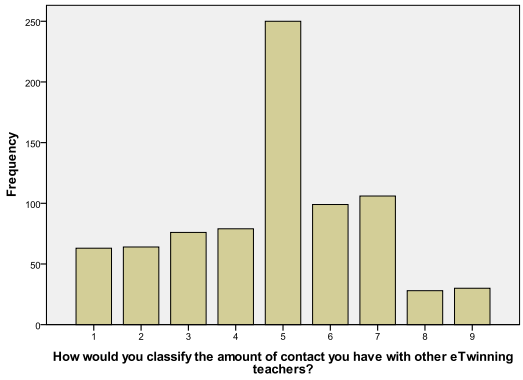

Figure 1 – Amount of contact (1- too litle to 9 – too much)

Most eTwinners made some new contacts in the past six months (see Figure 2), most of which were established through the use of the Internet.

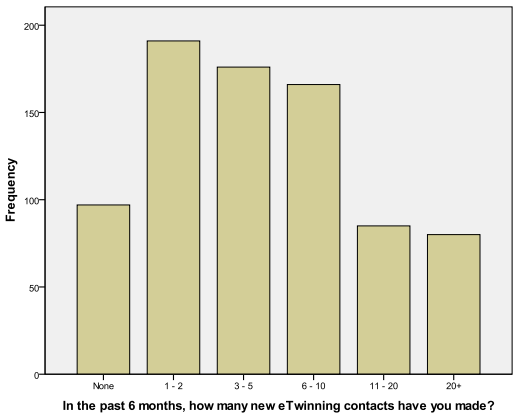

Figure 2 – New contacts made

In the six months preceding the survey, 42.5% of the eTwinners had been in contact with the eTwinning National Support Service (NSS) for support. In relation, 60.1% reported having had contact with other eTwinners for support. Most eTwinners prefer a mix of support of the NSS and their fellow eTwinners (Figure 3). Yet, to be three distinctive groups seem to prevail. On the one hand there are those who prefer support from the NSS. Then there are those who prefer support from their fellow eTwinners. Finally, the largest group prefers a mix. Interestingly, these preferences are not correlated with any of the other indicators measured.

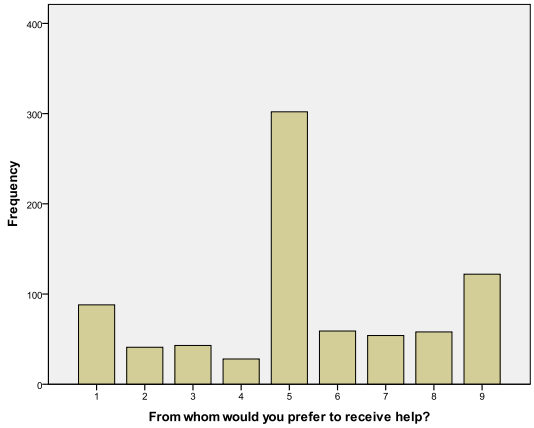

Figure 3 – preferred support ranging
(1 – Fellow eTwinner to 9 – eTwinning Support Service)

2.3 Social Network Analyses

Based on a datadump provided by eTwinning, Social Network Analyses (SNA) were conducted. In order to understand better the current state of the network, a set of questions was constructed. In the following part, a subset of questions is selected to conduct the first SNA to provide a deeper insight into the underlying relationships. The following four questions were selected for the first round of the SNA to test the analysis tools. The analyses were performed by colleagues from the RWTH University in Aachen, Germany [7].

Question 1: When looking at the project collaboration network, is it possible to divide the network into sub-communities and if so, what is their relation to the rest of the project collaboration network?

Even if the project collaboration does not constitute the most important part of eTwinning since 2008, studying the project collaboration network, its structure and core using the SNA measures gives insights into how possible new mechanisms could be created to help other networks to grow in the future.

Through the analysis, we were able to identify 2776 separate clusters (see Table 2). These clusters are formed through eTwinners collaborating in projects. First observations show that there are four very large clusters that create the core of the eTwinning project collaboration network. The biggest one contains 8807 eTwinners, two other clusters with about 3000 and one of 1172.

Apart from these large clusters, there are many small clusters. As Table 2 shows, 2627 of them consist of 2 to 9 eTwinners. It seems that the small clusters are those of people who collaborate only on one project during the time they have been part of

eTwinning, the cluster size most likely corresponding to the number of the project partners.

Cluster size (N eTwinners)	Number of times identified
8807	1
3669	1
3175	1
1172	1
100-1000	9
10-100	136
2-9	2627
Total:	2776

Table 2 – eTwinning network clusters

What we can understand from the clustering formation is that, for example, in the largest cluster, there is a group of eTwinners who have collaborated with each other in a high number of projects where partnerships create complex ties among themselves. Moreover, we see that there are four sub-communities in the core of eTwinning.

Lastly, we calculated the modularity of the clustering. The modularity indicates the quality of the cluster, a fraction of any node's connections within its cluster (internal edges) and its connections to other clusters (Pham et al., 2011). Empirical observations indicate that a modularity greater than 0.3 corresponds to significant community structures. In our analysis, we observe a modularity of 0.4, indicating significant community structures.

Question 2: When looking at the project collaboration network, how dependent is the eTwinning project network structure on a small core group of eTwinners?

The analysis was done based on the projects eTwinners participated in at the time of the snapshot, i.e. in mid 2010. eTwinners who did not participate in project collaboration were excluded from the analysis. Figure 4 shows a typical degree distribution that follows a power law, therefore indicating that the project network is scale-free. In a scale-free network one can usually observe a few big hubs followed by many small clusters[8].

This means that the project collaboration network is dependent on core eTwinners that can be seen as bridges (hubs) between different clusters. Nodes with a higher degree tend to have a lower clustering coefficient (clustering decreases when degree increases). That means lower-degree nodes are placed in dense groups (clusters) and these clusters are connected via hubs (nodes with high degree). However, as the betweenness is quite low (less than 0.1) there are apparently no super-hubs who exclusively connect the clusters. Clusters are typically connected via several hubs. In con-

clusion, although eTwinning is dependent on a core group, this is a large and well-connected group.

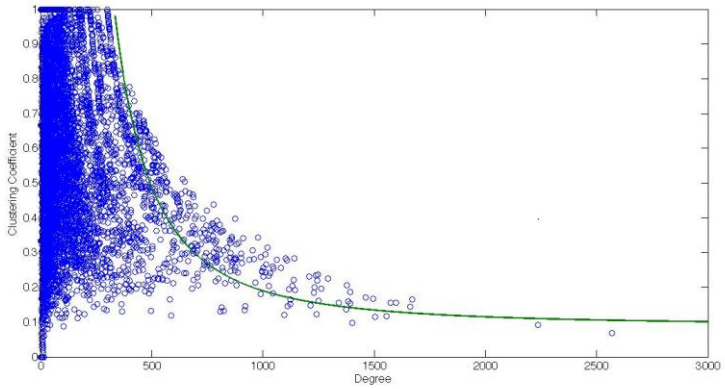

Figure 4 - Project Clustering vs. Degrees

Question 3: Over the years, how many eTwinners have gone inactive and were these eTwinners individuals who were connected through the project collaboration network?

The eTwinning platform uses different indicators to calculate "inactive" teachers, i.e. teachers who for example have not logged in onto the eTwinning platform during a predefined period of time. At the time of the snapshot, in mid 2010, out of the 114.020 (at that moment registered) teachers, 2750 individuals have been flagged as "inactive", resulting to 2,4% of all participants. The degree and clustering coefficient was calculated for these teachers. From the degree distributions, we can see that they follow a power law, the same as distribution in Figure 3. Actually, inactive teachers seem just a sample of the same distribution of the whole network. This distribution also holds when we constructed a network based on the blogs or the emails the teachers produced. The fraction of teachers who have clustering coefficient equal to NaN (Not a Number; means that they have only a connection - degree = 1), is 17.5% (project collaboration network), 49.01% (blog network) and 63.41% (email network). 41.4% of the inactive teachers do not have any activity in these (project, blog or email). Even for those who took part in various networks (projects, blog or email), they are quite isolated (as they have low degree and are placed in small, possibly disconnected, groups).

Question 4: eTwinners can create lists of MyContacts on their Desktop adding interesting people to the list for possible future collaboration. Is there

any evidence that teachers have added people from different countries in their contact lists?

As eTwinning by nature promotes cross-border collaboration, we also find that in "MyContacts", eTwinners overwhelmingly have added people from countries other than that of their own. If the creator of the list has a value of 0, it means that all contacts are from other countries, and 1 means that all contacts are from the same country. The mean for all eTwinners who had "MyContacts" is 0.16, indicating a strong preference for incorporating eTwinners from other countries in their lists. Figure 5 shows that only a fraction of contacts are within the same country.

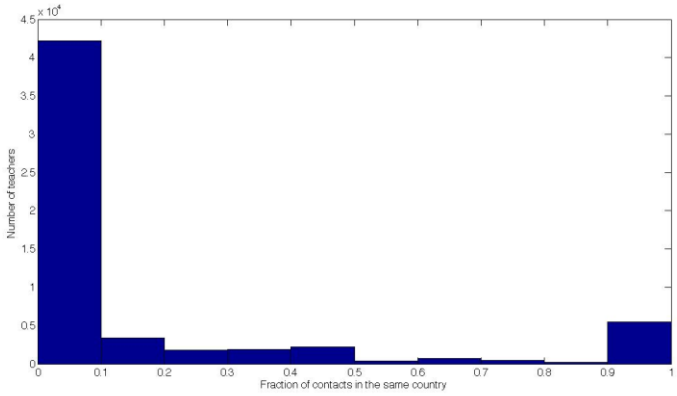

Figure 5 – Fraction of contacts in the different country than that of the e-Twinner (bar on the left) and in the same country (bar on the right).

2.4 Network picture

Given the data just presented, we can now paint a picture of the state of eTwinning. The results can be discussed from the eTwinners' and from the global perspective. We first discuss them separately and then combine them to give an overall conclusion. This then leads to a discussion of future work.

2.4.1 eTwinners' Perspective

As we found a strong core group found using the SNA methods, it is not surprising the eTwinners who responded on the sense of connectedness survey report that they have a rather high sense of connectedness, on the average, 6.65 on a 10-point scale. The likelihood that the respondents on the survey mainly belong to the core group is also reflected in the many new contacts they made in the six months preceding the survey. Only a few of them reported having made no new contacts whatsoever. The new contacts made in the last six months were primarily made online; yet it was reported that half of their contacts are not based solely on online situations. This reflects that eTwinning is a blended network, a network which combines online interaction with face-to-face interactions at for instance eTwinning conferences. The impression obtained is that those eTwinners who invest time and participate in school collaboration projects

are likely to become part of the core group. Once they are in the project collaboration network there are many incentives and contacts to keep people active. From this we conclude that the way the core group is organized provides a good base for eTwinning's future improvements and sustainment.

Yet, these results need to be seen in the perspective that most respondents of the survey are probably part of the active and connected part of eTwinning. Typically, surveys are unlikely to reach those people who are inactive, and this case is no exception. Due to the restrictions to use personal information, the data used by the project partners have been anonymised. This means that there is no way to identify a real teacher or a real school in the data without the consent of the individual. However, the results give us a good insight in the core eTwinners and shed some light on those that currently are not connected in any of the identified networks.

Finally, some eTwinners clearly prefer to receive support solely from the Central and National Support services and the others only from fellow eTwinners. Yet the majority prefers a mix of the two.

2.4.2 Global Network Perspective

As one can see from the numbers of eTwinning teachers, it is a large, fast growing community of schools and teachers in Europe. Most of the eTwinners remain active in eTwinning, meaning they log in at least once every 6 months. From the network point of view, to study eTwinning, evidence of collaboration between users is needed. In our case, we use the eTwinning platform to gather this evidence. At first, we looked at networks that were created through project collaboration, through contacts, use of internal messaging. Looking at the project collaboration network, we find that 73% of eTwinners are not connected. This may indicate that many eTwinners are not aware of each other, as they are not collaborating and interacting with each other through the platform. But note that interactions might take place outside of the platform. Those we cannot account for, though, in the Tellnet studies.

From the network point of view, this raises the concern that the network is very dependent on a small core group of users. When a network depends on a small core group, it is prone to fall apart when one of these core members drops out [2]. While the data show eTwinning is indeed dependent on a small core group, the SNA also shows this should not be a concern:

1. The core group consists of thousands of people.
2. The core group consists of many communities.
3. These communities are linked together through many connections rather than only through specific eTwinners.
4. The fraction of "inactive" teachers is relatively low.

Therefore, we may say that the core group of eTwinning is a strong and well-connected group, which provides a stable basis for future development and sustainability of the network. At the same time, however, many eTwinners remain unconnected to the project collaboration network, meaning that on the eTwinning platform we cannot show any type of interaction with others through these networks. From the

perspective that lurking is not necessarily a bad thing, this does not have to be problematic per se [9].

As an overall conclusion, the eTwinning network has established a strong core group that is well interconnected and supported. We believe that this core group will provide eTwinning with a strong base for the future. However, as this core group has been established using the snapshot of data, it also shows that a large number of eTwinners are not connected to the core network. Therefore, we suggest that now is the time not only to expand the connections in the network, but also to interconnect the networks further. eTwinning therefore now needs to focus on the eTwinners who are not part of the core network yet and efforts should be made to connect them to the core group. The use of peer-support mechanisms, such as the AHTGs tool described in the following section, in our view will improve the collaboration, sense of connectedness and social capital of the eTwinners.

3 Ad Hoc Transient Groups

In Ad Hoc Transient Groups (AHTGs) participants that have a request are helped by other participants in a private space ('ad-hoc') and for only a limited amount of time ('transience') [10, 11][†] (Figure 6). By creating many short-term moments of contact between participants of a network, an increase and larger spread of ties between participants is expected. It is expected, furthermore, that by introducing AHTGs, the sense of belonging will increase because participants will have more contacts and will perceive the community as more effective since members help each other to meet their needs [2]. Especially, the use of a matching system is believed to be of importance in such a large network such as eTwinning. It allows participants to become aware of each other, to increase their contacts with those whom they otherwise might never have met.

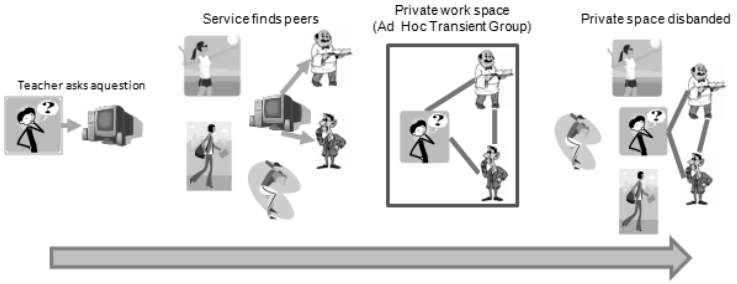

Figure 6 – General flow of the AHTGs peer-support service

[†] In the referred to articles the term Ad Hoc Transient Communities is used instead of Ad Hoc Transient Groups. We choose to use the Groups terminology in line with a redefinition 2. Fetter, S., Berlanga, A.J., Sloep, P.B.: Fostering Social Capital in a Learning Network: Laying the Groundwork for a Peer-Support Service. International Journal of Learning Technology 5, 388 - 400 (2010) of the term, as we deem communities are generally larger and are of a more permanent nature.

3.1 Validation of the AHTG tool

In order to validate the idea of implementing a peer-support service in the eTwinning network, a workshop was conducted in the eTwinning Conference of 2010. The aim of the workshop was to validate the design of the AHTG tool. In preparation of the workshop at the eTwinning Conference 2010, we constructed the initial design of a peer-support tool based on design considerations [3] determined earlier, namely:

- Participants need to be able to find the right participants with a matching system.
- Participants need to be accountable for their actions through ratings.
- Participants need to be shown other participant's previous activity and contacts to increase sense of belonging.
- Participants need to view the tool as usable and accessible.

We prepared four mock-up screenshots of the service (for an example, see figure 7), thus representing the main functionalities of the service. Each screenshot showed a step in the process of the service and was accompanied by a short questionnaire.

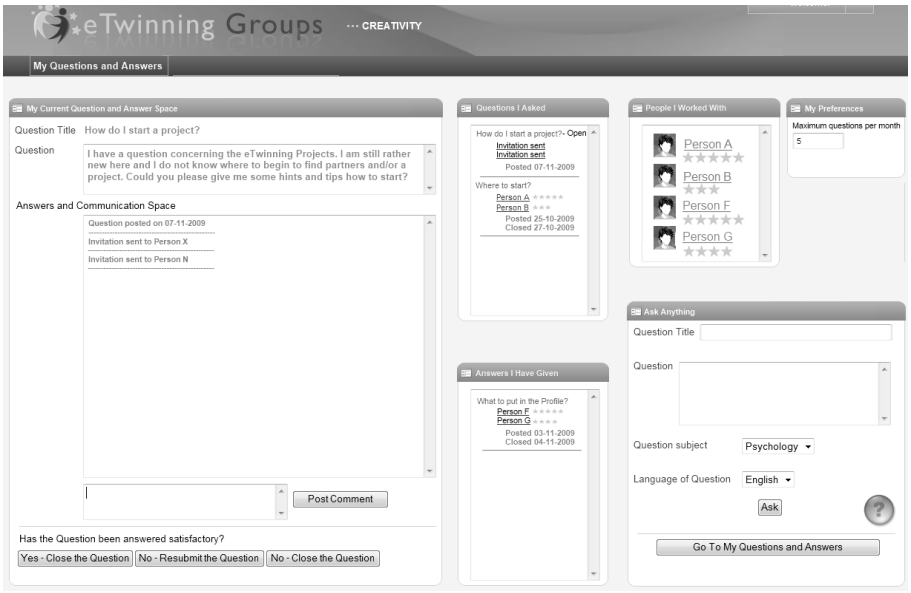

Figure 7 – Example of screenshot used in the workshop

In addition to these questionnaires, a questionnaire was constructed that asked about the eTwinning network, peer-support and possible improvements (see Table 3). This questionnaire was filled in at the start of the workshop. The goal behind these initial questions was twofold. First, it was for our own understanding of the people active in the eTwinning network. Second, we wanted the teachers to start thinking about the current situation in eTwinning network with regard to asking questions and getting into contact with other teachers.

Why did you join the eTwinning network?

Is it easy to get into contact with other eTwinning teachers and if not how could we improve this?
Do you have any thoughts on how we can involve people not yet connected to the other eTwinning teachers?
Is it important for you to be able to reach other teachers in the eTwinning network?
When you have a question about anything that has to do with eTwinning, what is currently the best way to get this question answered?
With regard to getting a question answered, what room for improvement do you see?

Table 3 – Initial questions asked

The workshop was set up in line with the user-centred design approach as described by Parmar [12]. This approach holds that the use of ICT should be seen as a tool, and should be developed together with stakeholders, enabling a more user-defined service that fulfils the actual needs of the stakeholders. Feedback was received through the questionnaires and by asking the teachers directly in the workshop to elaborate.

