Instituto Superior de Engenharia do Porto

Virtual Communities of Practice: Design and Development of Support Platforms and Participation Fostering

António Carneiro de Andrade

Dissertação para obtenção do Grau de Mestre em Engenharia Informática, Área de Especialização em Sistemas Gráficos e Multimédia

Orientador: Doutor Carlos Vaz de Carvalho

Júri:

Presidente:

Doutora Maria de Fátima Coutinho Rodrigues, Instituto Superior de Engenharia do Porto

Vogais:

Doutora Paula Maria Marques Moura Gomes Viana, Instituto Superior de Engenharia do Porto

Doutor Carlos Miguel Miranda Vaz De Carvalho, Instituto Superior de Engenharia do Porto

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Resumo

A aprendizagem em ambientes informais tem vindo a ser cada vez mais reconhecida quer como meio de aprendizagem continua em domínios de evolução rápida quer como alternativa aos ambientes de formação formal. Crescendo sobre o conceito de aprendizagem situada e colocando em prática a teoria de aprendizagem conectivista, as comunidades de prática são plataformas ideais para este modelo de aquisição de conhecimento. Esta dissertação aborda o seu potencial, analisa a implementação de três comunidades e faz a avaliação detalhada de uma delas. O seu objetivo é, por um lado, implementar e testar um estrutura de suporte a comunidades de prática virtuais e, por outro, experimentar mecanismos de animação e motivação para a participação.

Numa primeira fase é feito o levantamento do estado da arte na literatura. O primeiro exemplo documentado de uma comunidade de prática relaciona-se com um grupo de representantes da Xerox que na década de 80 se reúne espontaneamente para trocar dicas que otimizem o seu trabalho. A partir dessa primeira observação, as próprias empresas reconhecem o potencial destas estruturas e suportam-nas internamente, validando desta forma o valor tácito gerado.

A maior dificuldade nestas comunidades, recorrentemente documentada, é a criação de um ritmo natural de participação. De facto, alguns autores aprofundam o problema da participação voluntária, identificando algumas categorias e sentimentos motivacionais para os membros participantes: altruísmo, pertença, colaboração, conhecimento, reputação ou autoestima, etc. Outros autores demonstram esse fenómeno de passividade com base em métricas, sugerido que mais de 40% dos cidadãos europeus não participam na sociedade de conhecimento. Contudo, existe consenso quanto à sanidade da existência de diferentes níveis de participação assim como de um fluxo contínuo de entradas e saídas na comunidade.

Se o meio online é favorável ao suporte de comunidade de prática virtuais, propiciando uma adesão mais ampla e flexível, observam-se algumas alterações comparativamente às estruturas co-localizadas. Concretamente, devido à infraestrutura mais tecnológica, estas iniciativas tendem a tornar-se mais verticais; as normas de comunicação são diferentes das que encontramos numa discussão presencial; etc. A literatura também aponta que as comunidades de prática virtuais são muito mais demoradas no desenvolvimento.

Uma das principais práticas recomendadas pela literatura na gestão de comunidades de prática trata de fazer uma avaliação continuada. Nesta dissertação são analisadas várias perspetivas e frameworks para fazer essa avaliação das quais colocámos duas em prática. A primeira respeita comparar as atividades e expectativas para cada grupo-tipo de membros inicialmente planeadas com os resultados observáveis (informalmente) ao final de um período. A segunda consiste em fazer a análise de métricas segundo três perspetivas: tendências (de

adesão, participação, visitas e retorno de visitas, etc.), qualidade da comunidade (relação sinal-ruído nas interações; com base em classificação de conteúdos, número de ligações externas, etc.) e confiança na comunidade (com base no número de contribuições em que os membros demonstram alguma vulnerabilidade, pela procura de ajuda, partilha de narrativas pessoais ou contribuindo apoio emocional).

Após a comparação de diferentes plataformas de suporte a comunidade de prática virtuais concluímos que a mais apropriada é o Elgg. Embora não seja o sistema mais rico em termos de funcionalidades incluídas, é o que apresenta a estrutura mais equilibrada e flexível, permitindo fácil expansão, e o maior número de casos de uso. Assim, após ser descrita a especificação das comunidades implementadas, é feita uma exposição das principais funcionalidades desenvolvidas sobre esta framework.

