Analyzing and Monitoring Learning Communities in a Serious Games Context

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Abstract - In this paper, we focus on the analysis framework for learning communities in an organizational context. The purpose of such communities is to foster and maintain a fruitful environment for learning and development for the organizations the community is a part of. Introducing new technologies such as serious games for learning in organizations imposes new challenges on supporting the development of communities through the different phases of their lifecycle. In order to identify these challenges it is necessary to study the interrelationship and mutual reciprocity among the concepts of organization, community, learning, knowledge and technology, monitoring the development of learning communities on a continuous basis.

Keywords - Learning communities, analysis framework, monitoring communities, serious games, organizational learning

I. INTRODUCTION

Recently, there has been a growing interest in innovative forms of e-learning such as serious games that may be better suited to provide memorable and transformational experiences. Serious games are digital games that are driven by learning objectives. Such games can be deployed as testbeds for Experience Management that are highly motivating and emotionally engaging, causing high and long knowledge retention. In TARGET project, serious games are combined with digital storytelling techniques, thus enabling the learning community to store and share experiences reflecting complex situations.

The TARGET (Transformative, Adaptive, Responsive and enGaging EnvironmenT) project was started January 1st, 2009, as a large-scale integrated project under Digital Libraries and Technology-Enhanced Learning EU FP7 framework (www.reachyourtarget.org). The main aim of the project is to develop a new genre of technology-enhanced learning environment that supports rapid competence development, and the two domains of innovation and project management have been selected as pilot areas. The TARGET environment will consist of a learning process supported by the TARGET software platform (including a 3D virtual environment), whose main core is a so-called serious game. Interacting with the TARGET software, the learner will be presented with complex situations in the form of game scenarios. During the game-playing, the learner can try out different strategies and solutions, completely risk-free compared with real life, and see how these work. Playing the game over time will result in experiences that are gradually honed into knowledge.

Learning communities, where members develop their competences by leveraging the knowledge and experience of their peers, is a central part of the TARGET process. In general, the purpose of learning communities is to foster and maintain a fruitful environment for learning and development for the organizations the community is a part of. Using serious games for learning in organizations imposes new challenges on supporting the development of communities through the different phases of their life cycle. These challenges can be seen in the context of the changes in the learning landscape as well as adoption of state of the art 3D virtual world and web 2.0 technologies.

In order to identify these challenges it is necessary to study the interrelationship and mutual reciprocity among the concepts of organization, community, learning, knowledge and technology. It is therefore necessary to monitor the development of communities on a continuous basis. This will allow analyzing the emerging issues, the needs of the communities and problems they might face, providing timely corrections and support. In this paper, we present and discuss an analysis framework for learning communities in an organizational context, primarily focusing on the serious games scenario and using TARGET as an example. As a part of this framework, we identify success and failure indicators for learning communities and non-invasive processes and tools for monitoring communities’ development.

There exists an ambiguity in the literature concerning the possibility to “design” a successful learning community. Wenger’s original “emancipatory” understanding [1] of communities of practice stresses that communities emerge through informal social interaction while Swan et al. [2] argues that the current trend is focusing on the role of managers in constructing and supporting communities to exploit fully the human capital. In this work, we follow the understanding, principles, methodology and terminology suggested by Wenger, especially as suggested in [3]. In this tradition, the design principles for vibrant and alive learning communities are not meant to be “recipes” and are not the same as most organizational designs. They could rather be seen as triggers and catalysts for a community’s natural evolution, often based on pre-existing social structures.

The rest of the paper is organized as follows. The next section shortly outlines the theoretical background we use when discussing learning communities. In section 3, we introduce a community analysis framework together with success and risk indicators for monitoring development of learning communities. In section 4, we present a scenario for the development of a learning community in a serious game/TARGET context and outline the requirements for
corresponding monitoring tools. Section 5 concludes the paper suggesting directions for future work.

II. THEORETICAL BACKGROUND

The literature regarding learning communities with relevance to the TARGET consequently rests on a variety of learning theories that all gravitate around activity, dialogue and interaction. Activity theory offers a perspective on learning which contains a comprehensive and robust theory, a model and a terminology to better understand the processes of learning [4]. The main focus here is activity, along with context and situation [5]. Central concepts are mediation, the use of artifacts, dialogue, and the situated and social nature of learning [4]. Related to the perspective of activity is the dialogic tradition, represented by critics such as Bakhtin, Buber and Gadamer [6, 7, 8].