Multiple participants were eTwinning ambassadors and almost all used eTwinning on a regular basis. As the group was small (22 participants), opinions aired cannot bet generalized to the whole eTwinning population. Yet it does give an insight into the more active eTwinners, especially with the inclusion of the eTwinning ambassadors who are in regular contact with many eTwinners.

3.2 Descriptive results

The results reported below are based on a combination of the answers on the survey as well as spoken or written feedback. Due to the open nature of the workshop and survey, results are descriptive in nature.

When asked for what purpose the eTwinners would use the peer-support tool, the responses varied. This indicates the many different goals that the teachers have in eTwinning and how each has his or her own specific needs.

- Discussions.
- Ideas.
- Professional development.
- Technical problems.
- Related to area/curriculum.
- How to use eTwinning.
- How to organize a chat session.
- How to get a quality label.

As is clear from the goals and needs, people want to collaborate with other teachers. Yet, the question how easy or difficult it is to contact others had very varied responses. Some found it very easy, some thought it was very difficult. This will reflect the different level of expertise eTwinners have with regard to the use of ICT and eTwinning in general. On the other hand it points to the need to improve eTwinning in this regard, as finding new contacts should be easy for all eTwinners.

Regarding how eTwinners perceive the support they get from eTwinning, responses indicate that support mainly comes from the eTwinning National or Central Support Office and its ambassadors. In other words, while eTwinners indicate they would often like to receive support from their fellow eTwinners, most support comes through different channels. Nevertheless, there is a need to contact other eTwinners and receive their support. To achieve this, the eTwinners suggest using a number of communication tools, such a chat or a forum. In relation to this, they indicate that a better, more helpful website would be appreciated.

In line with the varied goals and needs are the reasons eTwinners gave to join eTwinning. The following three reasons sum up well the different angles from which the participants approached eTwinning initially.

- eTwinners feel the future of education lies in international collaboration between teachers and their students.
- eTwinners feel eTwinning provides a way to learn and use ICT in an innovative way.
- eTwinners feel eTwinning allows them to share knowledge and experience.

Overall participating eTwinners appeared to be social and to know exactly what they did or did not want. For example, when asked how comfortable the teachers felt about rating each other, it became clear that the community had a strong sense of oughts and ought-nots. While such ratings are common in many online Q&A communities, participants were very clear that they did not want to rate their peers. Also, they seemed generally concerned about the well-being of the eTwinning network.

4 Conclusions and Future Work

For Learning Networks to flourish, participants need to be aware of each others' existence and connect with each other. As the example of the eTwinning network shows, this to happen cannot be taken for granted. While it is clear that eTwinning has a strong, well-connected and large core group, the majority of registered participants seem to be in isolation. As is proposed in this paper, one way to reach these isolates is by using a peer-support service that uses AHTGs. Through this service, eTwinners can get in touch with each other in an easy, fast and meaningful way. Thus AHTGs might prove especially useful for those just starting in eTwinning. That is, as it might seem impossible for some newcomer to find the right person in such a large network, having a matching system that does the search for you will lower the threshold to actually ask a question and get connected. The results of the workshop also showed some important considerations for the actual design of the service. Most, importantly was the finding that eTwinners did not want to rate each other. Ratings were planned in the initial design but have been removed because of this finding. In addition, the user interface was improved because of the feedback.

As presented, the results of the validation workshop underline the importance of such a tool. The positive feedback of the participants together with the insight gained from the data-analysis allows for in-depth testing of AHTGs in a large-scale Learning Network such as eTwinning. Indeed, at the time of writing, a first pilot in eTwinning using AHTGs is being conducted. Furthermore, a second version of the prototype is

already underway using insights and feedback gained from the first. Results from both experiments in which the prototypes were used should provide valuable insight into the usability of AHTGs and their effect on the social network.

Future research to increase eTwinner involvement in the social network could focus on the development of the participants' Personal Learning Networks as places for their professional development. We define a Personal Learning Network (PLN) as a network of people set up by an individual specifically in the context of his or her professional activities through online platforms to support his or her professional non-formal learning. These egocentric networks can be diverse and suited to the needs of individual eTwinners, catering to their individual expectations from contacts within the network. PLNs, including contacts made online as well as contacts made outside the online social platform, are created through networking activities by the eTwinner at the centre of the networks.

Networking activities are at the core of the success of real and online networks. One possible reason for reduced levels of interaction in online networks could be that online networks often inhibit the engaging, free-flowing conversations that lie at the core of face-to-face networking activities. Teachers can interact with others, exploring each others' experiences, interests and capabilities through open dialogue. In the course of these conversations, individuals also define their own strengths, interests, expertise and experience, their own "professional identity" as it were.

Services provided on the online platform could then target the development of eTwinners' Personal Learning Networks. This could include dynamic feedback on digital identity creation, through social proxies [13]or the development of networking skills [14].

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Stimulating reflection through engagement in social relationships

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Abstract. Reflection on one's own behaviour and practice is an important aspect of lifelong learning. However, such practice and the underlying assumed principles are often hidden from the learner's vision, and are therefore difficult to evaluate. Social interactions with others stimulate the learner to re-asses and reflect on the nature of the learner's own behaviour and practice, such as in professional networking contexts and intercultural encounters. This paper describes the prerequisites of learning from these interactions and the possibilities of technological support. It presents one approach to providing support for developing the required skills, with the example of the CEFcult tool, which supports intercultural communicative competence building.

Key words: reflection, learning, social interaction, communication, networking skills, intercultural skills

1 Introduction

Reflection on one's own practice is an important aspect of lifelong learning [1]. For professional lifelong learners, this means questioning their professional practice (way of working), the self-created and organizationally-imposed structures they operate in, and the processes they use in their daily professional life [4]. However, such practice and the underlying principles are often hidden from the surface, and therefore, difficult to evaluate [2].

In discourse comprehension theory, the description of situations and practice is described in the terms of "schema" and "script" [6, 7]. A schema is a mental semantic representation of a situation or of an event. It is a prototypical storybook, a "what is to be expected". Schemata describe the unmentioned rules in a social interaction, depending on the context. The peculiarities of the instance decide the actual scripts used. These different layers of context have an influence on the way language is used to convey meaning and conduct conversations.

Socially agreed frameworks can be called into question in interactions with *others*, namely in those formal, non-formal and informal conversations between two or more individuals. These interactions can occur with particular learning

goals in mind, but do not need to. A clear example of this are conversations in an intercultural setting, where speakers may belong to different social groups. Their social identities will determine the underlying context of the conversation [8]. In professional settings, the underlying context of interactions are formed by the professional identities of the dialogue partners. These interactions occur in face-to-face networking activities, and even more so in online networking activities. We define professional networking as the act of making connections with other professionals, with or without the intention of making long-term ties with them [9, 10]. Such interactions can create the setting for misunderstandings, needing clarification and explanation, and consequently leading to situations where learning can take place [5]. The resulting dialogues creates a possibility for negotiation of common ground between the speakers. The level of trust between the dialogue partners can also influence the occurrence of misunderstandings and the extent to which they can be negotiated [17]. Also, a cognitive model of the partner will be created by each speaker, as complete as it is needed for achieving individual goals [5]. In short, dialogue with such others can be learning environments where the learners are encouraged to explain their practice more completely and potentially even redefine their own behaviour in a larger framework.

In the following sections, we will first describe the skills needed to engage in these interactions, from a perspective of learning and how technology can support the development of these skills. Next, we will describe the example of technology in the CEFcult project, which aims to support the development of intercultural communicative competence. Finally, we will look at future research steps.

2 Understanding the context and skills required

Social interactions can put lifelong learners in settings in which their underlying assumptions can be questioned and reflected on. But do all social interactions trigger reflection and learning? And does merely engaging in a social interaction automatically result in a learning situation? Can these social interactions be supported with technology? There appear to be some prerequisites for this type of learning: below, we discuss some situational requirements and skill requirements in the learner. We do not aim to be exhaustive in this discussion, but to describe some aspects that are relevant for technology design. Further research is needed to define a clearer picture of the nature of social interactions as learning settings.

2.1 Situational requirements

Not all social interactions necessarily result in a reflective learning situation. There are some situational requirements that need to be fulfilled.

Firstly, for learners' assumed schemata and scripts to be questioned, there needs to be sufficient and relevant differences between the dialogue partners. In circumstances where the partners are alike, it is more likely to have shared schemata and less misunderstandings, creating less opportunity to learn from

each other . However, too many differences between the dialogue partners will create little opportunity for creating common ground. (In other words, the dialogue partners need to be in each others' "zone of proximal development" [16]). Differences between dialogue partners can occur due to differences in social and cultural background, language differences, differences in professional backgrounds and interests, etc.

Secondly, the context in which the social interactions take place (particularly, time, place, social setting, etc.) can also play a role. For example, professional networking often occurs in work-related settings, where new encounters are made. Intercultural encounters can take place within different aspects of personal and professional life. However, the extent to which people are willing, able or required to engage in or dismiss professional or cultural differences can depend on the environmental setting [11]. Relatedly, the extent to which these interactions trigger reflection on one's own behaviour can also follow from this setting.

In recent years, Web 2.0 technologies, especially blogs and social networking sites, have created virtual environments where people can interact and enter into dialogue with many different people of various backgrounds. Research is ongoing in how far these new connections create learning situations for lifelong learners.

2.2 Required skills

Even when dialogue partners portray sufficiently interesting differences, this does not necessarily entail a learning situation. For a learning situation to occur (as opposed to a conflict for example), dialogue partners need to trust the other, and her intentions [17]. Learners also need to have the necessary reflective skills to be able to identify and understand the differences between themselves and their dialogue partners. For practicality, we have paraphrased the required skills as follows:

1. *"I can see that the other is talking from a different point of view"*: This involves the learners skills to be able to observe that the other person has different assumptions than ones own. It follows from being able to understand the other's language and infer the underlying worldview from the other person's messages [6, 5]
2. *"I understand the intention of the other in expressing a different point of view and trust her willingness to enter into dialogue about this issue"*: This involves the level of trust that exists between the dialogue partners. The learner needs to be able to assess the intentions of the other in their willingness to negotiate their point-of-view, in order to set up common ground. The learner needs to be able to identify the other's boundaries and her own [17].
3. *"I can understand that different point of view*: This refers to the learners skills to be able to understand and re-assess the conversation in light of the other persons framework. Meanings are negotiated in and during the interaction with the other person [12].

4. *"I can take up that different point of view and different perspective, as and when needed"*: This refers to the ability of the learner to understand the worldview of the other person and the ability to take the perspective of the other person, as far as it is needed and as far it is possible [6, 5]

Examples of these scaffolded reflective skills can be seen in intercultural competence development and networking competence as well. Research in intercultural competence development shows that knowledge, skills, attitudes and awareness of values are key factors in developing intercultural competence [8]. Figure 1 illustrates Byram's Model of Intercultural Competence Development [13]. Advanced intercultural skills entail the ability to show appropriate and effective behaviour in culturally sensitive issues [14]. This follows from the ability to "take the others' perspective." An interesting aspect to these interactions is that the learner also becomes self-aware of her own culture and cultural values. This is echoed in [5] when talking of "mutual modelling" in interactions. Similar reflective skills are involved in networking and personal network building [15]. By engaging in professional networking interactions, learners can explore and understand others' professional identities and define their own [18, 19]. Although quite some literature exists on the benefits of networking in professional contexts, more research is needed to explore the nature of professional networking and the required networking skills.

Learners develop these reflective skills often through self-reflection or guided reflection, triggered by social interactions. As more and more of these type of interactions take place online, it creates the opportunity to engage much more in this type of learning. The interest of the authors is to explore how technology can play a role in supporting the development of these reflective skills and promote this type of learning.

3 Issues in technological support

Technology can be used to train learners in their reflective skills of recognising, understanding and appropriating other peoples perspectives. The goal of using technology here is to capture a learner's behaviour in a particular social interaction (with at least one other person) and to provide feedback on this behaviour, taking into account some aspects of the other participant. When looking to design technological support to develop these skills, there are a number of issues to consider.

We will illustrate these technological issues with a running example: Suppose the feedback system is aimed at supporting journalists in training their interview techniques for live television interviews. In live interviews, these professionals have only limited time and opportunity to extract key statements from their interviewees. They need to perform to their best in these circumstances, picking the relevant issues from their interviewee's answers and building on them with the most appropriate questions. The feedback system is designed to support these journalists in training the relevant skills to perform better in live interviews.

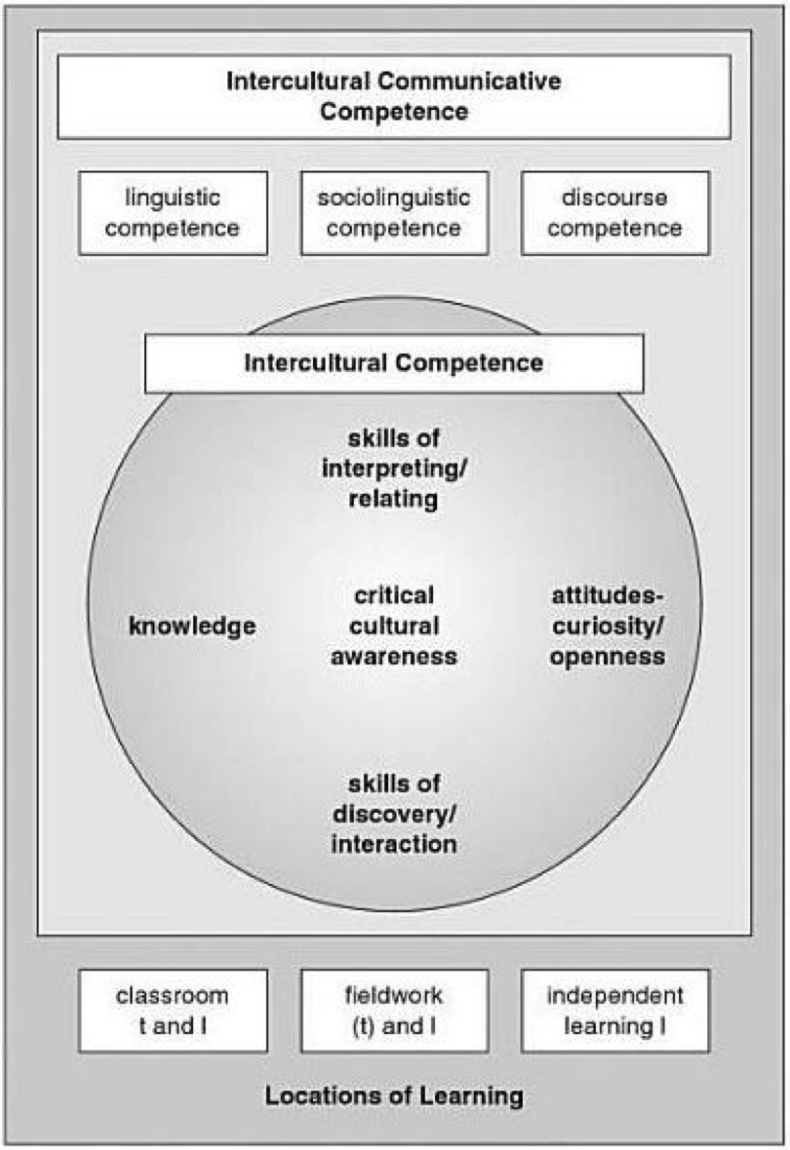

Fig. 1. Byram's Model of Intercultural Competence Development

- The technological support is aimed at training individuals in evaluating the behaviour they portray in social interactions, for example in the live interview. The users of the technology should therefore be able to exhibit their authentic behaviour within the environment, so that it can be scrutinized and reflected upon. In our example, the feedback system is a learning space, where the journalist should have the freedom to make mistakes in a (mock) live interview setting (without feeling bad about it) and to learn from these mistakes. As using technology for learning still forms a barrier for many people, the challenge here is to provide the learner with **a sufficiently safe environment to confidently engage in the learning experience, without inhibitions.**
- The technological support should also ensure that the elicited behaviour is the one that needs to be trained and that it is authentic. In our example, the feedback systems needs to allow journalists to portray their interviewing skills as they would in a real live interview. The challenge for the technology here is **to create settings in which the targeted behaviour is triggered or elicited from the learner in an authentic way.**
- The technological support has several possibilities to give feedback on the behaviour in the social interactions. In our example, the feedback on the journalist's behaviour can be regarding (i) the questions she asks, (ii) her responses to the answers given or (iii) even her language skills. The challenge for technology designers here is to **explore and define the different kinds of evaluation or assessments possible in the development of these highly reflective skills**, and to **determine the most effective ways to provide this feedback within the technical environment**.

These challenges need to be addressed in the design choices of technological support environments for social learning.

4 Example: supporting intercultural communicative competence development

In this section, we take a closer look at the approach taken in the CEFcult project to support the development of intercultural communicative competence. The CEFcult project (`http://www.cefcult.eu`) aims to promote intercultural professional communication with foreign language users by means of an assessment tool, based on Web 2.0 principles. The online environment designed in the project aids the assessment of speaking skills and intercultural competence in professional communication.

The tool consists of a web-based platform on which learners can go through observation or production tasks. In observation tasks, the learner is asked to view a recording of an event of intercultural interest and reflect on it using the provided assessment grid. The issues identified by the learner can then be compared with the model results. In production tasks, learners can create recordings of their own intercultural performance, following a text-based question or audio-visual prompt (figure 2). They can then self-assess these performances by using

the provided assessments grids. They can also invite others to assess their performance using the same assessment grids (figure 3). This social evaluation can give learner a more complete view of how their performance is perceived by different individuals. Evaluations can also be extracted from the platform to be included in individual ePortfoilo's.