Das três comunidades referenciadas aprofundamos o nosso estudo sobre uma em particular: a SEGAN – Serious Games Network. Esta comunidade foca-se na reunião de professores, desenvolvedores e investigadores em torno do domínio dos jogos utilizados para a aprendizagem. Durante o seu desenvolvimento confirmamos uma maior dificuldade no desenvolvimento da vertente virtual da comunidade, enquanto as atividades co-localizadas se produzem com bastante sucesso e adesão.

Tentando contrariar esta tendência, fez-se nesta comunidade uma experiência que passou pela implementação de um sistema de gamification. Gamification refere-se à utilização de elementos de jogo noutros contextos de modo a empenhar os utilizadores na consecução dos seus objetivos. Verificou-se que esta adição produz inicialmente algum aumento na participação.

Finalmente, as expectativas relativamente às plataformas a desenvolver foram plenamente alcançadas: todas as funcionalidades especificadas foram implementadas com sucesso sobre a camada abstrata da framework Elgg. Nem durante as entrevistas e inquéritos aos utilizadores nem em discussão nas próprias plataformas parece ter sido apontada qualquer dificuldade no acesso e participação na comunidade. Este cenário confirma a viabilidade da utilização do Elgg como ferramenta de suporte comunidades de prática virtuais.

O trabalho descrito neste dissertação foi rico em aprendizagens: antes de mais pelo contacto direto com especialistas de várias instituições europeias durante o desenvolvimento das comunidades; pela experiência técnica de desenvolver sobre esta framework social e, por último mas não menos importante, pela experimentação com vários mecanismos de animação da comunidade.

Palavras-chave: comunidades de prática, gestão do conhecimento, gamification

Abstract

The value of informal learning experiences have come to be increasingly recognized both as a way of continuous update on fast-paced environments and as an alternative to formal training. Building over the concept of situated learning e putting connectivist learning theory into practice, communities of practice are important platforms for this model of knowledge acquisition. This dissertation addresses their potential, analyses the implementation of three communities and does an in-depth assessment of one of them. Its goals are, firstly to implement and test a platform to support virtual communities of practice and, on a second stage, to experiment with community engagement and motivation fostering mechanisms.

In an initial phase a literature state of the art survey is done. The first documented example of a community of practice relates with a group of the Xerox company representatives who, in the 80's decade, would spontaneously get together to exchanges tips and tricks on how to optimize their work. From that first observation, companies started recognizing the potential of these structures and internally supporting them, hence validating the tacit value generated therein.

The biggest challenge for these communities, commonly documented, is reaching a natural participation pace. In fact, some authors look to deepen the understanding of voluntary participation, identifying some of the motivational feelings behind participating members: altruism, belonging, collaboration, knowledge, reputation, self-esteem, etc. Other authors who demonstrate this passivity phenomenon by analyzing metrics and suggest that over 40% of European citizens do not participate in the knowledge society. There is, nonetheless, a consensus as to the existence of different levels of participation being a healthy indicator, as well as a continuous flow of inputs and outputs in the community.

The online medium is considered favorable to support virtual community of practice, providing a wider and more flexible membership. A number changes are, however, observed when this context is compared to co-located structures. Specifically, due to the technological infrastructure, these initiatives tend to be more vertical; communication standards are different from those found in a face-to-face conversation; etc. The literature also indicates that virtual communities of practice take more time to develop.

One of the good practices recommended by the literature for the management of communities of practice is to make a continuous assessment exercise. This dissertation analyzes various assessment perspectives and frameworks of which two have put into practice. The first one consists of comparing the activities and expectations for each type of group members originally planned with the (informally) observable results at the end of a period. The second evaluating practice is to analyze metrics from three perspectives: trends (membership, participation, visits and returning visits, etc.); community quality (signal-to-

noise ratio; content rating, number of external references, etc.) and community trust (based on the number of contributions where members show some sort vulnerability by seeking help, sharing personal narratives or contributing emotional support).

From the comparison of different platforms to support virtual community of practice we conclude that Elgg is the most appropriate. Although it is not the richest system in terms of features included out-of the-box, it provides the most balanced and flexible structure, allowing for easy extension. It is also the system with the largest number of successful use cases across time. Thus, after specifying the requirements of each community, we dissertate on the main features developed over this framework.

Of the three referenced communities we will focus our study on one of them: SEGAN, the Serious Games Network. This community intends to gather teachers, researchers and developers on the subject of educational games and games used for learning. At SEGAN we confirm the difficulty of engaging users into the virtual community, in contrast with the success and engagement experienced in the co-located activities.

Trying to counteract this trend, we experimented in this community with the implementation of a gamification system. Gamification refers to the use of game elements in non-game contexts in order to engage users and foster likeability. We observed that this addition initially produces some increase in participation.