The “community of practice” represents the most established form of a learning community. However, modern organizations, such as potential TARGET users, have more complex and varied organizational realizations for collaborative arrangements. Building on suggestions from Nardi et al. [9], and Engeström [4], we perceive an emerging collaborative pattern where the traditional community of practice provides a basis and possible point of departure for other collaborative opportunities [9]. Traditional CSCW literature assumes that the major organizing principle is that of the collocated well-established team, with stable roles and interpersonal communication. Nardi et al. show how the team in the traditional sense gives way to multiple possible organization forms, from tightly knit communities of practice to networks of various density and regularity [9].

In addition to CoP, Engeström introduces the “knot” and “knotworking” as a new variety [4], while Nardi et al. also describes coalitions as new form of collaborative environment [9]. Most attention in this line of research is given to the concept of networks, in the body of literature concerned with social network analysis (SNA) [10, 11]. Activities and collaboration do not solely take place within the confines of one organization, but increasingly between different private and public organizations. Whereas the traditional CoP is focused on nurturing existing knowledge, the networks are characterized by their emergent and evolutionary nature. This applies both to their exact “form” or “shape”, and to the knowledge domain they take part in.

In line with the increased understanding of technology as a context for learning and communications, some critics have attempted to bring the theories outlined above more in line with technology rich learning environments. Connectivism is a recent theoretical approach that builds on an integrated approach to fields of research such as chaos theory, network theories, complexity and self-organization theories. In this perspective learning is seen as a process “within nebulous environments of shifting core elements- not entirely under the control of the individual” [12]. The focus is on networks being established between people through technologies. This perspective also emphasizes the multiple possibilities that technology affords, and mastering the affordances of networks, fluidity and change, becomes major prerequisites for learning.

III. COMMUNITY ANALYSIS FRAMEWORK

The communities involved in TARGET or related projects will typically consist of three possible components and constellations:

- The traditional in-house community where the members are co-located
- A virtual/distributed community connected by the 3D TARGET virtual environment and other collaborative tools
- A community consisting of members of various cultures - the intercultural aspect of TARGET.

According to [3], communities cannot be measured in conventional ways as traditional methods are not likely "to appreciate the creativity, sharing and self-initiative that are the core how a community creates value". In the perspective of Nardi et al. [9], the same applies to networks. The value of the knowledge produced by a community is highly dynamic and context-dependent. Also, it is important to keep in mind that not all important parameters can be measured quantitatively. Therefore, at this stage we will focus on providing a preliminary overview of probes and indicators that can be useful for monitoring a given variety of a community or network.

However, this set should be tailored and adjusted to individual communities and different contexts based on a throughout analysis of the actual realization of the communities in question. The concepts of domain, community (in an extended or augmented sense) and practice seem relevant to most realizations along the gamut of collaborative possibilities. In the following we list success criteria and risk indicators for learning communities along the above mentioned dimensions of domain, community and practice [3]:

A. Domain

1) Success criteria/probes
- Increased competency levels of community members (gaming scores)
- Contribution of the community to the shared repertoire (e.g. the overall peer ranking of community members in the TARGET system)
- The size and quality of the repository created by the community. For example, the amount of contributions, how often they are referenced/used by others (such as gaming scenarios)
- High-ranked contributions, showing to stakeholders the major trends and problems.

2) Risk indicators/probes
- Imperialism, narcissism, marginality, fractionalism [3]
- Too skew/uneven distribution of contributions (repository entries, forum entries) to different subtopics and subdomains
- Too uneven distributions of users across topics/subdomains, indicating possible fractionalism
- Little involvement of “outside” users (clients), representatives for top management, hosting organizations
• Indicators of hostility and exclusion between members of different “fractions” such as “banning” events, history of moderator interference to improper discussion ethics
• Statistics showing ignoring or unreasonably low grades in relation to repository elements posted by members of different sub-communities.

B. Community/network
1) Success criteria/probes
• Amount/structure of contacts: “friends” and “friends’ friends”, both inside and outside of the community
• Social connections across communities
• Networks across national borders
• Participation in joint activities (forums, game scenarios, online meetings)
• Community identity: blogs, symbols, conventions, ways of displaying membership
• Growth rate of the community (e.g. new members per month)
• Activity level of existing members (playing, updating repository, discussing)
• Social awareness (awareness of others’ resources, activities and social connections/roles); formal vs. actual roles
• Creation of new communities, creation of new networking patterns, connecting 2 earlier unconnected networks etc
• Interactions between different community types, sub-communities and networks, measured both qualitatively and quantitatively
• Involvement of actors from different organizations and organizational levels.