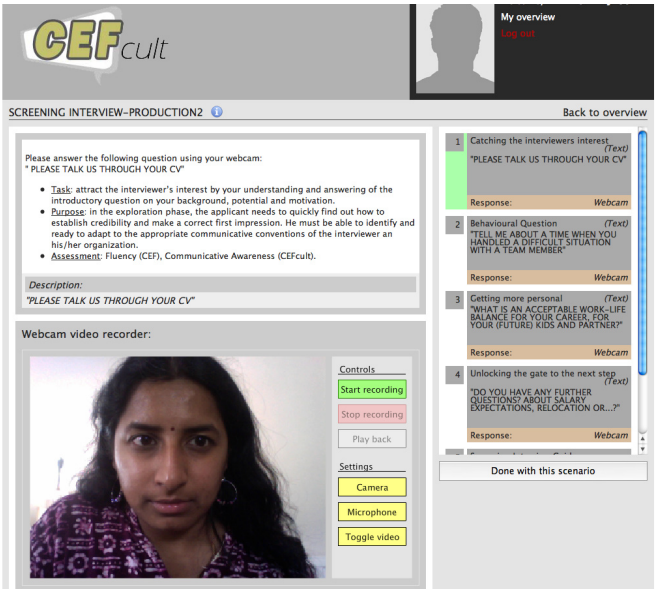

Fig. 2. Production Task in CEFcult tool

The training process embedded in the design of the CEFcult tool hinges on the following four principles:

1. **Scaffolded eliciting of behaviour**: the learner can follow predetermined scenarios, with specified tasks related to performance in intercultural settings. Scenarios consist of observation tasks followed by performance tasks. This simulated performance or reflective exercise can be captured in a video recording, for further processing in the environment.
2. **Guided observation of behaviour**: in observation tasks, learners are provided with the necessary tools for learning to observe instances of interesting intercultural behaviour. These include assessment grids with task-specific descriptors pinpointing the issues of interest in a particular task. Learners can go through observation tasks, assess what they see and compare their assessments with model-assessments.
3. **Accepted Instruments for self-assessment and peer assessment**: the CEFcult tool uses the CEF scales (Common European Framework of Reference) for assessing oral language skills and the INCA scales for intercul-

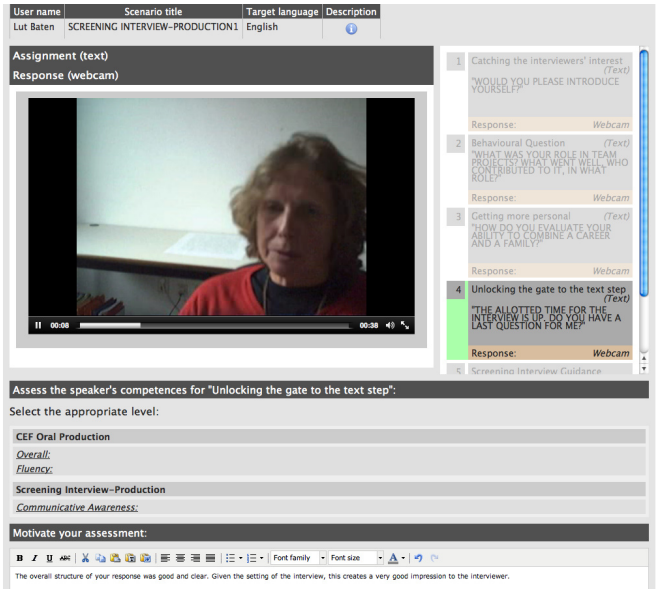

Fig. 3. Assessing a Production Task in CEFcult tool

tural competence skills, which operationalises Byram's Model of Intercultural Competence Development. Learners are also obliged to include textual annotations to the recording as part of their assessment. This forces them to express part of their reflections in a textual form.

4. **User control over performance and extraction to ePortfolio**: Learners can invite their selected peers to assess their performance according to the linguistic and intercultural scales. Only those peers invited by the individual learner can access the learners performance. Trust again plays a role here, as learners on the platform need to identify who can give them valuable feedback on their performance . The platform needs to enable learners in making these decisions, by giving them the information they need [17]. This gives the learner a high level of control over their own content on the platform. As a consequence, the CEFCult can also be used purely as a self-assessment platform.

Coming back to the technological issues raised in section 3, the principles followed in the CEFcult tool address the three issues in the following way: (i) the safe environment is ensured by giving more control to the user over their own performance videos and their choice of assessors, (ii) the authenticity of the elicited behaviour is targeted by the use of scenarios grounded in real situations and the use of role play and (iii) the feedback on the portrayed behaviour is guided through the assessment schemas based on known language and intercultural competence assessment frameworks, but allows for individual assessors to give personalised feedback through the annotations.

The CEFCult tool offers an approach that combines individual performance, individual reflection together with guided and controlled social feedback on an individuals performance. Similar approaches could be taken to support other contexts where these reflective skills are required. For example, to develop networking skills, a technological platform could be designed based on the same principles.

5 Conclusion: Further Research Steps

In this paper, we discussed how reflection on one's own behaviour and practice is triggered by social interactions. We described this process against the background of discourse comprehension, with examples from intercultural competence development and networking. We then looked at the prerequisites for social interactions for learning. Finally, the technological approach taken in the CEFcult project was described, which combines the individual training platform, with controlled social interaction.

Further research steps include developed understanding of social interactions as settings for learning and the design and development of similar technological platforms for the support of networking skills.

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Promoting reflection through annotations in formal online learning

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Abstract. This article explores the role of annotations as reflection amplifiers while studying in an Open Educational Resources distance course. A controlled experiment reveals that the treatment groups using frequent and local annotations did not perform better at the test. However, measures within the treatments exhibit a moderate but significant improvement of the mark in the group composed of high annotators.

Keywords: reflection, annotation, online learning, reflection amplifier, meta-cognition, meta-learning, OER

1 Introduction

Note-taking, either when listening to lectures or reading texts, is a "totem" of teaching and learning. It seems that for centuries tutors have been expecting that students do take notes and that tutees consider note-taking as a natural activity in a scholarly life. But what functions does it exactly fulfill?

According to Hartley & Davies [1], annotations (sometimes called "marginalia") have 2 faces. As a process, they help to maintain attention and apprehend the material in a cognitively engaged way. They assist in keeping learning going on and, as such, they can be signs of reflection addressed by the self to the self in the present of the interaction. They somehow make learning visible [2]. Annotations are also products. They are stored for the future, with possibilities to be reviewed, re-structured, enriched. Boch & Piolat [3] use a similar distinction but labeled differently: notes to record information (products) versus notes to aid reflection (process).

Despite a renewed interest for digital annotations in the context of Web 2.0. growth and the development of innovative tools likely to take on new annotation functions (tagging, sharing) in the digital world, research concerned with learning aspects of private electronic annotation do not abound.

2 Annotations as reflective micro breaks

An annotation is a personal trace left by a student on a read document. An annotation records readers' efforts to shape their interaction with the content. This article concep-

tualizes the making of a digital annotation as a process of personal *reflection*. Annotating is therefore conceived as a "reflection amplifier". According to the term used by Verpoorten, Westera, and Specht [4] in their structured inventory of reflective techniques, a reflection amplifier is a compact, frequent and focused tingling of reflection about the content and/or about the self-as-a-learner within a particular learning task. Reflection amplifiers contrast with time-consuming and post-practice opportunities for reflection like learning diaries or portfolios. Even though they take only a handful seconds, annotations are conceived as brief episodes of thinking while learning. This action of "writing on the reading" is deemed to enhance the quality of learning.

3 Research questions

The study investigated the outcomes of using digital annotation software in online courses.

First, it was hypothesized that frequent use of the annotation tool and of a dashboard of annotations would be positively reflected in achievement scores because it represented a beneficial active process of content internalization maintained by short but repeated efforts of reflection.

Secondly, it was predicted that some annotation strategies would contribute more significantly to learners‘ performance and overall engagement state.

4 Methodology

4.1 Learning Context

The online course. The learning material of the experiment was the 4-hour online course "Seks en de evolutie" (Sex and the theory of evolution), an OpenER course [5] designed and offered in Dutch by the Open University in the Netherlands. It offered 30 well illustrated pages of 800 words in average (Fig. 1) and 4 interactive animations. It covered quite complex and interrelated notions and mechanisms as defined by Darwin and his followers: mutation, natural selection, genetic drift, gene flow, survival of the fittest, etc. On the whole, the course gave an in-depth account about the evolutionary theory and invited the learner to use it as an interpretation grid of behaviors observable in everyday life. In all treatments, the course was introduced by a welcome video and closed with a test.

The tools. The digital annotation tool presented as a comment box displayed on each page (Fig.1). It kept record of all annotations produced by the learner on this very page, arranged by date. A static reminder was visible on all pages, saying: "Do not forget your annotation". The annotation tool unfolded through a click by the learner. Consistently with the length of the reading material and with the actions requested from the learner (frequent but short notes), the surface of the tool was intentionally

not extremely large and its function was deliberately restrained to the basic typing of very localized comments on the pages.

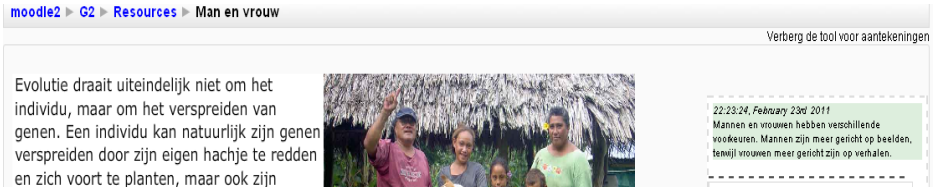

Fig. 1. – The annotation in its local context of a standard web page of the course

However, in order to prevent effects of fragmentation and to support the function of annotations as products, all marginalia were also recorded on a single page called "dashboard", available at any time by the student. On this page, the annotations were organized by section of the course content. By combining an annotation tool to a dashboard, this research attempted to differently treat the effects of annotations from the effects of reviewing them.

The annotation strategies. Treatment 1 and 2 used the same annotation tool located on each page but in a different way. In both conditions, subjects were asked to take an annotation each time they (re-) visited a page. However, participants in condition 1 could encode their marginalia in the way they preferred while those of condition 2 were requested to produce annotations as questions. Precisely, participants were requested to put themselves in the shoes of the teacher and to craft questions likely to be used in a final test about the content of the page. Verpoorten & al. label this reflective strategy: "Students set the test" and describe it as "Learners are asked to make up the questions they could get for their exam" [4].

4.2 Sample and Schedule

Invitations to participate were displayed on electronic and paper communication channels of the Open University. Announcements of the study were also sent to Dutch dailies and women magazines, as well as to a psychology popular publication. 247 subjects, randomly distributed into the 3 conditions, entered the course at least once but only 137 completed the final test and answered the evaluation questionnaire. They compose the final sample: 34 persons for condition 1 (control), 54 for condition 2 (free annotations) and 49 for condition 3 (annotations as questions).

4.3 Measure instruments

In this comparative study, the online course was delivered at 3 conditions:

- no annotation tool (control group);
- frequent free annotations;

- frequent structured annotations ("students set the test").

The intervention variables were the provision of an embedded annotation tool and the exposure to a strategy for frequent and local annotations. The dependent variable was the subjects' cognitive engagement with the content, broken down in 5 quantitative indices of performance:

- index 1: score at the final test. This index designated the score obtained at the final test taken straight after the study session. It measured learners' achievement through 16 multiple-choice questions controlling knowledge and comprehension;
- index 2: number of pages (re)visited;
- index 3: time spent in the course. This index was measured as the number of "active ten-minute periods" in the course. A period is considered as "active" when it records one click in the 10 minutes time span, between the arrival on the page and the departure;
- index 4: number of annotations;
- index 5: total number of characters for the annotations;

(Indices 1, 2, 3 were common to all conditions. The others were logging information available only for conditions 2 and 3).

Prior to the access to the course, participants filled in a pre-questionnaire comprising questions about note-taking habits, a shortened version of the MAI (Meta-cognitive Awareness Inventory) and self-reported evaluations of familiarity with the topic and with ICT.

5 Results

An alpha level of .05 was used for all statistical tests. Levene's test of homogeneity of variance preceded parametric tests and degrees of freedom were adapted if necessary.

5.1 Inter-group comparisons

Background questionnaire. To ensure equivalence between conditions at baseline, one-way ANOVAs were performed on the elements of the background questionnaire. The procedure indicated an even distribution regarding meta-cognitive capacities, $F(2, 134) = .27$, $p = .76$, familiarity with the topic, $F(2, 134) = .18$, $p = .83$, and familiarity with eLearning, $F(2, 134) = 1$, $p = .119$. Descriptive statistics also showed an equal distribution for age, sex and education level.

Index 1: score at the final test (3 groups). An ANOVA procedure exhibited no significant differences between groups regarding mean results at the final test, $F(2, 134) = .44$, $p = .64$.

Indices 2 and 3: logging information (3 groups). Significant differences (Table 1) emerged between conditions with regard to the total time spent on the course, $F(2, 134) = 3{,}494$, $p = .033$, and the number of page views, $F(2, 134) = 5{,}291$, $p = .006$.

Table 1. Means for the 3 performance variables common to the 3 conditions

	Final score at the test			Total time spent on course			Number of page views			
	1 (N=34)	2 (N=54)	3 (N=49)	1	2	3	1	2	3	Total
Mean	**6,462**	**6,059**	**6,464**	**245,00**	**322,41**	**333,67**	**57,09**	**73,19**	**84,18**	**73,12**
Std. Deviation	**2,3195**	**1,7320**	**1,8850**	**115,240**	**171,188**	**172,539**	**23,020**	**36,881**	**44,961**	**38,477**
Minimum	**,0**	**1,9**	**2,5**	**100**	**50**	**100**	**29**	**31**	**29**	**29**
Maximum	**10,0**	**9,4**	**10,0**	**510**	**810**	**970**	**110**	**222**	**252**	**252**

Post-hoc tests revealed that the amount of time and page views was higher for treatment groups compared to the control group but equivalent between treatment groups.

Indices 4 and 5: logging information (2 groups). Table 3 provides information about the use of the annotation tool in conditions 2 and 3. From the observation of the logs, it turned out that the participants in the treatments displayed quite different annotation behaviours, some learners made a large number of annotations (more than 20.000 characters in condition 2 and more than 10,000 characters in condition 3), while others did with a few hundreds. These differences in approach may not become visible in the total time spend (no significant difference between condition 2 and 3), but clearly they cannot be ignored.

5.2 Intra-group comparisons (profiles)

At this stage, the analysis moved its focus from inter-group comparisons to measures based on intra-groups profiles. In this context, each participant to the 2 treatment groups was labeled “high” or “low” for each index or “protein” of performance: low/high annotator, low/high total number of characters, low/high browser. Profiles were built on the ratio between the absolute number of “annotations”, “characters”, “page views” obtained by a learner and the total time spent by this learner in the course. The frequencies of these different kinds of enactments on the learning material quantified the reflective engagement with this material. Relating these high and low behaviors to the performance at the test exhibits significant differences only for index 4 (number of annotations), $t(101) = 2.146$, $p = 0.034$, $d = 0.37$ and for index 5 (total number of characters in annotations), $t(101) = 2.76$, $p = 0.007$, $d = 0.35$. High

timers (time spent in the course) and high browsers (page views) did not make better than their low peers regarding test performance.

6 Discussion

Going back to the underpinning hypotheses of this study, it must be concluded that:

- average score at the final test does not differ between control and treatments groups. Offering an embedded annotation tool for frequent and local annotations and a synoptic dashboard for these annotations does not create any observable leap in learners' results compared to a plain distance course;
- the structured annotation strategy did not produce any significant enhancement of learners‘ performance compared to its free counterpart.

Regardless of the denial of its two main hypotheses, this study nevertheless delivered some results when the focus was put on high annotators versus low annotators. In this case, it appeared that annotations can be a vehicle for a reflection, traceable in the learners' achievement at the final test. Unsurprisingly, students who took advantage of the annotation tool, in number and length of annotations, learnt more from the texts that those who did not (see similar results regarding the number of handwritten annotations in [6]).

The study also invites to refine the notion of “reflection”. The word “reflection amplifier” was here used to point at the intended effect of the annotations. But a more neutral label like “thinking amplifier” might be better. Yet, the only secured observation is that high achievers in the treatment group show a higher level of “physical” activity (annotating) while learning. That this “active reading” can be equated to “active reflection” remains an open question. The performance enhancement might also be credited to indirect effects of the annotations on ownership, commitment or attention. Further research is needed to disentangle these notions and their connection to reflection.

Lastly, the study indicate that minimal tools and interventions can already help for learning online. Without spending huge amounts of time and resources (the technical development of the note-taking tool and the associated dashboard took one week), it is possible to equip Open Educational Resources courses with a basic support to reflection that can make a difference when adequately used.

7 Conclusion

This article investigated the possible links between an optimal standard of learning (reflective, autonomous) and the annotation process. Are students right to make frequent and local annotations? Should that practice of “writing on the reading” be recommended to everyone ? With what intensity? Should a teacher worry in case of no-annotation? Do these reflective breaks alter learning? This research provides some indications that frequent and local electronic annotations, conceived as short and re-

peated episodes of reflection on the content, can be positively related to learners' performance at the final test.

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Tools

Awareness-support in Scientific Events with SETapp

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Abstract. The recent rise of social media applications in all fields of our social life has also governed scholarly communications. With the so-called Research 2.0, scholars make use of social media to enhance their work and networking activities. On the other hand, those changes may have negative impact on awareness in Research Networks. Especially in the context of scientific events many information sources are used by the stakeholders to interact with each other. Smart devices, location-based services and recommender systems have been promoted to enhance awareness of people. Recently NFC found it's way into smart devices and is so far mainly used for mobile payment scenarios. In this paper we introduce SETapp, a prototypical application that makes use of NFC to support awareness in the context of scientific events. A first evaluation shows that users like the speed of NFC and prefer to carry out event-related tasks with support of NFC instead of doing them manually.

Keywords: awareness, nfc, android, research networks, scientific events, mobile computing, location-based services

1 Introduction and Motivation

The emergence of ubiquitous computing was enabled by the wide availability of smart mobile devices, high network coverage, affordable data plans and the increasing coverage with wifi. Location-aware applications support the user in gaining awareness about his surrounding; interesting people, recommended cafés, Wikipedia articles for near sights or constellations are only one touch away. So-called Native Mobile Social Networks (NMSN) like Foursquare and Gowalla have been created in which user can check-in to physical locations, share recommendations and pictures of the location. Each check-in is rewarded with points or badges and users heavily engage in contests who checked-in most often into a location. Such location-based services are dependent on the GPS positioning system in order to detect a user's exact position. The mobile applications of Twitter, Google and many other provide the users with location-aware news and search-results resulting in better awareness information for the user.

In the context of scientific events, researchers often feel overwhelmed with the amount of relevant information that is shared in various communication channels

[18]. Often, multiple items of the program run in parallel so it is difficult to stay aware about relevant times, rooms and people. Recently, scientific events faced the introduction of many social media applications, which for some people made it even harder to stay up-to-date. The microblogging tool Twitter[1] is often used for backchannel discussion, facilitating attendees to express their view on a talk or to stay informed about what's going on in parallel sessions. So-called *Twitter walls* are often used in public places at an event to increase the overall perception of the Twitter backchannel. Some users also use the above NMSNs to inform their networks about their current location at an event (e.g. *"I'm now in room A for a session on B"*). As those applications are dependent on GPS data, it is often difficult to use them inside a event venue. The Sociopattern project[2] has created RFID-enabled trackers of social interaction in conferences, exhibitions and fairs. While the tracking with RFID works well and may provide valuable insights in the social dynamics in large communities, the setup requires a huge effort, the equipment is rather expensive and all rooms have to be equipped with RFID readers [2,8].

In this paper we report about the rationale, design, implementation and evaluation of a mobile application to support awareness in scientific events. The Scientific Event Tracker Application (SETapp) makes use of the Near Field Communication (NFC) technology to exchange information between NFC-enabled mobile devices and so-called NFC-tags that can store data. So far, NFC is mainly used for mobile payment solutions. Our goal was to develop a prototypical NFC-enabled application for supporting awareness in scientific events with priority on support for direct physical interactions between attendees, rooms and posters and to compare the performance of NFC with that of QR codes. The paper is structured as follows: in Section 2 we discuss needed awareness support in Research Networks and scientific events. Following, in Section 3, we report about the design and implementation of the Android application and its GAE-based server-backend. In Section 4 we present the results of the SETapp evaluation and give an outlook on prospective applications of the NFC technology in other fields of TEL in Section 5.