Conclusively, the expectations regarding the platform development were fully met: all specified functionalities have been successfully implemented on Elgg's abstract layer. Additionally, neither during interviews, user surveys or discussion in the communities themselves has been shared any concern regarding access or usability of the platforms. This confirms the feasibility of using Elgg as a tool to support virtual communities of practice.

The work described in this dissertation was rich in learning experiences: firstly from the contact with experts from different European institutions during the development of the communities; then from the experience of technical development over this social framework and, last but not least, from the experimentation with different engagement and community participation fostering mechanisms.

Keywords: communities of practice, knowledge management, gamification

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This work would not have been possible without the support of a number of people and institutions for which I'd like to express my gratitude.

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1 Introduction

1.1 Introduction

In the current context of near-ubiquous internet connectivity, virtual communities (and social networks) seem to successfully support informal knowledge and information exchange. In this sense, the concept of *community of practice* gets new contours where the technological groundwork is key.

Although one can argue that communities of practice have been part of all types of human learning experiences since ancient times, the concept has first been defined in the 80s, in the context of enterprises. There, it would serve the role of organizing and transmitting information in the scope of the company's activity. However, as we will be seeing, the beneficial impact of communities of practice can be observed in diverse contexts and, regardless of the community's origin, a number of processes and variables have been identified in these structures.

This dissertation aims to survey the concept of community of practice in the scope of virtual networks and social platforms, highlighting the important dynamics in the development and maintenance of platforms supporting virtual communities of practice. Based on that analysis, a number of functional support prototypes will be proposed and their usage in live virtual communities of practice assessed as a demonstration of the reviewed concepts

1.2 Objectives

The main objective governing this work is to develop a virtual community of practice supporting system which assemblies and implements best practices, hence optimizing the efficiency and effectiveness of these structures. To that end, the intermediate goals are:

- Define “community of practice” and “virtual community of practice”;
- Identify social and anthropological constraints in the scope of communities of practice and virtual communities;
- Survey technologies supporting virtual communities and specifically oriented to virtual communities of practice;
- Draft a specification for a virtual community of practice supporting model, grouping the previously analysed best practices;
- Implement a prototype system which fits the specified model;
- Validate the implemented model.

1.3 Motivation

There are two main motivating factors for this work. First of all the enriching experience of working at Virtual Campus Lda., a consulting company in the fields of Information Systems and Technology Enhanced Learning. At Virtual Campus Lda., and mainly in the context of European Lifelong Learning projects, I’ve been challenged to tackle, conceptually and technically, most of the questions addressed in this dissertation.

In somewhat abstract terms, the European Lifelong Learning programme aims to support the development of quality lifelong learning and help member states of the European union develop their own education and training systems. In other words, its actions focus on the creation of links between people, institutions and countries in education and training – what the programme describes as the "European Dimension" of education and training (European Comission, 2006). In this sense, the experience of planning and implementing these projects in collaboration with expert partners from diverse European institutions has been particularly enriching.

On the other hand, this experience rekindled my latent interest for self-learning and informal learning in general. Probably recognizing both my own multidisciplinary route, largely consolidated by continuous informal and autonomous learning, and the quantity of freely available information, I believe this form of learning is today one of the most effective for the motivated learner.

Convinced of the relevance of virtual communities of practice in the individual development, it seems important to me to contribute my own insight towards their adoption, expansion and credibilization. Against this background, studying this topic in detail became positively inevitable.

1.4 Organization of the Dissertation

To begin this dissertation we propose a review of the state of the art on the communities of practice domain. Then we describe the technical implementations related to the development of virtual communities of practice. Finally, one of the three virtual communities presented in this dissertation is assessed in detail.

This dissertation is set in five chapters:

The first and present chapter introduces the dissertation topic, its motivation and goals.

The second chapter digests the state of the art for communities of practice, including their theoretical background, evolution, best practices, assessment and virtual platforms to support online communities of practice.

The third chapter starts by giving an overview of the Elgg framework and then focuses on the actual development and deployment of online communities of practice taking the case of three communities supported by Virtual Campus Lda.

The fourth chapter regards the detailed assessment of one of the three communities presented.

Finally, the fifth chapter summarizes this dissertation's findings.

Bibliographic and other references used during the preparation of this dissertation are included at its end.

2 State of the Art

To synthetize a state of the art we start by framing communities of practice in their theoretical background. Then, we survey the context of virtual communities of practice as well as the tools available to support them.