2) Risk indicators/probes
• Cliques, egalitarianism, dependence, stratification, disconnectedness, and localism [3]
• Identifying problematic conditions by graphs showing the patterns of connections between community members (such as membership on each other’s friends list, commenting each other’s contributions etc) and contributions by individual members
• Groups that are too dominant in discussions and other activities
• Leadership roles too concentrated on few persons
• Majority of the community does not contribute actively, contributions focused around a limited group
• Static community borders, small numbers of newcomers, especially newcomers from other communities/organizations/regions.

C. Practice
1) Success criteria/probes
• The amount of contributions to the shared repertoire (e.g. new game scenarios)
• Usage of contributions across different practices/communities (e.g. how often these game scenarios are played, downloaded, updated)

• The trajectory of artifacts (modifications and additions, by whom and where used). Transition through different media: e.g. written scenario into a game module
• Amount of work spent on shared vs. individual artifacts
• Existence of “specific tools and representations” used in a particular community and witnessing of an established community identity [1]
• Interactions and collaborations during game playing inside community/across communities
• The speed of the information flow and propagation of innovation [3]. Measured by e.g. how quickly new scenarios and innovation to the TARGET platform are taken into use.

2) Risk factors/probes
• Documentism, amnesia, dogmatism, mediocrity, stickiness and leackiness [3]
• Too little/too few entries documenting community activities
• Rigid routines not changed for a long times, no mechanisms for reviewing such
• No/few cases of outstanding contributions as shown by feedbacks by independent experts (e.g. mentors in the TARGET framework) or cited/reused outside the community (as measured by e.g. citation index)
• Too closed/too open borders between communities, as seen by active participation by members from other communities and the degree of dissemination of results across communities.

IV. ANALYZING AND MONITORING COMMUNITIES: REQUIREMENTS FOR TOOLS

In the following we outline the requirements for tools for monitoring and analyzing learning communities in an efficient and unobtrusive way. We present a general scenario showing how a typical learning community develops through the different phases of its lifecycle. The organizational context is typically a knowledge intensive company, a healthcare enterprise, a company with dynamically changing strategies.

A. An initial scenario: monitoring

A group of persons (“initiators”) in TARGET-participating companies want to start a distributed cross-cultural community for collaborative game playing and creation of a shared repository using the TARGET platform. As successful communities usually build on existing social networks, the initiators need to monitor such networks, activities and skills by performing network analysis and direct interviews among potential community members, trying to link together those with similar interests and activities. During the whole lifecycle of the community, the social networks are explored and analyzed by using appropriate techniques and tools. It is important to emphasize the value of the new communities to the management, stakeholders and members and to facilitate the design of the new practices, ways of sharing knowledge, and repositories. To achieve these goals, the existing workflows,
practices and so on are monitored, analyzed, visualized and mapped, identifying existing problems and ways of improvement.

When the community is launched, the initiators focus on attracting new members by emphasizing the value of the community and by creating a strong community identity. This is done by launching a community website, establishing community spaces for both synchronous and asynchronous collaboration and negotiating community practices for knowledge sharing. Connections between the community members are further strengthened (especially within the core group) and contributions and value added by individual members are emphasized by establishing personal profiles and portfolios with overview over expertise, activities, participation in different networks/activities and contributions (additions to the TARGET repository, best gaming scores etc). As the community grows, the coordinators have the challenge to redefine the boundaries and establish mechanisms for regulating admission of new members and the corresponding processes. At the same time, the community is monitored for “warning signs” to enable coordinators starting necessary corrective intervention as soon as possible. For example, if there is an overload of social communication compared to work-related one or an unhealthy dominance of a certain group in the community, coordinators may take certain measures. Such measures may include rebuilding trust in the community by engaging in shared problem solving and organizing joint projects, encouraging multi memberships for better connections between communities and strengthening mentor-apprentice framework to integrate newcomers.

At the same time, the growing knowledge repository needs maintenance and possibly reorganization. In order to demonstrate the value of the community to the organization, managements and other stakeholders, the community’s performance is monitored and measured by using appropriate indicators and tools. For sustaining momentum and keeping communities alive, the coordinators and the leaders in the community make sure to establish a healthy rhythm of events, both regular and “unexpected” ones. As knowledge loses its value unless it is managed, updated, renewed and extended, the coordinators monitor the development of the knowledge repository of the community, focusing on such issues as too extensive or insufficient documentation, amount of new additions, their quality and their subsequent usage/development. When discovering irregularities such as skew representation in the contributors to the repository, coordinators may choose to perform a number of measures. These include encouraging members’ involvement in the development of practice and knowledge, making sure enough time is allocated for active participation as well as emphasizing members’ contributions by connecting them to members’ reputation and position in the organization.