2 Awareness Support in Scientific Events

According to Merriam-Webster, being aware of something means "*having knowledge of something [...and...] alertness in drawing inferences from what one experiences*" [10]. The term has been widely used in the context of communication and information system research as well in the domain of Computer Supported Collaborative Work (CSCW). Its definition however has not yet reached consensus within the scientific community. Instead, many composed terms have been used to describe specific forms of awareness such as *'group awareness'*, *'workspace awareness'* or *'social awareness'*. With the rise of mobile devices and ubiquitous computing, interest in location and context awareness has gained momentum. In

[1] `http://twitter.com`
[2] `http://www.sociopatterns.org/`

[16,17] we discussed the need for a better understanding of the term *'awareness'* in the context of Learning Networks that is less focussed on providing real-time awareness-support as it has been the case in CSCW research. If the participants in a Learning Network are scholars, we use the term Research Networks to refer to these specific networks. Attending and speaking at scientific events such as conferences and workshops is a core task of most scholars and thus essential part of their daily work. The connections made at such events strengthen one's professional network and are often important triggers for prospective joint research work and subsequent publications.

Scientific events are among the most frequently used means of presenting research results and ongoing research efforts to a larger community of fellow researchers. Following [6,7,13,15], such events can be divided into multiple phases (Figure 1) that make different demands on awareness support features. Moreover, different stakeholders that are involved in the event require different awareness support in the respective phases. In the preparation phase for example, the organization committee might be interested on how frequently the event's web presence is accessed and how the visitors reached the page. Potential attendees of the event on the other hand wish for information about the requested submission format, remaining time for submission as well as which people from their professional network also attend the event.

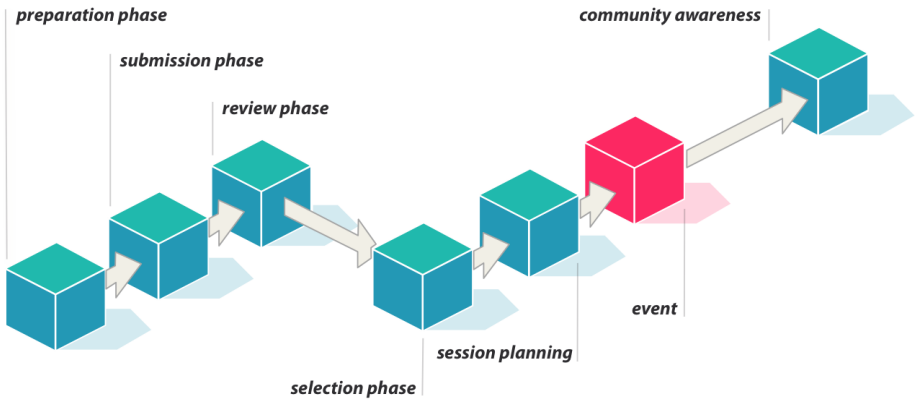


Fig. 1: Generalized phases of a scientific event [15]

Additional to the frequently used conference management systems that are supporting the organizers of an event, many Social Media tools have been used in the context of scientific events as well. Most prominently, Twitter has gained much utilization as backchannel for discussion and sharing of additional material [14] even for people that are not able to attend an event physically. Moreover,

there are dedicated platforms like Crowdvine[3] or Lanyrd[4] that aim at building social networks around events. Large social networks for researchers like ResearchGate[5], Mendeley[6] or Academia.edu[7] are creating a focused interaction space for the users that assemble around shared objects of interest. Those social networks and social media tools are enhancing scholarly awareness on a general level but are still detached from the conference management systems that are often a core tool in the management and attendance process. With ginkgo[8] we proposed an integrated Research 2.0 application that brings together the strengths of the separate tools [15]. Ginkgo serves as connector of several otherwise separate information databases with the goal to provide awareness information for all stakeholders in all phases of the event.

While a web-based application is an appropriate mean of communication before, during and after an event, a mobile application can be helpful to remove frictions from the awareness support during an event. The focus on location-based information together with the limited user interface and the often reduced set of features is supportive for staying focused and carrying out one's work effectively. Moreover, a mobile device is much more handily because of its dimensions. Enhanced awareness in the context of scientific events could be achieved using mobile applications that

1. support *attendees* with adaptive news streams depending on the current location and talk,
2. support *attendees* to easily exchange messages with other attendees,
3. support *attendees* to easily understand shared interests (common research fields, similar bibliography or shared event participations) with fellow researchers,
4. support *attendees* to generate their individual event schedule by selecting interesting talks from the overall program,
5. inform *attendees* about recent changes to the event schedule,
6. provide an easy overview for *session chairs*, who of the speakers are already in the room,
7. provide *event organizers* with quantitative and qualitative summaries of social media coverage of the event,
8. provide *event organizers* with an comprehensive list of attendees that have already registered on-site for the event,

It is important to state that applications like ginkgo or SETapp are not intended to replace existing socio-technical solutions but rather to enrich them. For example, for the time being, it is very unlikely for many researchers to switch from Twitter to SETapp for sharing backchannel gossip or from Facebook to

[3] `http://crowdvine.com`
[4] `http://lanyrd.com`
[5] `http://researchgate.net`
[6] `http://mendeley.com`
[7] `http://academia.edu`
[8] `http://ginkgosem.com`

ginkgo to manage their social circles. Instead we see the need for mediating applications that connect various information silos in order to provide the user with more awareness support. In the next section we introduce the general idea, concept and implementation of the Scientific Event Tracker Application (SETapp).

3 Concept and Implementation of SETapp

Near Filed Communication (NFC) is a subset of the well-known Radio Frequency Identification (RFID) technology. NFC is a relatively new technique which was first defined in 2002 by NXP Semiconductors and Sony. NFC is most often promoted as a technology to support cashless payment but NFC can also be used in other contexts. Some companies use NFC tags in their business cards and even modern passports use this technique for the identification of persons. The transmission range for NFC has been specified with maximum 10 centimeters. This limitation results from the requirement that a person should clearly recognizable declare her intention and will to carry out a certain act. So if a person would like to pay via NFC, the NFC-equipped mobile phone must be placed on an appropriate reader as it is the case with a credit card as well.

The first practical use of NFC in Germany was made by Deutsche Bahn with Touch & Travel that is already available at many stations. The system supports the user with easier booking of tickets. The system will soon be available for public transport as well [3]. With Google Wallet, another big NFC-based project was recently presented by Google [5]. Google Wallet offers cashless payments via NFC with certain partners, such as Radio Shack, Subway and Foot Locker. Currently the project will be tested in two major American cities (San Francisco and New York) and even supports NFC-payment with non-NFC phones. So far only a very limited number of devices is equipped with NFC. However, Peter Chou – CEO of HTC – predicts that by 2015 we will see more than 500 million NFC-enabled devices in the market [9]. Thus, a big increase in NFC usage can be expected soon.

SETapp's (Scientific Event Tracker application) primary focus is on awareness-support for attendees during a scientific event. SETapp can be also used prior to an event as well as afterwards but the main field of application is at the event location. Thus, we intended the following main features for the first SETapp prototype:

1. Exchange of professional profiles between SETapp users.
2. Exchange of scientific documents between SETapp users.
3. Exchange of private messages between SETapp users.
4. Check-ins into scientific events and talks.
5. Access additional information for posters.

3.1 NFC tags and tag types used

In order to support the different interactions described above, different type of NFC tags are needed to represent events, talks and posters. The exchange

of professional profiles is realized using the built-in NFC functionality of the respective device. The phone has to be NFC-enabled and must run at least Android 2.3.3 (Gingerbread) that supports both reading and writing NFC tags as well as the whole NFC Data Exchange Format (NDEF). To ensure maximum compatibility between Android and the NFC tags, Mifare Classic 1k tags were chosen, which hold a total of 1024 bytes and thus provide enough capacity for extensive records. Other standard sizes available with NFC tags are 64, 96, 152 and 192 bytes. The tags used are in accordance with the specifications of type 1/A of NFC tags [11].

In order to represent the different objects that exist in the context of scientific events, we created different types of NFC tags: such representing 1) events, 2) talks, 3) poster and 4) documents. The NFC-enabled phone itself serves as the container of the fifth tag type: persons. While text records, URI records or smart records only store short strings and their content can be evaluated by all available applications with NFC Permissions, the tags used in our context should only be recognized and processed by SETapp. To ensure this, a separate MIME type was introduced to clearly identify tags to be used with SETapp: `application/x-setapp-share`. If this MIME type is detected in a calling intent of Android, only the SETapp is called. Regular intents would show each application that has the rights to read NDEF definitions within an Android-typical intent-chooser. The distinction between the five possible NFC tag types is realized via the description of the entity in the packet structure. For instance, persons will be identified by `de.upb.messerschmidt.set.entity.Profile`. This information, as well as additional information is then written to the NFC tag. The information on the NFC tag serve as shortcut to a more extensive record that is stored in the server backend (see Section 3.3). Information on poster tags, as opposed to the other tags, are not stored in the server but on the NFC tag itself.

3.2 Android-based mobile application

The Android-based SETapp serves as the front-end for the user to interact with NFC tags and other users of the application. It uses the OAuth authentication method to let users create an account with the software using an already existing account with another software. We chose to allow users to authenticate using their existing Mendeley account (see Figure 2a); this way SETapp does not need to store credentials of the users itself, but rather only an OAuth token that is provided by Mendeley. Moreover, SETapp obtains access to the user profile data stored in Mendeley as well as the list of publications that a user has published there. The main screen of SETapp (see Figure 2b) allows instant access to the main features of the application. The design is based on wide-spread mobile applications as Facebook[9] or Hashable[10]. If the user taps the *'check in via NFC'* button, the device is going into NFC read mode and is able to read information spread by an NFC tag or another NFC-enabled phone. When the

[9] `http://facebook.com`
[10] `http://hashable.com`

user touches a tag with the appropriate MIME type as described above, SETapp opens automatically an activity for the scanned entity and displays the existing information for that record (these are to be loaded from the GAE (Section 3.3) or in the case of a poster directly read from the tag). Thus, the user saves much time navigating manually through the application to the desired record.

Tapping the button *'share your profile'* lets SETapp send the user's profile via NFC. *'Lookup an event'* allows the user to manually screen through the events that would use SETapp for supporting social interactions. For each of those events, the user can express his interest in the event by choosing a status from *'attending'*, *'maybe attending'* and *'not attending'* (Figure 2c). Finally, *'show the events you're attending'* allows the user go through the events that he attended or will attend in the future.

The user profile in SETapp (see Figure 2d) allow access to the list of publications (those that the user published on Mendeley) as well as the straightforward sharing of those using the Android-standard sharing interface. This way, a publication can be shared via email, to Facebook, Dropbox or to another SETapp user. Furthermore, on a user profile you can explore the other connections a user has, the events he is attending as well your own meeting history. The meeting history shows the events two users have in common; either because both of them attended them, planed to attend them or connected their phones at the event. This way, SETapp supports the awareness about a common scientific history.

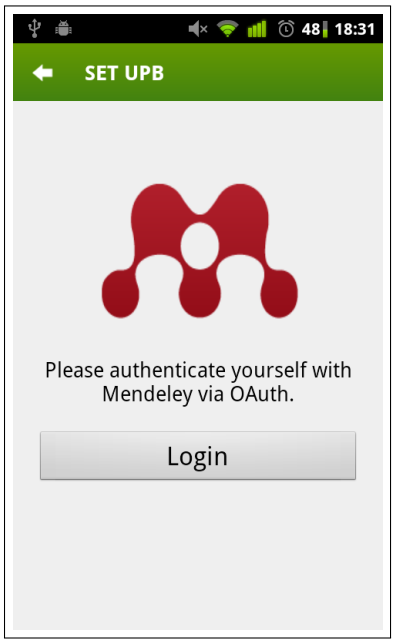
SETapp also features a simple NFC writer application that allows the manual creation of new tags that could be used in our experiments. In a realistic scenario, the NFC tags would be written using a professional writer facility.

3.3 Google App Engine backend

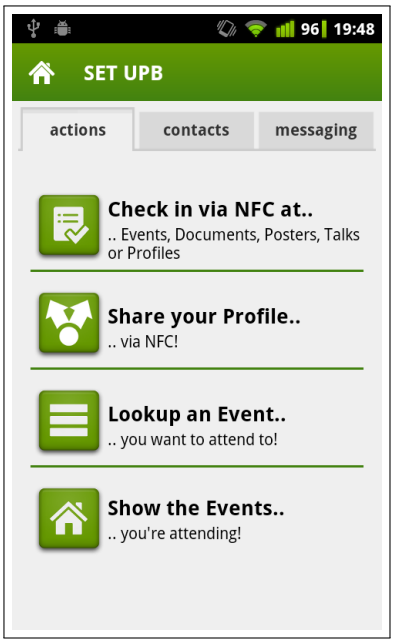
In addition to the Android application, a server backend was needed which enables the necessary data exchange and coordinates communication between participants. Google App Engine (GAE)[11] is a fully scalable and easily implemented platform which was used for the implementation of the Java backend. The technologies used in the implementation can also easily be implemented on alternative server platforms such as Apache HTTP and Apache Tomcat thanks to Java and established standards such as JDO. GAE also supports the automatic deployment of an application via Eclipse as well as a local testing facility, which is operated with a Jetty server. The data storage is managed automatically and requires no local MySQL database.

For communication between the Android application and the GAE backend, efficient data structures had to be chosen in order to make the data exchange error-resistant and to simplify the data processing on the client. To this end, JSON has been selected as the exchange format. JSON is natively supported by Android and can easily be integrated in the Google App Engine using external libraries. Figure 3 shows an example of how data is requested by the user in SETapp and delivered from the GAE. The implementation of the GAE scales

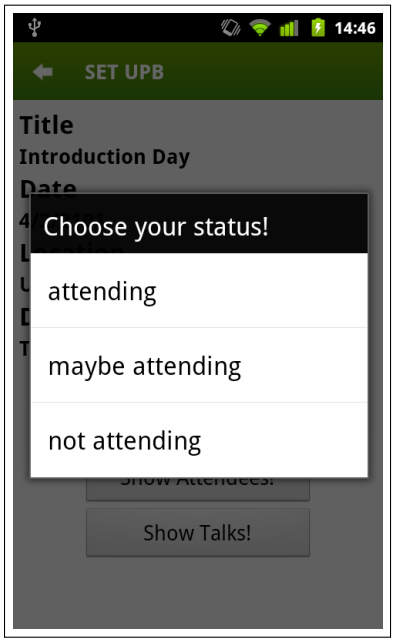
[11] `http://code.google.com/appengine`



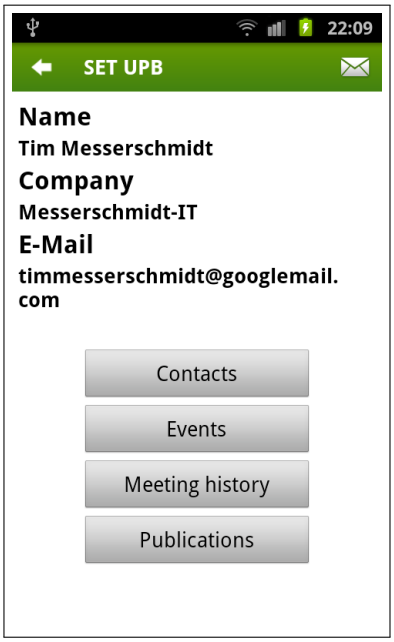
(a) Sign up and Login



(b) Instant access to main features



(c) Choosing an interest in attending



(d) A user profile

Fig. 2: SETapp on Android

with instances that are created for each query and thus should provide an ideal amount of computing power and memory. Especially for long running calculations or many simultaneous accesses to the GAE, this has the advantage the resulting load can be distributed across multiple instances. As soon as the number of queries is declining, the number of running instances is also decreasing until no instance is running anymore. This, in turn, leads to the situation that the next incoming request restarts the whole system. Irregular requests on the GAE therefore lead to the fact that inappropriately long response times occur that can lead to time-outs in the client application. Our evaluation of the GAE's instance model revealed that a request is answered nearly 39 times faster if at least one instance of the GAE is running (69ms) compared to the same request and a required instance start (2666 ms, mean values from 10 independent tests).

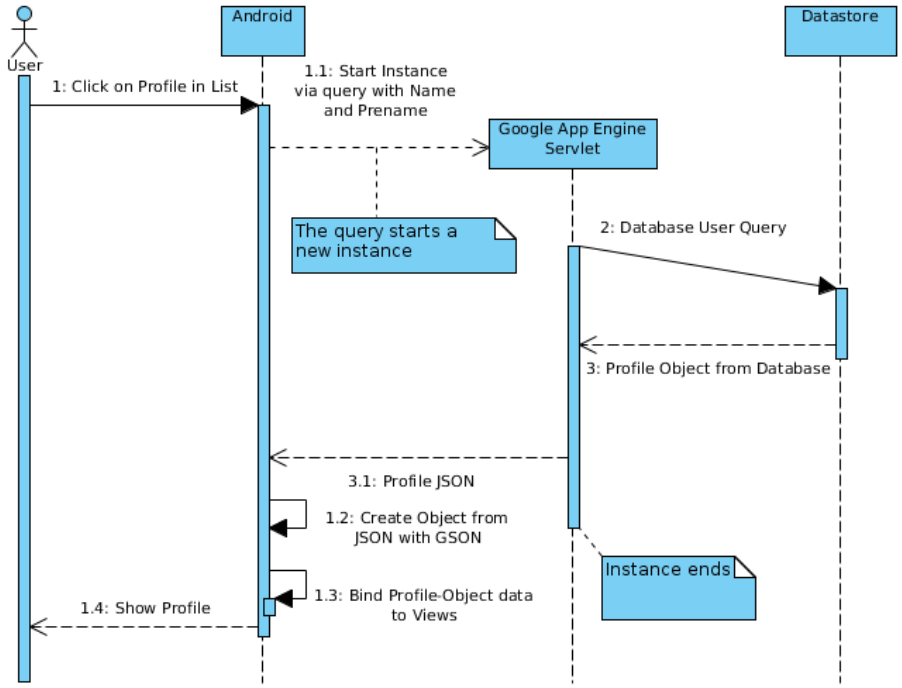


Fig. 3: Interplay of Android, GAE and DataStore: Requesting a user profile

This problem could be overcome with the GAE backend system introduced in version 1.5.0 [4] as this uses no deadline for requests to turn itself off. This kind of instance could be operated during the entire duration of an event to continuously work on important requests.

4 Evaluation of SETapp

SETapp was evaluated twofold: first we compared the scan times of an NFC tag and a QR code holding the same amount of information. Secondly, we evaluated SETapp in an exemplary setting with 11 users that had to carry out real tasks using the application.

In principle it would also have been possible to use QR codes for the purposes of the application described here. To measure the performance of QR codes and NFC tags in a realistic setting, we simulated a poster session in which additional information for the poster was stored on a QR code and also stored on an NFC tag. Both media held the same data and thus the time efficiency could be measured and compared. Table 1 shows the results of six independent measurement runs using the Android application *Barcode Scanner*[12] and SETapp. The actual time was measured from the time of starting the application to the successful display of the information stored on the respective medium.