2.1 Background

Communities of practice are in their essence a medium for informal learning. To understand the dynamics behind this learning concept we should put it in contrast, namely with formal and non-formal learning.

Formal learning refers to the main obligatory education path, the complementary secondary academic level as well as the higher education degrees and specialized professional training. Shugurensky (2000) characterizes formal learning as an institutionalized and hierarchic vertical structure where students are at the basis. Following the author's description, this learning context is composed by rigid and propaedeutic programs which culminate in a diploma or certificate which attests the level of transmitted information, be it for the labour market or the next stage of formal education.

Taking European Union's definition (2012), a non-formal learning context designates training programs happening outside of the formal learning context, which are deliberately taken by learners. Although this kind of training may lead to certification, that is not implied here. Non-formal learning is hence generally optional. Compared to formal learning, it tends to have shorter cycles.

Like formal education, non-formal learning contexts are structured and depend on a teacher and a program (which can be slightly more flexible in this case). Unlike formal learning however, the participation in non-formal learning will generally not have prerequisites. Thus,

one of the main targets for non-formal education is adult lifelong learning as well as skill recognition and transfer programs. Other examples of non-formal learning are contexts of personal skill acquisition such as language or art courses happening outside the formal context.

Finally we should consider all other learning happening outside the two contexts we just reviewed. By stating that no one escapes education, Brandão (1981) is in fact recognizing that all daily activities lead to some learning outcome – this process is referred to as informal learning.

Not all activities are, however, to produce the same density of learning. Seeking to clarify this context, Schugurensky (2000) delineates a simple taxonomy for informal learning, mostly discriminating different levels of intentionality.

Table 1 – Three forms of informal learning (Shugurensky, 2000)

Form	**Intentionality**	**Awareness** (at the time of learning experience)
Self-directed	Yes	Yes
Incidental	No	Yes
Socialization	No	No

Expanding on the author's thoughts, "self-directed learning refers to 'learning projects' undertaken by individuals", both intentional and consciously, such as within a study group.

Incidental learning happens when the subject has not only becomes aware of the learning outcome right after it happened, not having purposefully arrange the experience. This could be illustrated by the moment a toddler touches a hot iron and immediately learns it would not be wise to do it again; or when a person watching the news learns about a historical fact of which she was not aware of until that moment.

Finally, "socialization (also referred to as tacit learning) refers to the internalization of values, attitudes, behaviours, skills, etc. that occur during everyday life". This is the kind of process at play when a toddler learns to speak its first language.

All of these three layers of informal learning will be very present when analysing communities of practice, particularly the concept of tacit learning. Furthermore, there are three other important formulas we should highlight for a proper uptake on informal learning.

The first is the constructivist theory which, summarized, advocates that the subject is to construct his own knowledge through problem-solving and by maintaining a critic stance regarding the learning experience itself, articulating and integrating it with previous

knowledge (Glasersfeld, 1989). Compared to previous behaviourist and cognitivist theories, the constructivist perspective introduces important ruptures with a more formal, vertical, structure. Firstly, a constructivist learning experience does not produce uniform outcomes – each subject is producing his personal outcome. Consequently reaching a uniform scale of learning assessment becomes very hard. Secondly, the teacher role goes from an information transmitter to a learning facilitator. Learners are also to "learn to learn", which means acquiring "high level" competencies instead of specific ones. Hence the constructivist learning method gives a lot of focus to social interaction, specifically cooperation and collaboration setups. This approach to learning has a number of success cases documented, namely by Hmelo-Silver et al. (2007).

The second relevant formula is the situated learning concept, developed by Jean Lave and Etienne Wenger (1991). It is a reaction to vulnerabilities found in the traditional formal learning contexts, often too abstract or out of sync with the real world needs. The situated learning model mandates that learning should happen in the same context where the knowledge will be applied. This means learning is done be socialization and by doing, not only as a medium for information transmission but mostly as a co-construction of knowledge. In other words, in the situated learning model, learning is an enculturation phenomenon.

Considering its nature, informal learning applies not only to academic or professional purposes but also to all domains in life. Nevertheless, it stands out on professional areas requiring a continuous knowledge update. In such cases, situated learning is very relevant. It is in fact the root of communities of practice.