In order to maintain focus on the “cutting--edge” perspectives and “rejuvenate” the community, connections are established with other related communities, e.g., involving companies not earlier connected to TARGET. The coordinators are constantly monitoring associated risk indicators such as limited connection between the domain and the business needs or the domain overshadowing the interests of community members, leading to decreasing motivation. To resolve such problems, coordinators and moderators may focus on making stronger links between business needs and issues important to community, as well as offering community members challenges, participation in important decisions and introducing new perspectives on the domain.

Based on this preliminary scenario, we will now suggest a set of requirements for monitoring tools. This is a very preliminary list and will be elaborated and iterated in cooperation with developers and community members.

B. Tools for monitoring, requirements:

1) General requirements

- Monitoring tools should be an integral part of the TARGET portal, repository and game engine
- Monitoring tools should provide accurate data on the usage of the system and community development, including data on the progression and development of individual members so that one could evaluate to what extent TARGET contributes to learning and professional development for the community members
- At the same time anonymity and safety of the community members should be protected where appropriate
- Appropriate metadata standards should be applied when e.g. adding an item to the repository in order to identify the topic, creator and so on.

2) Visualizations

In order to provide community coordinators with efficient overview and analysis mechanisms for monitoring different aspects and dynamics within the learning communities, we pay significant attention to visualizations. There should be tools available for advanced visualizations of collected data such as:

- Visualizations of social networks, connections between different community members and between communities, in this ways showing the development of community network and highlighting risk indicators such as cliques, disconnectedness, localism and so on
- Visualization of distribution of contributions to the TARGET repository, discussion groups and so on across individual members, sub-communities and topics/domains
- Visualization of correlations between different factors such as gaming scores vs. contributing to different domains vs. subgroups belongings
- Visualization of learning trajectories of individual members (anonymized when appropriate), showing e.g. improvement in gaming scores, increase in network connections and peer rating
- Visualizing trajectories of artifacts (documents, game scenarios, repository entries), including history of creation and modification (within and outside community), history of usage (e.g. of game scenarios), transition between different forms (e.g. from text document to video)
• Visualizations of participation of certain groups of people (e.g. clients, higher management and members in general) in discussions related to different domains to see if everybody participates or few people dominate
• Visualizations of activities in community such as updating the repository, participating in events, contributing to discussions, gaming interactions
• Graphs showing the patterns of connections between community members such as membership on each other’s friends list, commenting each other’s contributions etc
• Visualizing intensity of interactions within and between the different TARGET communities: mentor, learner, university, enterprise
• Monitoring and visualizing the intensity of interactions within community vs. interactions across communities.

3) Detection of patterns and events
In addition to visualization of social network aspects there should be tools for automatic analysis of certain patterns and events with the possibility to give a warning sign to the coordinator, such as:
• Mechanisms for detection of new patterns, e.g. connecting two sub communities into one
• A set of thresholds with automatic notifications to the administrators/coordinators when these are passed, e.g.:
  o when amount of new contributions per week falls below a certain value
  o when no new contacts are established during the last week
  o when frequency of community events (regular meetings) drops below a certain value
• Incorporating tools for search and textual analysis of entries in the repository, to identify most discussed topics and concepts, inappropriate remarks and prevalence of social conversations vs. work-related ones
• Mechanisms for monitoring frequency of community events by corresponding metadata and/or search for key words/text analysis
• Mechanisms for peer rating of community members and their contributions and mechanisms for monitoring these ratings and various correlations such as:
  o correlations between member rating and activity in discussions (power issues)
  o rating of contributions vs. how often they are reused
  o personal rating vs. gaming scores (personal competence development).

4) Monitoring the overall competence development, higher order skills and social relations
The tools in this category will require advanced mechanisms and analysis techniques, including:
• Mechanisms for monitoring the emergence of community identity by identifying emergence of symbols, specific tools, representations, community “language” (detected by different forms of textual analysis, e.g. frequency of a specific vocabulary)

• Tools for monitoring quality of the community repository and outstanding contributions by different means:
  o connecting to established citing services and measuring cite indexes for the contributions related to TARGET (might require some metadata standardization)
  o measuring cross-referencing of contributions within the community
• Mechanisms for monitoring the level of social awareness, i.e. awareness of other members’ activities, social relations and resources (e.g. who is most often contacted for help, amount of cross-referrals and peer recommendations)
• Monitoring propagation of ideas/innovation, e.g. how quickly new scenarios (put into repository) and other innovative items in the TARGET platform are taken into use (requires metadata).