Table 1: Comparison of scan times QR codes and NFC

Run	QR code	NFC
1	4,730ms	910ms
2	5,300ms	1,920ms
3	5,400ms	2,320ms
4	7,800ms	1,620ms
5	4,710ms	2,260ms
6	5,540ms	2,160ms
Mean	5,580ms	1,865ms

For QR codes, the average scan time is 5,580ms. We have to note that the scans were conducted under optimal light conditions and ideal distance from the printed QR code. External factors such as poor light or slow camera autofocus often found in cheaper phones would significantly deteriorate the measured times. The average time measured for scanning an NFC tag with SETapp was only 1,865ms. This time includes starting the application by intent and showing the tags content on the display. Even under ideal conditions for the use of barcode scanners, NFC is more efficient by almost factor 3 (cf. Table 1). NFC is more efficient not only in terms of time, but also in terms of integration in Android applications. With NFC, functions can directly called from within a custom application and read values can directly processes. To be able to integrate barcode scanners in a custom application, it is necessary to use large external libraries, which implement the detection algorithms for QR codes. In addition, weather

[12] `http://code.google.com/p/zxing/`

resistance and ease of use are other advantages of NFC compared with barcode scanners.

The second evaluation of SETapp involved real users in a constructed application scenario. 11 users in two groups worked with a pre-final version of SETapp installed on Samsung Nexus S smartphones. The users were given a short introduction to the purpose of SETapp, its functionalities and the setup of the user test. The tasks that had to be carried out by the users included:

1. the check-in into an event using NFC and manual check-in,
2. the check-in into a talk at the event using NFC and manual check-in,
3. the exchange of professional profiles using the NFC facilities provided by SETapp,
4. the lookup of publications and event participations of other people,
5. adding other users to their list of followings,
6. the exchange of personal messages with one's followings,
7. the lookup of additional information in a poster session using NFC.

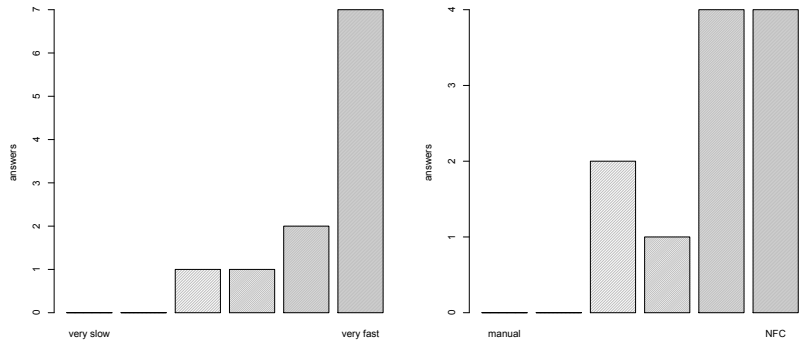
After the user tests all participating users were asked to fill in an online questionnaire dealing with the test. The evaluation questionnaire was partially building on the reworked Nielsen usability heuristics [12] and also covered questions regarding the efficiency of SETapp as well as questions focusing on visual and implementation decisions made. All closed questions were six-stepped Likert scales. In all, 11 people with an average age of 27 took part in the evaluation. We made sure that the participants had no prior knowledge of the application, so we would be able to observe learning effects of the participants. To be able to test the single features of the application, all testers worked with a fresh system, containing no prior interaction data.

Dependency on Internet connection The current implementation of SETapp is designed to rely on a reliable connection between client and server. Only the access to the data stored on poster tags is currently feasible without having Internet connection. This, in turn, would require the event organizers to provide stable wifi connections throughout the event, if the attendees shall be relieved from paying roaming costs or suchlike. Especially for very large events this could be an issue.

Usability and user interface design While text color, text size and background color of SETapp were perceived pleasantly, the arrangement and design of icons were partly rated adversely. Some of those rating can be explained with the rather large percentage of iOS-only users (45%, 5 persons[13]). 64% of all users (7 persons) had experience with Android before the test, 27% (3 persons) had also experience with Windows Mobile or Symbian.

The overall interface design was perceived as being deeply minimalistic (73%, 8 persons), which is amongst others attributable to the sharp distinction between different functionalities and the utilization of the ActionBar design pattern. Some

[13] The participants could select all mobile OS they had hands-on user experience with.



(a) Users' perception of NFC speed (b) Users' preference of NFC functionality over manual processing

Fig. 4: Users' perception of NFC features (N=11)

of the uses design patterns however seem to be confusing for persons very familiar with iOS, as they are not in line with Apple's User Interface Guidelines for mobile devices [1]. The implementation of the ActionBar was consistently rated positive with some participants suggesting a better differentiation between background and buttons would be helpful. The introduction of separation lines between the single buttons in the ActionBar would certainly achieve a higher usability of SETapp.

Despite a high satisfaction with SETapp's usability, the evaluation also showed that some of its functionalities need to be made more prominently. For example, the testers suggested that adding a person to one's contacts after having exchanged profiles with each other should be made easier and more eye-catching.

NFC technology The results of the evaluation have shown that using NFC for check-ins can effect significant efficiency enhancements over manual check-ins. 64% of the testers (7 persons) perceived this equally and rated the NFC features as being *very fast*; 82% (9 persons) rated it *fast* or *very fast* (see Figure 4a). Even after only short usage of SETapp and the NFC technology, a steep learning curve could be identified. While the first check-in using SETapp (into the event) took 1m12s for 3 persons (24s / person), the second check-in (into a talk) only took 41s (14s / person).

As Figure 4b shows, 82% of the participants (9 persons) prefer using NFC-enabled functions over performing the same task manually (e.g. the registration for an event at a desk reception). The other 18% said that they did not like the way the exchange of user profiles was implemented in SETapp. Their critique is mainly caused by the missing duplex feature of the NFC component found in the tester Samsung Nexus S. Currently people will need to start one activity

where they receive data from other phones and another one, where they send their own profile. Allowing full duplex in future versions of NFC would overcome this point of critique.

The users found the possibility to read data from NFC tags without having to open SETapp especially appealing. This allows a very easy handling of NFC tags in the context of scientific events and significantly reduces the time needed to check-in. Moreover, the users found the large capacity of poster tags very interesting as reading information from those tags worked even faster and without access to the GAE (and potential issues with wifi etc.). Additional to the currently available functions of the poster activity (showing title, abstract, authors and URL with additional information), users wished to be able to reach the user profiles of the authors to get to know more about them or contact them via direct message. Moreover, the users wanted to have a history feature for scanned (poster) tags implemented, which would support them in post-event reflections and prevent repeated scanning of tags.

5 General Discussion and Outlook

In this paper we discussed the impact of social media applications on the awareness in scientific events. Building on our research on future scientific event management systems [15], we presented a generalized set of phases of a scientific event that can be supported with web-based and mobile applications. We discussed how a mobile application could be enhancing the awareness of attendees at such events and discussed exemplary awareness-support areas in Section 2. Moreover, we introduced the concept and the prototypical implementation of the Android-based SETapp together with its GAE-enabled server backend and introduced the way to interact with NFC tags. Our evaluation shows that scanning NFC tags is at least 3 times faster that scanning QR codes with the same amount of information. Moreover, the integration of NFC facilities in custom applications is a far easier task than integrating good barcode scanners in an application. Scanning and recognizing QR codes is heavily influenced by external factors such as weather, light and the speed of the autofocus of the built-in camera, whereas NFC is independent from all these factors. The evaluation of SETapp with users also showed that they prefer the usage of NFC over the manual pendant and that they perceive NFC as working at great pace.

Also, we showed how a new technology that is so far mainly used to support mobile payment solutions could be adapted to the domain of scientific event management. While our specific focus was on supporting researchers, SETapp could also be used in regular events and fairs easily. We also see potential use of the NFC technology in the domain of Technology Enhanced Learning and describe possible use cases hereinafter.

5.1 Application of NFC to support other TEL fields

For one thing, the NFC technology could be also applied in the context of client-support in career guidance as relevant within the MATURE project[14]. Personal advisors (PAs) have to visit students at schools and support them in terms of future planning, overview of labour market information and job opportunities. Supporting knowledge maturing in this context can be two-fold if the NFC technology is available on both sides: On the one hand PAs can be provided with context-specific information about the students. Information about strengths and weaknesses, personal data and information about grades and graduation could be available from a central information system that would be accessed via NFC tags. On the other hand, students do not necessarily need an appointment to the PA for getting information about the labour market, individually matching her/his personal information if NFC tags are provided publicly. The student could simply place her NFC-enabled mobile phone at a NFC tag placed in a public place. The mobile application would then access available labour market information, match it against the profile of the student and present her with a list of recommended job opportunities. That way, the overall process of career guidance could be much more focused on the needs of the clients and could be improved in terms of efficiency, added value and sustainability.

For another thing, the NFC could be used for recommending courses or (open) educational resources to learners. Given that some mobile application had access to the institutional repository of courses and education resources it could recommend them after learner scanned a book for example. A recommender system would take into account the learner's profile, the objects scanned and the institutional offerings to present the learner with possible learning options.

5.2 Outlook

Retrospectively, the decision to use Google's App Engine as server backend was not optimal. Caused by the issues of the current instance model, the mobile application often faced timeouts that hindered the usage of SETapp. The new instance model introduced in version 1.5.0 of GAE could relieve this issue, but other problems with the platform would remain. Also, choosing Mendeley as OAuth provider caused serious problem in the development process. Until June 2011, the provided API did not even provided access to data stored in the user profile, access to user-stored publications was not given and so on. With the call for Mendeley's binary battle[15] the API was undergoing constant changes and improvements, leading to an API that provides access to most data stored in Mendeley today. Due to the novelty of the API it still comprises some errors and instabilities. To overcome those limitations and problems, we plan to integrate additional OAuth provider like Twitter and Facebook, which also would allow to get in contact with people that are friends/followers in those platforms.

[14] `http://mature-ip.eu/`

[15] `http://dev.mendeley.com/api-binary-battle`

Moreover, it would be interesting to analyze the meeting histories of the SETapp users, resulting in a network of physical meetings combined with the information about the context (event, location, date or even talks). Finally, we plan to integrate the preliminary insights in how users perceive and use a mobile application for awareness-support in scientific events into a mobile application for our scientific event management system ginkgo[16] [15] in the future.

Despite the very satisfactory evaluation results of SETapp, the evaluation also made clear that we need evaluation frameworks for mobile applications that are able to differentiate between the users' prior knowledge of mobile OS. If an application to be evaluated uses design patterns that are common standard in Android OS, it will receive high agreement from people that are familiar with this OS. Users that are unfamiliar with Android and its design principles (e.g. users of iOS or Blackberry OS) however will find it difficult to identify those patterns and thus will be more confused with the application. We see the need for comparative studies that research how well users familiar with different mobile OS are able to work with applications from different mobile OS. The research should also take into consideration how the results differ, if the application design sticks closely to the design guides for the respective OS. Moreover, this research should investigate how well Nielsens usability heuristics are also valid for the evaluation of mobile applications' usability.

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Affective Metacognitive Scaffolding for the Enhancement of Experiential Training for Adult Learners

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Abstract. The EU funded ImREAL project addresses the question as to how to align the learning experience obtained from a simulated environment with the real world context and day-to-day job practices of the workplace. This requires the development of a radically new way of enhancing these simulated environments to provide augmented simulated experiential learning. A suite of intelligent services are being developed that augment an experiential learning environment by connecting the simulated learning experiences with real world practice in a user-adapted way.
ImREAL is developing tools to support a growth in *knowledge of real world activity* which enables reasoning about what is relevant and how to exploit that relevance. ImREAL will also derive an *augmented model of the learner* which connects performance in the simulated world with performance in the real world Finally, ImREAL will offer *adaptive affective metacognitive scaffolding* via metacognitive tools to provide positively valenced feedback adapted to experience in the simulated and real world, and to promote self-regulated learning adjusted to the requirements of adult learners.

Keywords: Affective metacognitive scaffolding, affect, metacognition, scaffolding, adult learning, experiential learning

1 Introduction: Simulated Environments for Learning

Immersive simulated environments for experiential learning are growing in popularity and will play a key role in tomorrow's technologies for adult training. The major challenge is to effectively align the learning experience in the virtual environment with the 'real-world' context and 'day-to-day' job practice.

The ImREAL project aims to provide a new class of cost effective adaptive systems adjusted to adult learners' needs, pioneering a new psychologically and instructionally sound technological approach to seamlessly link the simulated

learning experience and 'real-world' job-related experiences; developing a novel conceptual framework — augmented simulated experiential learning — where innovative adaptive services extend virtual environments by making a connection with the 'real-world'; and delivering a new open framework of intelligent services which can be plugged into virtual environments to enhance self-regulated learning.

In order to leverage real world experiences, the following are the key properties of the ImREAL **augmented simulated experiential learning environment**:

Real world activity modelling — developing a holistic representation of real world activities grounded in job practice and incorporating cognitive, social and affective aspects;

Knowledge-enhanced access to real world experiences — multi-faceted capture of real world experiences through seamless integration of analysis and semantic annotation of existing records, collectively created user content, and storytelling;

Advanced context awareness — aligning the real world activity model with a model of the simulated situation to gain a better understanding of the learners and to map the activities in the simulated world to activities in the real world;

Improved learner models — combining performance analysis in the simulated world with dynamically obtained characteristics of real world activities, e.g. in an interactive open learner model providing an extended understanding of the learners' behaviour;

Adaptive affective metacognitive scaffolding — generating user-tailored affective feedback which can influence the learner's motivation, reflection, emotion and promoting metacognition focused on self-reflection, self-evaluation and self-awareness;

Openness (scrutability) — providing appropriate means to engage learners and tutors/trainers in tuning the environment by allowing them to provide feedback on the quality of adaptation and the mechanisms for promoting metacognition.

In this paper we outline our approach to enhancing how simulations are experienced/used by a learner to promote self-regulated learning (i.e. stimulating motivation, self-reflection and self-awareness and learning competence). More specifically, we outline our approach to the development of intelligent services for affective metacognitive scaffolding. These scaffolding services will interact with the simulation environments to help learners develop a better awareness of their skills, tendencies, practices and training needs/performance. The scaffolding services can be thought of as a 'coach' or 'mentor' (learning companion or buddy) which can (based on context models, learner models or simulation execution feedback) suggest, indicate or promote actions within the simulations or within the overall learning environment to enhance self-regulated learning. The scaffolding services will be delivered via a 'non-invasive' approach so as to

ensure that interactions with the learner are perceived as an integral part of the simulation and such scaffolding services do not break the fidelity, momentum or engagement of the learner. By non-invasive we mean interventions that are cognitively approporiate and in line with the instructional model. A non-invasive intervention therefore should seem to seamlessly fit within the immersive simulation, most importantly maintaining the fidelity of the simulation. For example, in an instructional model where training is taking place with oversight by a tutor, the scaffolding intervention may be represented as input from the tutor. This may apply a cognitive load on the learner and interrupt the flow of the simulated interactions they are undergoing, however, it does not invade upon the instructional model, nor overwhelm the fidelity nor flow within the learning scenario as a whole.

There are, therefore, three facets of the framework:

1. A learner monitoring system that is assessing and evaluating behaviour according to pre-defined indicators and learner behaviour.
2. A learner support system focusing on metacognition and affective aspects.
3. A learner support system that relates learner's experiences to peer experiences of similar situations.

2 Affective Metacognitive Scaffolding

Scaffolding has been a major topic of research since the pioneering work of Vygotsky [29] and the key work of Bruner and Wood and colleagues (cf. [31]). Ensuring the scaffolding support is removed as a learner's skills progress (i.e. fading) received more attention as a result of the work of Palincsar and Brown [17] and Collins, Brown and Newman [6].

Work on the use of scaffolding with the help of computer-based learning environments has been extensive (cf. [12]). Originally, the emphasis was on cognitive scaffolding which has many forms (cf. [5]). In the last twenty years or so, there has been a move towards research in metacognitive scaffolding (e.g. [2, 8, 10, 28]) as well as in the use of metacognitive scaffolding in adaptive learning environments (e.g. [14, 3, 24]).

Other forms of scaffolding have also been explored both in educational and technology enhanced learning contexts — such as affective scaffolding and conative scaffolding. Van de Pol et al. [28] sought to develop a framework for the analysis of different forms of scaffolding. In the technology enhanced learning community, Porayska-Pomsta and Pain [20] explored affective and cognitive scaffolding through a form of face theory (the affective scaffolding also included an element of motivational scaffolding). Aist et al. [1] examined the notion of emotional scaffolding and found different kinds of emotional scaffolding had an effect on children's persistence using a reading tutoring system.

There are different forms of metacognitive scaffolding. Molenaar et al. [16] investigated the distinction between structuring and problematizing forms of metacognitive scaffolding and found that problematizing scaffolding seemed to have a significant effect on learning the required content. They used Orientation,

Planning, Monitoring, Evaluation and Reflection as subcategories of metacognitive scaffolding.

Sharma and Hannafin [27] reviewed the area of scaffolding in terms of the implications for technology enhanced learning systems. They point out the need to balance metacognitive and procedural scaffolds since only receiving one kind can lead to difficulties — with only procedural scaffolding students take a piecemeal approach, and with only metacognitive scaffolding students tend to fail to complete their work. They also argue for systems that are sensitive to the needs of individuals. Boyer et al. [4] examined the balance between motivational and cognitive scaffolding through tutorial dialogue and found evidence that cognitive scaffolding supported learning gains while motivational scaffolding supported increases in self-efficacy.

While it is recognised that all scaffolding is likely to have a mix of affective, cognitive and conative effects it is also to be expected that there are metacognitive, meta-affective and meta-conative aspects as well. There have been relatively few attempts to examine the ways in which metacognitive scaffolding can be supplemented with affective scaffolding. The key question is whether the affective scaffolding is intended to support performance or the process of learning from the experience.

In this latter sense, affective metacognitive scaffolding is to be understood as various forms of metacognitive scaffolding combined with affective support for metacognition. Rather than, for example, praise a learner for performing at the domain level, the praise is targeted at a metacognitive activity. This approach potentially supports learning from the interaction at the metacognitive level — for example, Roll et al. [24] point out that few systems provide evidence for lasting improvements in student's self regulation skills, and Roll et al. [23] argue that the provision of a metacognitive scaffold does not always lead to metacognitive learning.

For the ImREAL project, we therefore take affective metacognitive scaffolding to mean the provision of an affective dimension to metacognitive scaffolding. This conceptualisation has to be fleshed out further in future work; and adopting this notion does not preclude the project from incorporating elements of affective and motivational scaffolding where appropriate. The affective metacognitive scaffolding services required support metacognitive activities (e.g. Orientation, Planning, Monitoring, Evaluation and Reflection) within those environments by providing appropriately tailored dialogue.

An important aspect of metacognitively adaptive teaching, essential within a process of guided self-regulated learning, is the removal of the scaffolding, allowing the learner to take control/responsibility. It could be said that there are much more serious consequences in too much scaffolding — distraction, annoyance, overwhelming any core subject material and so on, than there are in providing few prompts. The fading of scaffolding, this removal of support, is therefore a key facet of the services provided by the framework. A number of approaches will be investigated including those based on metrics such as the time the user has been engaged with the system, their competency and famil-

iarity with the environment and material; and more complex models of learner behaviour, cognitive dissonance and metacognitive profile.

Recent work by Saadawi et al. [25] reinforced the importance of the intervention not only being appropriate in terms of the frequency of intervention, but also the timeliness — their work clearly demonstrating that feedback should be immediate to be effective. As such, the services provided by the framework will not only be non-invasive but also real-time — operating with minimal separation between the requirement for scaffolding and its provision. It should be pointed out here that the long-term goal for the framework is to provide packaged content for simulation environments — whilst the framework itself may deliver scaffolding content within microseconds, the delivery of the same may be framed within the wider context of the simulator — for example not inserted directly on delivery but rather at a time appropriate to the context of the training simulation.

Work such as Puntambekar and du Boulay's [21] and Lane's [13] typically concerns embedding metacognitive scaffolding WITHIN a particular learning framework. Often technologies which have some kind of support for reflection or other metacognitive activities (Such as Gama's [9]) do this in a manner discontinuous with the training material — in a similar way that early education games often contained crude switches, so-called Shavian reversals [18], between gaming and learning content. In order to avoid this, there will not be a need for the learner to move between different modes either cognitively or within the training environment in order to deal with the scaffolded material.

The service proposed herein will sit alongside learning scenarios, providing contextually aware (in the broadest sense) support. It is important to note that, although the scaffolding service is technically decoupled from the learning system, supporting and training learners' metacognition is not independent from actual domain learning, but should be integrated in that learning process and thus constitute a symbiotic part of the system (e.g. [30, 32]).

3 Implementing Affective Metacognitive Scaffolding Support

Unlike others, this framework is decoupled from the learning system. Whilst support systems in general generate a certain level of dissonance and distraction, that's in line with the real world training experience, where there are both aspects of distraction from the external 'guide' (e.g. the senior registrar overseeing the interview in Use Case A below) and internal cognitive processes (reflection, recollection, application, etc.). The real challenge is to ensure that the interventions during the training encounters are of appropriate and timely content, of suitable size and duration.

Therefore, we will take semantically tagged triggers from the learning environment and delivers scaffolded support, informed by the real world model of the learning scenarios — both in terms of activity and content. The domain

model of the training content may not be particularly relevant to the metacognitive scaffolding (it may inform the examples chosen), but the characteristics derived from inferential processing of learner contributions to be a key facet to improving the models of metacognitive behaviour.

Building on the previous work in the area of enhanced personalised learning through non-invasive adaptation of immersive learning environment [19], the project will develop adaptive scaffolding services which can affect motivation, reflection and awareness of the learner without breaking the simulation's fidelity and immersive experience [7]. The approach to affecting the learning experience can, for example, be realised by affecting particular actors' behaviour within the simulation, influencing the simulation to increase/decrease challenge, unobtrusively suggest reflections or self awareness (metacognition). The project also envisages a dialogic approach following mentor-like coaching interactions.

The Metacognitive Awareness Inventory (MAI) [26] will be used. The MAI is comprised of five factors that describe the regulation of cognition including planning and information management strategies. Planning itself is not an observable construct, however it may be exemplified by a number of observable items. On the MAI, these include items such as 'I pace myself in order to have enough time' and 'I set specific goals before I begin a task'. In order to map the learning task to the inventory items, an extra layer for modelling learner traits has been created. Such a model is ETTHOS (Emulating Traits and Tasks in Higher Order Schema) [15], where each learner is modelled according to Traits and Tasks. Traits are high-level metacognitive aspects such as Metacognitive Knowledge, subdivided into Factors (a lower level than traits, such as Planning). The structure of these traits draw from methods used to create psychometric inventories (such as factor analysis). A factor can be described as a linear sum of variables. The combination of a number of related observable items describes each factor. (I pace myself while learning, I ask myself questions). The tasks modelled are a set of cognitive activities a learner undertakes where each activity may be broken down into Sub Activities: for example, the Activity Overviewing the Learning Object (part of the Before Starting task), may be broken down into sub activities such as: Noting important parts, Gathering information relevant to the goal, Determining what to do in detail.

We will also consider affective factors in the SRL processes in order to create positive experiences that empower learning.

Finally, we propose filtering the *open social* noisy real world inputs and scaling them for cognitive dissonance, appropriateness, quality, etc. Whilst King's [11] approach to constructivist teaching, the Guide on the Side decentralises authority, it still provides a role for it. Utilising the model of cognitive load illustrated by Gama then, perhaps, we can see a sliding (parabolic?) scale of disruptive content where the farther away from the Performance phase you are, the higher the level of non-salient, non-Quality Assured content would be allowed.

For example, work such as Richardson & Newby's [22] focuses on cognitive engagement with learning systems as a measure of on-task activity. We will derive similar models to address distance from the performance phase of the

Self-regulated learning model as a driver for engagement with non-normative information.

4 Context

The work is being applied within two complementary use cases. The affective metacognitive scaffolding framework itself sits within the ImREAL suite of services and simulated training execution environments. We will now indicate how the framework might actually perform.

In brief, a learner will register for a training course using a supported simulator. They will receive prompts from the framework before they attend the training session, perhaps as an email, perhaps as Google calendar appointments to plan/prepare. At the start of the training session the framework supports their preparation within the simulator execution environment, then through to the main learning scenario, providing opportunities to reflect and record learning in an appropriate, non-invasive manner, as above. After the session, the framework will provide scaffolded deeper reflection, and ways to allow the learner to tune their interaction with the services provided.

During the training session, the services provided by the framework will enrich that environment with examples from the learner's previous training (if available), that of their peers (e.g. at this point Alice thought X) and from andragogically designed prompts (e.g. did your actions have the outcome you expected?).

Either side of this central performance phase there are opportunities to deliver further scaffolding targeted to forethought and reflection, based on the pool of examples and delivered through a variety of media depending on the training scenario — perhaps through LMS messages, SMS, email, additional text on training calendar reminder prompts, etc.

Use Case A: Medical Interview Training This use case concentrates on the *enhancement of an existing simulator and on facilitating its integration in a training environment.* The use case will be developed within the **medical interview training domain** (training doctors to interview patients) with the EmpowerTheUser's simulator ASPIRE. It simulates diagnostic interviews with patients, which would ordinarily be carried out under the supervision of a senior registrar, who would sit in on interviews, providing minimal support and prompting as required with actors representing patients in the first instance, then moving on to real patients. The focus is on adding new functionalities (feedback, metacognitive scaffolding) and improving the adaptation (augmented user model). Creation of new content for the simulation itself is not directly targeted. However, it is envisaged that ImREAL services will facilitate content expansion and augmentation by enabling tutors and simulator developers to become aware of relevant examples with real world situations.

Use Case B: Job Interview Training / International Mentors This use case focuses on *intelligent support to develop a simulation environment for training based on real world modelling and content input.* This use case will be implemented within the imaginary simulator and illustrated in several connected scenarios. Starting from a simple **job interview scenario**, the simulator will include situations for training the recognition of verbal and non-verbal signals. Further iterations will involve training for cultural awareness in typical scenarios involving **communication between international students and their buddies (mentors)**. The simulation environment will be expanded based on the provision of new content with examples of real world situations. Content about real world experiences will be collected either from open social spaces or from social spaces for storytelling developed within the project. The content will be semantically tagged using an activity ontology, which will facilitate its aggregation.

5 Methodology

To provide initial experimentation of metacognitive scaffolding, an adapted Wizard of Oz methodology will be employed to identify the effects of certain metacognition or adaptation suggestions in the simulation. In this methodology a human coach will perform the expected affective metacognitive scaffolding to extend the base level interactivity in the simulators, we will then derive heuristic rules for what support should be given and when from this initial human-based simulation of the framework's function.

These initial models will be implemented using ETTHOS in order to provide a framework for metacognitive competencies and processes. Learners' initial metacognitive awareness will be tracked and enhanced by non-invasive interventions in order to promote the development of self-regulated learning practices.

In order to investigate affective models, an explicit affective monitor, the Smiley-Based Affective Index, will be deployed alongside simulators. Provided as a small popup, it allows learners to indicate their emotional state by clicking on a 'Smiley' as pictured below in Figure 1. These smileys are aligned to Ekman's basic emotional states and a cross-correlated study with IMA's moodmap (an example of which is shown in Figure 2) will allow further development of the affective model and interventions within the framework.

Currently, one partner's simulator (ETU's ASPIRE) has a space after each phase of the interview to allow free text reflection of the learning just undertaken. In order to evaluate initial appropriateness and suitability for the ETTHOS framework we will replace the open reflection within ASPIRE with text from the MAI, aligned with the phases of the simulation. Alongside this will be a short feedback mechanism to measure the appropriateness of the provided text and for the learner to provide their own scaffolding prompt and answer. A collected corpus of this material will be compared to the responses from the open-ended free-text material collected during the project's initial base-line study. A

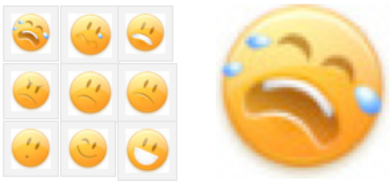

Fig. 1. Smiley-Based Affective Index — presented as a popup — the learner can click on one of the smiley faces to indicate their current affective state at any point during the learning scenario.

screenshot of a prompt, along with the feedback gathering within ASPIRE can be seen in Figure 3.

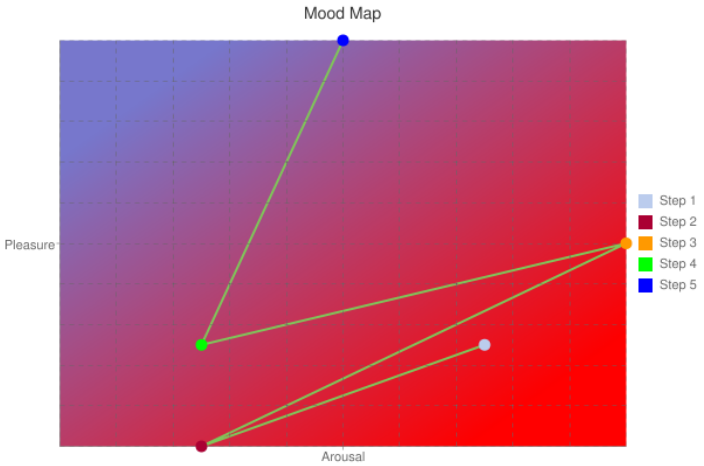

Fig. 2. An example of the IMA moodmap final diagram. A learner's mood state is plotted for each of the five steps taken along 2D axes of Pleasure vs Arousal.

All of these approaches are part of the work scheduled to begin to formulate an approach to the provision of affective metacognitive scaffolding and will lead to the development of the roadmap to the design of future interventions combined with the instructional models and revealing answers to the questions below, which have been developed to drive the research.

6 Discussion and Conclusions

We have outlined our approach to developing affective metacognitive scaffolding services, and, as usual, there are a number of key questions that need to be

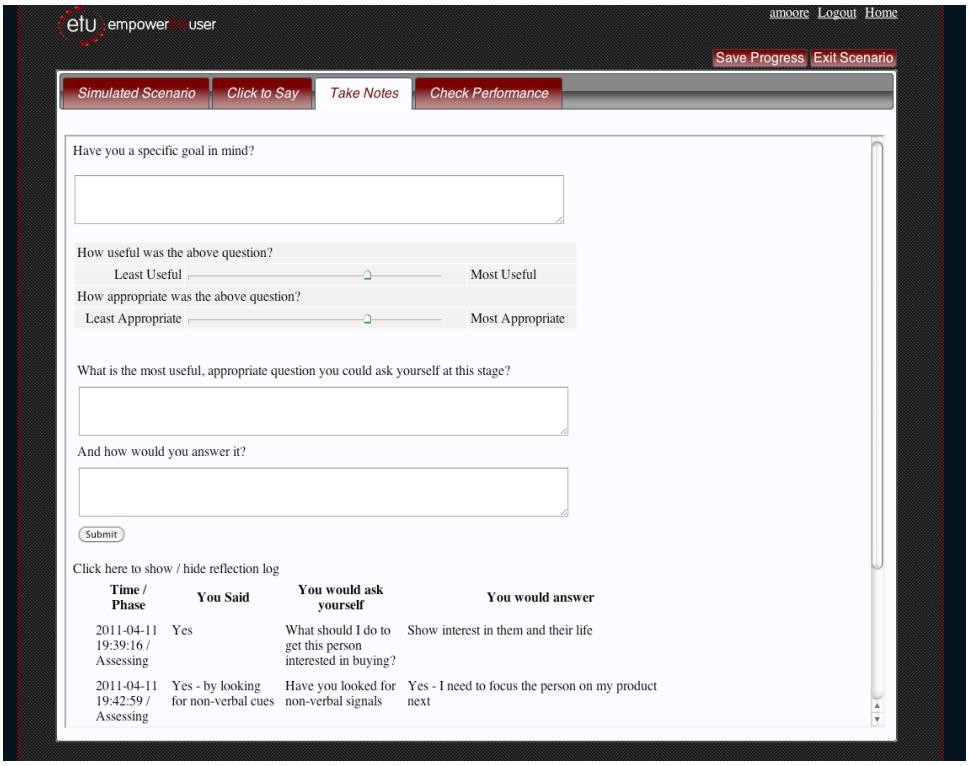

Fig. 3. Screenshot of ASPIRE training simulator showing a reflection prompt (the top text and text box) along with feedback gathering and an extract from previous reflections.

resolved both during the design and implementation and afterwards through appropriate experimental work and field trials.

The overarching issue is how to provide salient, timely services to support the metacognitive processes involved in self-regulated learning within the framework of experiential training in a cognitively sensitive (non-invasive) manner related to, but not embedded within, e-Learning simulation execution environments. This can be broken down into a number of questions.

How to specify the needs of affective and metacognitive features of a user model — the mapping of knowledge captured from these (possibly external) models, and their correlation with metacognitive strategies and affective triggers? That is, how do we ensure that the internal representations of the metacognitive characteristics we are hoping to monitor and develop are aligned with the real characteristics of the learner, reflecting their goals, surroundings and progress?

How to ensure saliency and timeliness? That is, how do we ensure that the interventions we provide through the services developed are delivered when they are required and the contents are appropriately framed?

How to ensure non-invasive interventions that are not too cognitively demanding nor out-of-reference/frame? How do we ensure that the interventions, when delivered, make sense to the learner and don't overly distract from the learning task at hand?

How to provide scrutability and personal tuning of the services we provide? How much is appropriate/effective? It is almost impossible to deliver too little scaffolding but how much is too much and how much control should the learner have over these levels?

How to measure/evaluate the efficiency and effectiveness of the services we create? It is often stated that metacognitively aware learners are better learners but how do we measure the improvement of learners' abilities and then relate that back to the interventions we have provided?

The ImREAL project team is going to address these questions. Hopefully, we can begin to flesh out our response to the underlying issue — does the approach lead to more effective training?

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ART (Analogical Reflection Tool): using analogies to promote reflection in science education

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Abstract. There are two basic categories of reflection, according to where the learner reflects on. In self-reflection, the learner reflects on her/his own actions, while in comparative reflection the learner reflects on others' actions. We propose an alternative reflection type, as a subcategory of the comparative reflection, the analogical reflection. In analogical reflection, students reflect on analogies, collating their actions with the analog's (analogical model) functions. During the collation, students are asked to correlate the source with the target. We designed a software tool that supports analogical reflection and is called ART (Analogical Reflection Tool). The ART is a scaffolding tool that assists students while reflecting analogically.

Keywords: reflection, analogical reasoning, modelling.

Introduction

The contribution of reflection in learning is an issue that concern various research domains, such as psychology, didactics, pedagogical and technology enhanced learning. In educational artificial intelligence, the student model saves information about students' actions. The past artificial intelligence systems used to hide the student model from the student. The modern ones, which are called "Open Learner Modelling" (OLM), bring to light the student model in order to promote reflection. The student model can be visible to the system's user for self-reflection, or to other users for comparative reflection.

W-ReTuDiS (Web-Reflective Tutorial Dialogue System) [1] is an OLM system that uses dialogues based on the student model and it is applicable for teaching history. The system asks questions to the students and then returns their answers, annotating the wrong ones or validating the right ones. The students may ask from the system for extra explanations. In such case, the system responds by setting up a dialog with the students, in order to pull the trigger of reflection. Another tutoring system is DIALOG [2], which exploits the artificial intelligence algorithms to use natural language and reflection arises from Socratic dialogues.

Besides dialogues, concept maps support learning through reflection. Cimolino et al. [3] proposed the Verified Concept Mapper (VCM) system as an innovative way of

creating concept maps. In VCM, the user has to verify the created map and justify its components.

Van Joolingen et al. [4] distinguished the reflection in "reflection-on-action" and "reflection-in-action", considering that the reflection-on-action corresponds to the evaluation at the end of the activity, while the reflection-in-action is a kind of monitoring the activity's progress. Manlove [5] also used the distinction between reflection-on-action and reflection-in-action, as Schön [6] had defined it. The reflection-on-action emerges from the requirement to summarise and evaluate the entire activity. On the other hand, by the reflection-in-action students monitor specific stages of the activity and reassign its' progress.

White et al. [7] used the SCI-WISE agent based software, in which each agent has its role, trying to accomplish specific targets. Such agents are the Planner, Collaborator, Assessor, Inventor and Analyser. Their inquiry activities followed the cycle: Question – Hypothesise – Investigate – Analyse – Model – Evaluate. At the beginning, a question about a phenomenon is given to the students, who make a hypothesis, for investigation. Then, they analyse the results and start modelling. Finally, the results' evaluation accomplishes the cycle. At this last stage, students reflect on the entire activity, searching for their model's limitations.

Analogical Reflection

Analogical reasoning is a mental process by which learners adapt their knowledge from a familiar cognitive domain to an unfamiliar domain. Through the analogical reasoning, students exploit their own existed knowledge in the familiar domain in order to understand the studied domain. The two domains are similar in their structure and/or functionality, while students must be capable to analyse and compare them. The analogical system is called "source" and the system that is being studied is called "target". One target may be related to sources from different domains [8]. For example, a computer network (target) could be represented by different analogs (sources), such as road network, rail network or post office. If a characteristic/function of the source shares similarities with the target, then the analogy is "positive", while if the characteristic/function is opposite to the target then the analogy is "negative". Negative analogies may generate misconceptions to students and, therefore, they must be clarified. If the characteristic/function of the source seems similar with one of the target, but it is not actually relative, then the analogy is "neutral" [9].

For example, an analogical model for the simple electric circuit model is the hydraulic analogical model. This analog consists of a water pump and water conductors. The pump causes the water's flow inside the conductors, like the voltage source causes the electrons' flow inside the metal conductors at the simple electric circuit model (Fig. 1).

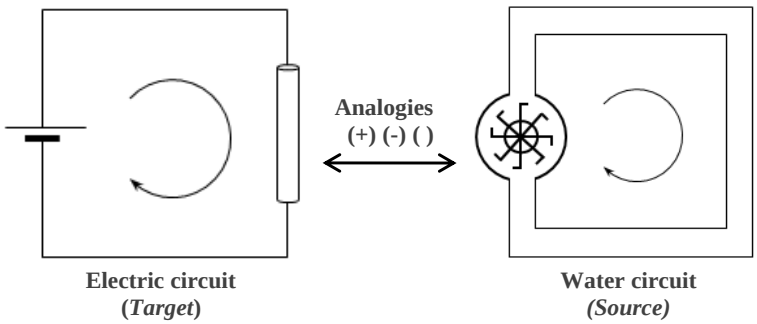

Fig. 1. Simple Electric circuit (target) and hydraulic analogical model (source).