C. Contingency plans
Based on the scenario above, we provide a summary and an overview of the major causes of problems in the course of a learning community’s development, suggesting possible solutions and plans for getting back on the “right track”. These recommendations are mostly based on the ones suggested by Wenger et al. [3], but elaborated further to apply for the TARGET context.

1) Domain
The first major cause of problems at the domain level is a failure to make connection between the domain and the business needs [3]. In the case of TARGET this will primarily mean the failure to develop games scenarios close enough to the actual business realities and needs of the intended players. A related issue is developing erroneous or oversimplified models of different game aspects, such as learners and their competencies. Another cause of problems at this level is when domain overshadows interests of community members, e.g. when learners do not see a personal gain in spending time and effort on adding and improving repository items. Possible solutions to these problems could be summarized as follows:
• Focusing on the strategic value of the domain, i.e. the innovative aspects of the TARGET approach being developed and its importance for the broad business and academic community
• Focusing on the link to business needs and issues by maintaining a close relationship with the intended users of the game (e.g. representatives from major European companies), involving them in community events and discussions and the overall development process
• Involving community by adding value, offering challenges, participation in important decisions, e.g. by emphasizing the value of support from peers and possibilities for personal development a learner will get by participating actively in the community (for example access to guidance and advanced gaming scenarios)
• Introducing new perspectives to increase the motivation and engagement, e.g. by focusing on alternative scenarios and usage areas for the TARGET gaming environment.
2) Community/network

The major cause of disorders at the community/network level is unclear/problematic “sense of belonging” that affects relations both within and outside the community. In TARGET or similar context this will primarily mean tensions that may arise between members working for different companies and educational institutions. Creating a shared community identity among participants with diverse professional, organizational and cultural backgrounds working from different countries might be a challenging task. Solutions would include:

- Rebuilding trust by engaging in shared problem solving by organizing several joined workshops, meetings, joint gaming sessions and other community events
- Bringing in new generations (e.g. PhD students), introducing and strengthening mentor-apprentice framework by e.g. established community members assisting newcomers through the gaming process
- Encouraging multimemberships and organizing boundary activities (joint events, gaming sessions, summer schools) between members of different communities and organizations in TARGET for cross-fertilization, involving and supporting knowledge brokers.

3) Practice

The major cause of problems at the practice level is that knowledge loses its value unless it is managed, updated, renewed and extended on a continuous basis. In a serious games context like TARGET this means that game scenarios need to be kept up to date with ever-changing business practices and contexts. At the same time, shared practice may act as a blinder, preventing community from discovering and adopting new approaches. The solutions to these problems could be summarized as follows:

- Encouraging members’ involvement in the development of practice and knowledge, e.g. by contributing to the community portal and game repository
- Benchmarking the practice of other communities in different areas, including gaming communities, professional communities of practice, business and academic ones
- Valuing members’ contributions by connecting them to members’ reputation and position in the organization. This means e.g. introducing special reward incentives for contributing to the community repository, “reputation” mechanisms by peer feedback, providing additional resources to compensate for time and effort spent on contributing.

It is important to have a nuanced view on the situation and examine occurring problems from different angles as disorders often combine and reinforce each other. On the other side, many disorders are extensions of “success” qualities, e.g. social relations in a very well-functioning network may with time dominate over the actual task the network was created for. Therefore, according to Wenger et al. [3], “Successful communities acknowledge their weakness and leverage this awareness to spur their growth and reaffirm their long-term longevity”.

V. CONCLUSIONS AND FURTHER WORK

In this paper we have presented an analysis framework for supporting learning communities through their lifecycle in a serious games context. As we mentioned in the Introduction, there exist different approaches to this issue. Our approach is mostly based on the understanding adopted by Wenger [1, 3], focusing on the fluid and emergent nature of learning communities. Therefore this analysis framework and corresponding requirements for monitoring tools are by no means final and will be extended and supplemented as the TARGET project develops. Further work includes discussing and elaborating a new perspective on technology rich collaborative learning environments and the challenges and affordances of the continuum of possible collaborative settings. We have seen that the modern workplace rarely offers a single or isolated type of collaborative activities. TARGET and similar environments need to account for multiple settings and multiple types of collaborative forms a modern worker will find himself or herself embedded in, exploring the constraints and advantages of each type.

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