Between these two models, there are positive, negative and neutral analogies. Some examples are given in the Table 1.

Table 1. Analogies between simple electric circuit model and hydraulic analogical model.

Analogies	Simple electric circuit model	Hydraulic analogical model
Positive	1. The voltage source forces the electrons to move inside the metal conductors. 2. The electrons are not generated from the source. They exist inside the metal conductors.	1. The water pump forces the water to move inside the water conductors. 2. The water is not generated from the pump. It exists inside the water conductors.
Negative	1. The electrons move only in one direction, (negative to positive pole). 2. If the electric conductor breaks, the electrons' flow stops immediately.	1. The water may flow in both directions. 2. If the water conductor breaks, the water runs out.
Neutral	1. The model's shape is rectangular.	1. The model's shape is rectangular.

When the learners reflect on their own actions, they may improve their metacognitive skills. If the learners study an analogical model instead of the target domain, then the revision may be more substantial, because they may find out their errors through their own existent knowledge from the familiar source domain of the analogical model. There are two basic categories of reflection, according to where the learner reflects on. In self-reflection [6], the learner reflects on her/his own actions, while in comparative reflection the learner reflects on others' actions [10]. In groupware learning environments, comparative reflection is characterised as collaborative reflection or co-reflection [11]. We propose an alternative reflection type, as a subcategory of the comparative reflection, the analogical reflection. In analogical reflection, students reflect on analogies, collating their actions with the analog's (analogical model) functions (Fig. 2). During the collation, students are asked to correlate the source with the target.

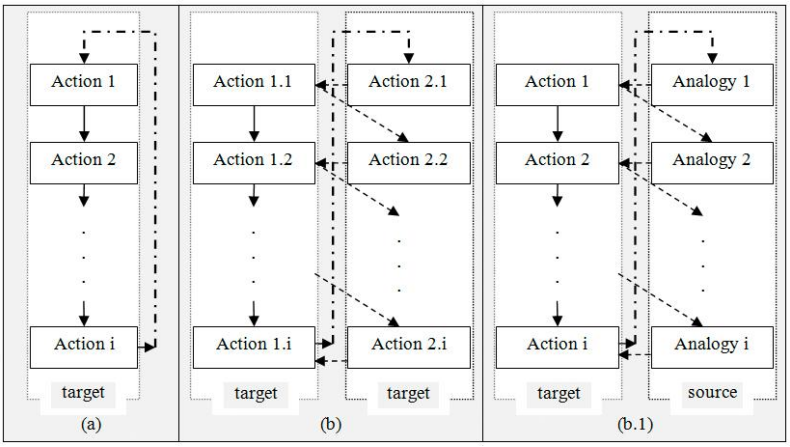

Fig. 2. Reflection types: (a) self, (b) comparative, (b.1) analogical.

The idea for introducing and examine the analogical reflection came from the state of the art and, specifically, from the combination of the analogical reasoning with the comparative reflection:

***Analogical** Reasoning*
*Comparative **Reflection*** } ***Analogical Reflection***

In a previous pilot research, in which we tested the three reflection types (a) self, (b) comparative and (c) analogical, we hypothesised that in self-reflection, it is highly probable that someone cannot recognise her/his own mistakes. In comparative reflection, this probability is potentially reduced, because perhaps the others do not make the same mistakes. We estimated that this probability is minimised when the analogical reflection is activated, because it is easier to recognise a strange behaviour in a familiar domain, where the normal behaviour is well known.

Students were asked to reason analogically and reflect on modelling activities, in order to exploit and improve their metacognitive skills. The modelling activities took place in the ModellingSpace [12], an OLM system in CSCL environment with metacognitive support such as Interaction Analysis tools.

According to the results, through the analogical reflection students exploited their correct perceptions in revising the incorrect ones. The students that worked in analogical reflection mode showed better performance than the students that worked in the comparative reflection mode and much better than the self-reflection mode. However, in analogical reflection mode students had some difficulties, especially in the analogical reasoning stage. After proper scaffolding by the teacher, students overcame their difficulties and finally reflected on the analog. Thus, a major conclusion was that there is a need for a scaffolding tool, assisting students to reason and reflect analogically.

ART (Analogical Reflection Tool)

Based on the last conclusion, we designed a software tool that supports analogical reflection and is called ART (Analogical Reflection Tool). The ART is a scaffolding tool, consisted of five steps: (1) Model's Description, (2) Analogies' Record, (3) Analog's Description, (4) Analogies' Validation and (5) Analogies' Report. The main idea is that the user reflects on the source domain (analog) in order to understand the target domain (Fig. 3).

Fig. 3. ART's splash screen.

At first, the user completes her/his personal data (name, etc) and then start to follow the five steps that we describe shortly below.

(1) *Model's Description*: Students describe the model [7] that they had created previously in a modelling software, such as ModellingSpace. The description includes the model's entities, parameters and functionality.

(2) *Analogies' Record*: Students correlate their actions and during the model's creation with analogies (positive, negative, neutral) from an analogical model that is given to them. We changed the terms "positive" and "negative" analogies to "real" and "misleading", correspondingly, in order to be more suitable to the students' perception.

(3) *Analog's Description*: Students study a description of the analogical model, including analog's entities, parameters and functionality.

(4) *Analogies' Validation*: After Analog's Description, students validate [3] or change or even delete any analogy that they had recorded at the Analogies' Record step, or they add a new one (Fig. 4).

(5) *Analogies' Report*: A report presents to the students what they had done before, in order to reflect. This is the stage in which the student model appears to the students, as OLM systems do [1], [2], [12]. The report consists of five tabs: (1) Real Analogies, (2) Misleading Analogies, (3) Neutral Analogies, (4) Deleted Analogies and (5) Total Actions. In particular, the report includes all the real (positive), misleading (negative) and neutral analogies, that students recorded/validated but also those that have been changed or deleted. The "Total Actions" tab presents the number of the initial recorded analogies (Analogies' Record step), the final validated

analogies, those that had been changed, added or deleted, separately for each type of analogies.

Finally, the user saves her/his data in a file (*.art) for future use.

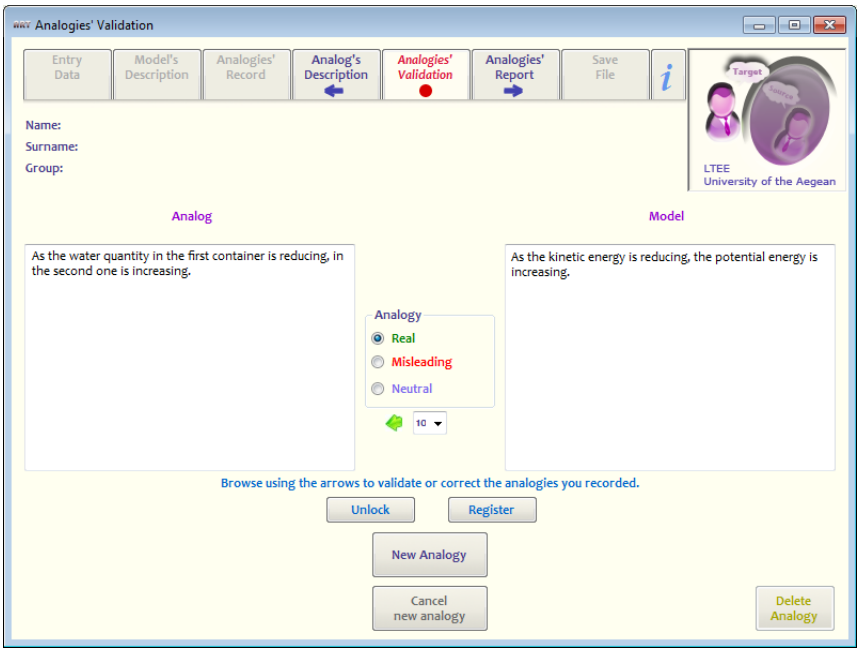

Fig. 4. ART's screen in Analogies' Validation step.

Example: Energy Conservation and Water Transfusion Analogy

We plan to test ART's contribution to reflection and learning in a framework of inquiry modelling activities. When students create models in the ModellingSpace technological environment (collaboratively or individually), they reflect using the Interaction Analysis (IA) tools that the software provides. IA tools are proper for self-reflection or comparative reflection, but not for analogical reflection. These tools are useful for the students to analyse their own activities (self-reflection) or their classmates' activities (comparative reflection), but they don't scaffold students to examine an analogy and reflect on it.

An example of modelling based activities is the motion of a body moving towards the top of an inclined smooth plane. This scenario deals with the Principle of Conservation of Mechanical Energy. After the students finish the modelling activity, the teacher demonstrates (without explanations) an analogical model, created in the ModellingSpace. The analog represents the water transfusion from one container to another. Its visualisation shows the water that goes out of the one container gets in the other one. Therefore, if a third container represents the total water of both containers, its water level should be constant.

Using the ART, students are guided step-by-step to reason analogically and, finally, to reflect analogically. At the first step, students have to describe the model that they had created previously in the ModellingSpace. The description includes magnitudes (such as kinetic, potential and mechanical energy, mass, height and inclination) and the relations between them. At the second step, students correlate their actions with analogies (real, misleading, neutral) from the analogical model. For example, they correlate the relation between kinetic and potential energy with the water transfusion from one container to another. By this way, students justify why they equalised the kinetic energy reduction with the potential energy increment. At the third step, students study a description of the analogical model (including entities, parameters, functionality), while at the fourth stage they have to validate or change or delete each analogy that they had recorded previously or add a new one. If a student made a mistake during the modelling activity and didn't realise it, neither using the IA tools nor at the Analogies' Record step, then she/he may find out the mistake through the analog's description. Therefore, students review their modelling action by reflecting on the analog. The analogical reflection is completed at the fifth step, were students watch their total actions in the ART. They review what they had recorded before the examination of the analog's description and what they changed after. Deleted analogies indicate strong misconceptions (according to data from our pilot research) before the analogical reflection. For example, a student initially may correlate the mass of the body with the quantity of the water, which is wrong. If after the analogical description she/he deleted the analogy, the "Deleted Analogies" tab at the final report of the ART will highlight this misconception.

Discussion-Conclusion

The most interesting modern educational technological environments do not focus on the transmission of knowledge, but on triggering metacognitive functions. Reflection acts as a booster for metacognition. Analogical reasoning can enforce reflection, acting as a booster of metacognition. In the analogical reasoning stage, students exploit their knowledge in a familiar domain (source), in order to understand an unfamiliar domain (target). Scaffolding helps students at this stage to correlate the two domains.

In our work, we presented a scaffolding tool, by which students reason analogically and finally reflect on analogies, in order to exploit and improve their metacognitive skills. The Analogical Reflection Tool assists students while reflecting analogically. We work further to find out more evidence about analogical reflection and to test and improve the ART.

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An Architecture for the Automated Detection of Textual Indicators of Reflection

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Abstract: Manual annotation of evidence of reflection expressed in texts is time consuming, especially as fine-grained models of reflection require extensive training of coders, otherwise resulting in low inter-coder reliability. Automated reflection detection provides a solution to this problem. Within this paper, a new basic architecture for detecting evidence of reflection is proposed that allows for automated marking up of written accounts of certain, observable elements of reflection. Furthermore, three promising example annotators of elements of reflection are identified, implemented, and demonstrated: detecting reflective keywords, premise and conclusions of arguments, and questions. It appears that automated detection of reflections bears the potential to support learning with technology at least on three levels: it can foster creating awareness of the reflectivity of own writings, it can help in becoming aware of reflective writings of others, and it can make visible reflective writings of learning networks as a whole.

Keywords: reflection detection, learning networks, awareness

1 Introduction

Agreement of human coders about levels of written reflection seems to be a difficult task. Wong et al. [1] report regarding inter-coder reliability that the use of a fine-grained categorization schema with six categories was problematic and less reliable. They state that in the literature is more discussion about the concept of reflection, than research on how to assess reflection. Sumsion and Fleet [2] report 50% inter-coder reliability for a three-stage categorization system for reflection (highly reflective, moderately reflective, not reflective). On the other hand trained coders can achieve high reliability in assessing journal writings using a three-category schema (non-reflector, reflector and critical reflector) [1].
Although these methods provide valuable insights about reflections in writings, their application is time-consuming and results are usually available only far after the act of reflective writing.

Methods for the automated annotation of writings regarding elements of reflection can be a promising technology to raise awareness about levels of own reflective writings, to find reflective writings of others, or to get an overview of reflective writings

of the whole learning network, immediate and independent of the daily performance of the evaluators.

This research describes a first approach of how to automatically detect accounts of reflection with natural language processing techniques with the goal to make visible traces of reflection in online learning networks with large number of participants.

To fulfil this vision several steps have to be taken. The following text focuses on the central ideas and exemplifies it with three annotators, which are derived from theories of reflection. The annotators build the fundament of the software architecture. The related approach section show successful implementations of automated content classifiers in an educational setting. Then the architecture of the reflection detector is outlined and its main strength described. The concrete implementation of the core building blocks of the architecture targets reflection. Therefore definitions of reflection and definitions, which contain reflection, are described to explore the manifold facets of reflection. Three elements of reflection are highlighted, which later will be used as examples of automated detection. After the theoretical foundations, Subsequently, three annotators based on the identified elements of reflection are presented and demonstrated with the help of an example of reflective writings and an encyclopaedic text.

2 Related Approaches - Automated Classification of Content

One approach in the area of automated content analysis focused especially on the related concept of reflection – critical thinking. High inter-coder reliability was reported between the computerized content analysis system and human codes of 0.65 and 0.71, for four categories of critical thinking [3]. The classified contents were discussion forum posts. The automated essay scoring was based on Bayesian networks.

Another system reports about the automatic analysis of collaborative learning processes [4]. According to the study a novel algorithm for the automated classification of content was used – the confidence restricted cascaded binary classification approach. For each of the seven classification categories they calculated Cohen's Kappa. Values for their baseline approach ranged from 0.49 to 0.91. Only two categories, the epistemic and the social modes of co-construction dimensions, were below 0.7.

Both approaches are based on pre-annotated data sets, which are used to train a classifier. The high reliability scores seem encouraging for further research in this area. Especially the first approach is more similar to the domain of reflection, while the second one uses a more sophisticated approach, applied however in another domain than reflection.

The use case of both approaches is to help researchers with the annotations of texts and text segments for content analysis. The ACAT (Automated Content Analysis Tool) system for example contains a quantitative content analysis (QCA) training module, with which users can train a model for their content analysis. This model has to be created beforehand with a model management tool [3]. The mentioned approaches are static insofar as the process foresees to import into the system a defined set of documents, which are then annotated by the system.

The proposed architecture however targets the dynamics of content creation in online learning networks, in which learners create content on the Web with tools of their choice (for example blogs or wikis), while others can subscribe or follow the work and contribute back. The goal of the architecture is to automatically retrieve these dynamically growing contents, annotate them according to their reflective elements and provide an interface to retrieve reflective documents. The architecture will be therefore web-based compared to the above outlined desktop-centered approaches.

3 Architecture for Detection of Reflection

The core of the reflection detection architecture consists of analysis engines, which analyze textual artefacts. They add structure to unstructured data. An analysis engine consists of annotators, which add metadata to the artefact. If an analysis engine consists of only one annotator it is called a primitive analysis engine if it consists of more than one annotator it is an aggregated analysis engine. The outcome of an annotator results in a common analysis structure (including the type, features of the annotation, and the position in the text).

The architecture envisions a web-service taking as input (web-)documents and returning either an annotated version of the document or statistics about the document. Several document formats like html, feeds, rich text format, and PDF should be supported. A mime type detector assigns each document type to a specific parser to extract the content and metadata.

In the case of webpages and other documents usually only the content is important and not so much the information about the navigation or other decorating elements. A cleaner therefore removes the boilerplate of such documents.

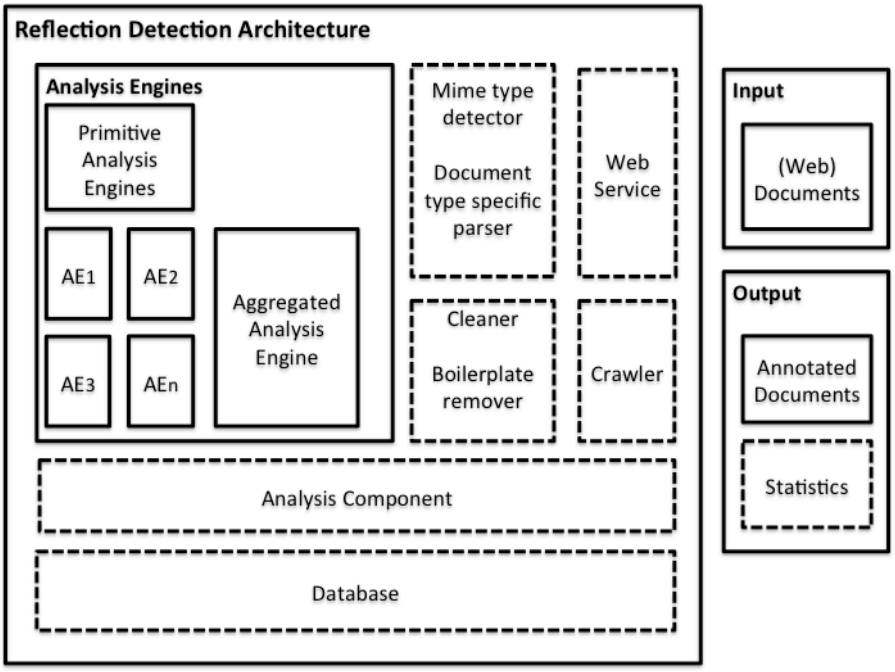

Fig. 1. Reflection Detection Architecture (solid lines: core building blocks; dotted lines: optional building blocks).

An extended analysis component would be necessary to return more elaborate statistics than counts of each annotation type per document. This could be a rule engine combining the information of each annotator based on rules with the goal of making statements about the depth of reflection.

The documents, annotation, and metadata, can be indexed and stored in a database. Optionally a web crawler could help to spider documents starting with seed URLs. This could be helpful to compare a set of webpages over time, according their reflective accounts. The following figure shows the reflection detection architecture.

The current implementation of the reflection detector is based on Apache Unstructured Information Management Architecture UIMA[1], a framework architecture to gain structured information analyzing unstructured data. The framework provides a standardized environment for developing components, which can be shared and plugged in other infrastructures, which adopt this standard.

As mentioned, the core of the architecture are the analysis engines, which analyze and annotate documents. The goal is to develop engines, which are tailored to detect indicators of reflection in writings. Before I outline three concrete implementations of these core elements, the following section serves as a short overview of reflection theory with the goal to show the variety of elements, which make up reflection.

[1] http://uima.apache.org/

4 Elements of Reflective Thinking

Several concepts are connected to reflection, which some authors in the literature subsumed as reflective thinking, others highlight as a related but different thinking skills. Examples include strategic thinking, meta-cognition, critical thinking, and logic.

Dewey, for example, describes reflective thinking as an "active, persistent, and careful consideration of any belief or supposed form of knowledge in the light of the grounds that support it, and the further conclusion to which it tends" [5]. Reflection is seen as the critical evaluation of own assumptions and conclusions.

Halpern especially focuses on critical thinking: "Critical thinking is the use of those cognitive skills or strategies that increase the probability of a desirable outcome. It is used to describe thinking that is purposeful, reasoned, and goal directed – the kind of thinking involved in solving problems, formulating inferences, calculating likelihoods, and making decisions, when the thinker is using skills that are thoughtful and effective for the particular context and type of thinking task" [6]. Reflection and critical thinking are seen as highly connected.

The model of Pintrich [7] deals amongst others with meta-cognitive skills in the context of self-regulated learning, which he defines as "an active, constructive process whereby learners set goals for their learning and then attempt to monitor, regulate and control their cognition, motivation and behaviour, guided and constrained by their goals and the contextual features in the environment". This theory emphasizes the close relation of self-regulation and reflective thinking.

Emotions, critical thinking, and the change in mindset are seen as crucial elements of reflection in the theory of Atkins & Murphy [8]. They conclude in their initial review that despite the differences between the accounts of authors describing their model of the reflective process, three key stages can be identified:

1. Awareness of uncomfortable feelings and thoughts. The skills needed are seen in self-awareness and the ability to describe feelings and thoughts.
2. Critical analysis of the situation, feelings, and knowledge, which according to the author needs the skill critical analysis
3. Development of new perspectives on the situation, which needs the skill set of synthesis and evaluation.

Already these four definitions suggest that reflection is an important part in several theories and has many facets. This character of reflection makes it an interesting area of research. Each element of reflection bears its own research problem regarding the automated detection. Three elements of reflective critical thinking, which are seen as a starting point for an automated reflection detector, are outlined in depth to illustrate this point.

4.1 Reflective Keywords

Reflections can be expressed in many ways. Some nouns, verbs, adjectives, and adverbs however are semantically connected to the concept of reflection. An example for a close semantic relation of words is "to reflect about something" and "to muse

about something". Musing means to reflect deeply on a subject. While reflecting about something and to praise something is still an act of thought, they have a very different character. It is reasonable to assume that people writing reflectively will use these keywords that are semantically connected with reflection more frequently when writing non-reflective.

4.2 Premise and Conclusion

One of the skills involved in critical and reflective thinking is the ability to craft correct and convincing arguments. The study of logic is conducted in several disciplines, for example in computer science, maths, philosophy, and argumentation theory.

The critical analysis of the situation can be expressed with arguments. One type of arguments is sentences that relate premises to conclusions. To proof a conclusion the premises have to be true and the argument valid. The writer has to think about the situations under which the conclusion is valid thereby making explicit the underlying logic of its arguments.

To state a premise and conclusion several indicator words exists. According to Halpern [6] the following premise and conclusion indicators can be found:

Table 1. Premise and conclusion indicators, according to Halpern [6].

Premise indicators	Conclusion indicators
Because, for, since (in the meaning of because and not related to time), if, given that, being that, as shown by, as indicated by, the reasons are, it may be inferred (or deduced) from, the evidence consists of, in the first place (suggests that a list of premises will follow), secondly, seeing that, it follows from, whereas	Therefore, hence, so, thus, consequently, then, shows that (we can see that), accordingly, if follows that, we may infer (conclude) (deduce) that, in summary, as a result, for all the reasons, it is clear that

4.3 Thought provoking Questioning

Questions are one of the most important techniques to engage people in thinking about the answer of the question or to create new questions. In a learning scenario a teacher can use questions for guiding learning. And the ability of students to ask own questions and to find answers is a highly desirable skill for learners. Self-questioning is one of the success criteria of a highly reflective accounts [9].

Questions can be either closed questions, which can be answered with yes or no, or open questions, which need a longer argument to answer. Latter ones bear more potential to provoke reflective and critical thinking.

Table 2. Thought provoking questions, according to King [10].

Thinking Skill	Question

Application	What is a new example of...?
Application	How could … be used to…?
Prediction/hypothesizing	What would happen if...?
Analysis/inference	What are the implications of...?
Analysis/inference	What are the strengths and weaknesses of...?
Identification and creation of analogies and metaphors	What is ... analogous to...?
Activation of prior knowledge	What do we already know about...?
Activation of relationship (cause-effects)	How does…affect...?
Activation of prior knowledge	How does ... tie in with what we learned before?
Analysis	Explain why...
Analysis	Explain how …
Analysis	What is the meaning of... ?
Analysis of significance	Why is ... important?
Comparison-contrast	What is the difference between...and...?
Comparison-contrast	How are ... and ... similar?
Application - to the real world	How does ... apply to everyday life?
Rebuttal argument	What is the counterargument for...?
Evaluation and provision of evidence	What is the best ... and why?
Synthesis of ideas	What are some possible solutions to the problem of...?
Comparison - contrast	Compare ... and ... with regard to...
Analysis of relationship (cause-effect)	What do you think causes...? Why?
Evaluation and provision of evidence	Do you agree or disagree with this statement:...?
Evaluation and provision of evidence	What evidence is there to support your answer?
Taking other perspectives	How do you think ... would see the issue of...?

King [10] outlines that when questions are factual, the tendency is that only facts are recalled (see Table 2). If questions are thought provoking critical thinking is more likely to occur. As a guideline for students a table of question stems could help students to formulate their own thought provoking questions, based on these generic questions.

The description of these three elements focused especially on a word and sentence level. These textual cues can be matched in texts with regular expressions, which was mainly used for the annotators in the following example section. Regular expressions are seen as one of many possible methods to detect reflection in writings. One of their benefits is that no model has to be trained in advance and the time to parse content is relatively short compared to more complex methods. I will now outline the translation of each of the three elements of reflection into an analysis engine.

4.4 Annotator for Reflective Keywords

For the annotator of words, which are semantically related to reflection WordNet 3.0[2], a lexical database of English was used in combination with the Java WordNet Library[3] to automatically retrieve these words for their latter use in the annotator. WordNet organizes words into so called synsets, which is a set of synonym words. These synsets are linked to other synsets, which have semantic relations like hyponyms, hypernyms, and entailment relations, etc.

WordNet contains relatively few adverbs, however, adjectives can be in most cases converted in adverbs by adding an affix (-ly) to the end. Most connections between synsets are made within the same part of speech (nouns, verb, adjectives, adverbs), with some links between different parts of speech (POS).

POS	Unique Strings	Synsets	Total Word-Sense Pairs
Noun	117798	82115	146312
Verb	11529	13767	25047
Adjective	21479	18156	30002
Adverb	4481	3621	5580
Totals	**155287**	**117659**	**206941**

Fig. 2. WordNet Statistics[4]

To find all related words the starting point is to determine the appropriate synsets. Reflection for example, has eight senses in WordNet. One sense is described as "a calm, lengthy, intent consideration", while another sense is about "the phenomenon of a propagating wave". Only senses, which are related to cognition are kept for the further analysis. This process is repeated for the verb "reflect", the adjective " reflective", and the adverb "reflectively". The filtered senses serve as seeds for the next step, which finds all associated synsets of the seed synsets. This extended set of synsets is then enriched with related synsets. The following relations are considered:

- Hypernyms: Y is a hypernym of X if every X is a Y: "Consider" and "think about" are hypernyms of contemplate. Only hypernyms up to the second degree were considered.
- Hyponyms: Y is a hyponym if every Y is an X: "Introspect" is a hypernym of "soul-searching", "self-analysis" and "examination". Only hyponyms up to the second degree were considered.
- Coordinate Terms: The synset siblings (hyponyms of its hypernyms): "puzzle over", "rationalize", "think", "philosophize", "brainstorm", etc.
- Verb groups: A group a verb belongs to.
- Synonyms: X is synonym of Y.

[2] http://wordnet.princeton.edu/
[3] http://sourceforge.net/projects/jwordnet/
[4] http://wordnet.princeton.edu/wordnet/man/wnstats.7WN.html

Based on four seed words, this process generates 194 synsets containing 416 words (nouns, verbs, adjectives, and adverbs). Positive examples of this list with their WordNet glossary are:

- Think (noun): an instance of deliberate thinking; "I need to give it a good think".
- To muse (verb): reflect deeply on a subject; "I mulled over the events of the afternoon"; "philosophers have speculated on the question of God for thousands of years"; "The scientist must stop to observe and start to excogitate".
- Wondering (adjective): showing curiosity; "if someone saw a man climbing a light post they might get inquisitive"; "raised a speculative eyebrow".
- Reflectively (adverb): in a reflective manner: "he watched her reflectively".

Negative examples include:

- wisecrack (noun): witty remark.
- dally (verb): to consider not very seriously; "He is trifling with her"; "She plays with the thought of moving to Tasmania".
- highbrowed (adjective): highly cultured or educated; "highbrow events".

As the goal of this annotator is to find keywords that are related to reflection, this set of words can serve as a starting point, as most words are positive hits. However the word list has to be manually refined to compensate for associations, which are according to WordNet associated with reflection, but seem not suited for the purpose of this annotator.

The annotator uses regular expressions to find sentences, which contain these words. By now the annotator uses the infinitive form of the words and does not take into account inflections.

The annotator can be aggregated with an annotator for self-references (I, my, me, myself, mine, etc.), to annotate sentences, which are referred to own inner reflective thoughts.

4.5 Premise and Conclusion Annotator

The premise and conclusion annotator takes the above outlined indicator words to match them using regular expressions. Some of the indicator words, however, need special attention. For example the word “since” needs special treatment, as it can be used as an indicator word for a premise, but it can also be used to express a temporal dimension. Another example is the word “for”. It can be used in the sense of because, but it can also be used in other senses, e.g. “for the sake of”, “to be all for it”, “what for”, etc.

4.6 Question Annotator

The question annotator consists of three parts. It uses again regular expressions to identify all sentences ending with a question mark, sentences containing interrogative words (for example why, how, what), and sentences, which follow Kings [10] blue-

print of thought provoking questions. A sentence, which is annotated as thought provoking and contains an interrogative word, and a question mark, is annotated three times. In the analysis process only one of this three annotations can be considered for further use.

5 Annotated Example

The first example is taken from the resource chapter of Moon [9], which is highlighted as a "reasonable reflective writing". From the left to the right it shows the premise and conclusion, the reflective word, and the question annotator in action. The detected parts of the text are highlighted. It shows that the analysis engine detects words and sentences according to the outlined indicator words and can distinguish between the three types. What is not visible in the examples is that every annotator consists of a finer level of detection. For example premise and conclusion are two distinct features, and questions consist of simple questions and thought-provoking questions.

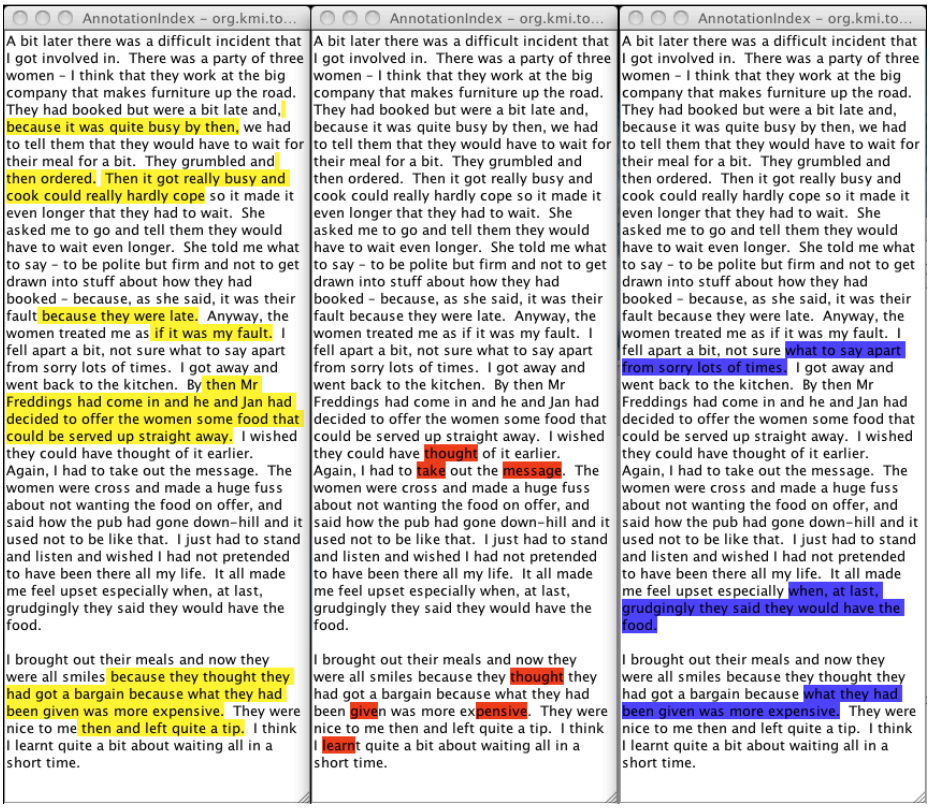

Fig. 3. Annotations of a reflective account (left: premise/conclusion, center: reflective keywords, right: questions).

The second text is taken from the Wikipedia article about awareness. As it is an encyclopedic article the purpose of the writing is to present a result and not the reflective process, which lead to this article. Again the three annotations are shown.

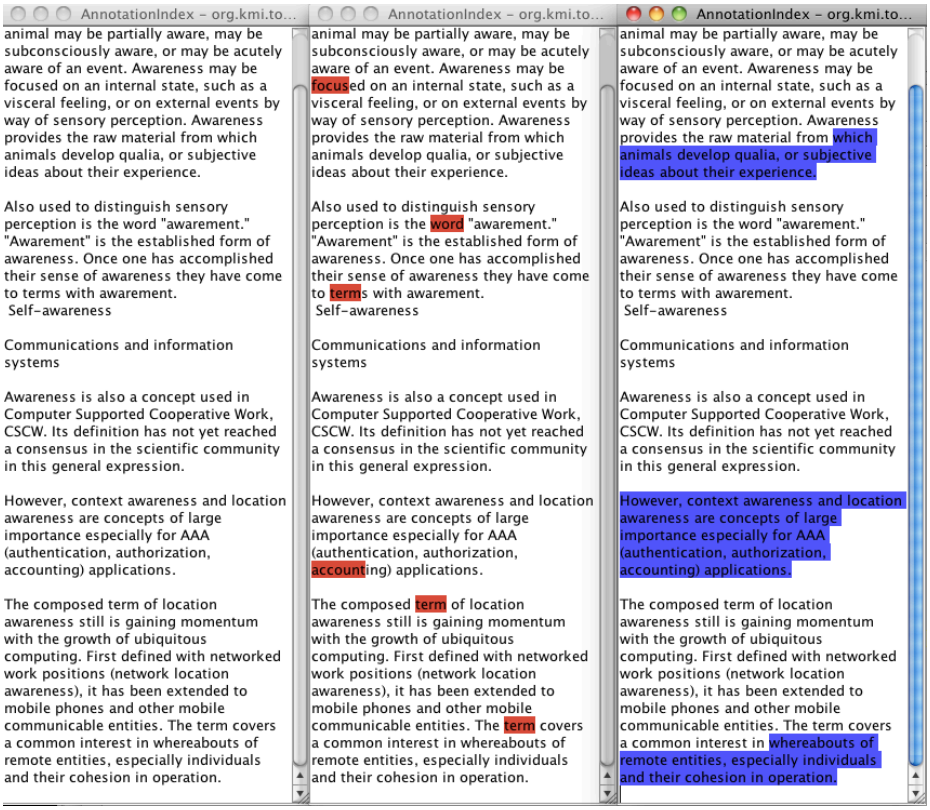

Fig. 4. Annotations of the encyclopedic article (left: premise/conclusion, center: reflective keywords, right: questions).

Besides the correct annotation according to the indicator words it can also be said that this three annotators can be useful on its own, for example to find all questions, or premises, or conclusion of a learning network and to present them in a meaningful way. Used only separate however, they say little about what a reflective writing is and what not.

As can be seen in both examples, the three annotators are not always identifying reflective accounts as intended, leaving room for further fine-tuning. Still, they manage to identify a set of relevant reflective acts expressed in the text. Even if single indicators have lower accuracy, in sum they bear the potential to flag the level of reflectivity to the interested analyzing person.

6 Evaluation

There are several ways of how to evaluate the quality of the detection. It largely depends on the purpose of the reflection detector. In the case of a supporting tool for content analysis, as it was in the case of the described in the related approach section, the goal would be to achieve high agreement between human coders and the automated annotation. The level of detail of the analysis is usually on paragraph level, sentence level and the whole document. The annotations of each level of text can then be compared with the automated annotation to calculate agreement. One of the most common measurements is the inter-coder reliability (inter-rater, or interjudge reliability), which expresses the degree of agreement between independent raters. Cohen's kappa is one of the most common measure for inter-coder reliability. The outcome of Cohen's kappa is between <0 and 1, while a value > .7 is seen as an acceptable agreement between raters (however this value varies in the literature). Precision and recall of human annotations of texts can complement the picture, particularly as the calibration of detection algorithms have to find the best possible equilibrium between high precision and high recall (often complemented by the f-measure, a combination measure of both).

Another way of evaluating the quality of the detection is to evaluate the usefulness of applications for people in learning networks, which are based on top of the detector architecture. The applications would be tailored to raise awareness about elements of reflections in online learning networks. This could be for example a reflection search engine, or a feed containing only reflective contents, or mash-ups based on reflective contents. Acceptance of the tools and their usefulness would then be the starting point of evaluation. [11].

7 Conclusions and Outlook

One of the benefits of the proposed architecture is that annotators can be independently developed and plugged into the framework to enrich the reflection detector with further elements. As a starting point of the development of the reflection detector a keyword based approach was chosen, however the techniques from the mentioned content classifiers seem to be promising and relevant for the next set of annotators.

The assumption was that there exists a set of words, which reveal reflection. However, we have to consider that a person writes in a reflective manner without using any of these words, or that they use these marker words without being reflective at all. On a general level these words have to be seen as indicators for reflective thinking and not to be mistaken with reflection: it is only possible to inspect evidence of reflection expressed in texts. For assessment of reflective capabilities of humans, this therefore means that it is subject to the assessment set-up, instruction, and method to show that it could validly be used to detect such competence. However, this is not only a problem for automated reflection detection and shared by 'manual' detection. The relatively low inter-coder reliability presented in the introduction expresses the diffi-

culty of human coders to evaluate what reflection is and what not, especially for fine-grained methods.

Another challenge of future work can be seen in the intelligent combination of the detected elements of reflection to ultimately indicate reflection, and furthermore to indicate depth levels of reflection. The architecture therefore foresees an analysis component.

As literature indicates, it would be interesting to investigate emotions and connect this work with sentiment detection in texts, as e.g. feeling of puzzlement seem to be strongly connected to reflection.

As the architecture foresees web-services as the central access point, this open infrastructure will allow integrating the annotated data into mash-ups of learning and research networks. The intended applications are not necessarily dependent on the most accurate reflection detection, as the goal is to support learning networks with awareness indicators of reflection. In this case, having a multitude of indicators could be more rewarding than restricting to the few that yield high precision.

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