Finally we have the connectivist theory of learning, defended by authors such as Downes (2007) and Siemens (2011). The connectivist theory sees learning as the process of creating connections (links) between information, data, feelings, images, etc. (nodes). This theory appears to create the notion of "know-where", in contrast to previous focus on "know-how" or "know-what" and, hence, "at its heart, connectivist is the thesis that knowledge is distributed across a network of connections, and therefore that learning consists of the ability to construct and traverse those networks" (Downes, 2007). In this sense learning seems to become more important than knowing and the main intent of learning activities is to keep up-to-date and accurate. In practice, the connectivist theory as defined by these two authors resulted in the Massive Open Online Courses (MOOC) model.

2.1.1 Communities of Practice

The first documented example of a community of practice was reported within the Xerox Company where co-workers spontaneously organized an internal support group and knowledge base, making common problem solving easier for other colleagues (Orr, 1986). Eventually the company recognized the value of such structure and created the Eureka project (Brown & Duguid, 2000), an institutionalized approach to generalize this model. Nowadays

these structures are being exploited by many other companies of dimensions comparable to Xerox's (Probst & Borzillo, 2008).

A community of practice can hence be defined as a body of individuals with a common set of interests who willingly come together and wish to learn about or to help evolve and mature such interests through collaborative efforts. In other words, it is a group of people who share interest in a particular domain or area and created the community with the specific goal of gaining knowledge related to that field by sharing information and experience within the group (Wenger, 1998).

The structural characteristics of a community of practice are (Wenger, McDermott, & Snyder, 2002):

- **Domain**: the domain of knowledge is the common ground that gathers members and community activities. However it is important to remember that each member will have a different level of expertise on the domain, spawning from amateur to specialist;
- **Community**: the community refers not only the isolated members' characteristics but mostly the fabric of relationships and interaction norms established between them in the context of the community of practice. Of course, a strong sense of community or belonging will foster interaction.
- **Practice**: the practice of a community represents the amassed and shared products and activities in the specific domain, i.e., the core knowledge produced by interaction between members. Earlier Wenger (1998) would define this as a shared repertoire.

Hence, going back to Orr's example, we can clearly identify the main characteristics of a community of practice in this group of Xerox employees exchanging tips and tricks. In sociological terms, the value produced by these communities is referred to as social capital (Lesser & Prusak, 1999).

Social capital, which is firstly defined by Pierre Bourdieau (1972), refers to another layer of value over the human capital (which considers the individual's value as the sum of its formal apprenticeships). It is the value of networking in individual's ambition formation. Lesser & Prusak describe this social capital in three dimensions: the structural network of people, the identitary and relational norms and the cognitive dimension. Although in the presented definition this concept remains too wide, it succeeds to give us an overview of the tacit value of networks and communities.

Communities of practice have been applied to diverse environments including organizations, education, associations and the social sector, governmental institutions or for international development. Typical activities engaged inside a community of practice relate to problem solving; information request; experience seeking; asset reuse; coordination and synergy; development discussion and knowledge mapping (Wenger, 2006). Thus, considering its

potential to exploit implicit knowledge, communities of practice are also considered valuable knowledge management tools (Abou-Zeid, 2007).

2.1.2 Participation and Motivation

Communities of practice are by nature dependent on the voluntary contribution of their users. Therefore it is important to analyse the main motivation that drives participation in communities at the individual level. Trevor Moore was concerned by this question before and came up with a number of motivational categories (2007). Among others we can think of altruism and belonging, collaboration and validation or power, influence and building of reputation.

Table 2 – Motivational Categories and their Correlating Expressions (Moore, 2007)

Motivational Category	**Correlating Expressions used by Past Researchers**
Altruism	Benevolence, charity, concern for community, public duty, social support
Belonging	An attempt to combat loneliness, taking pleasure in sense of community
Collaboration	The assisted articulation of ideas, development of insight, refined thinking
Egoism	Personal gain, generation of employment, portfolio-building
Egotism	Attention-getting, bragging rights, peer recognition
Emotional Support	An emotional connection
Empathy	Compassion, understanding, a willingness to selflessly help others
Knowledge	Seeking information, self-efficacy
Power	Influence, ownership
Reciprocity	Moral obligation, fairness

Reputation	Social standing, status
Self-Esteem	Respect, positive reinforcement, esteem support
Self-Expression	Catharsis, expression of emotion, offering opinions
Wisdom	Learning, challenge, creative thinking

Blanchard and Markus (2004) and Chiu, Hsu and Wang (2006) also tried to provide an anthropological perspective to the design and implementation of a virtual community. On both essays we recall Moore's motivational categories, either by defining the importance of a "sense of community", as are feelings of membership, influence or fulfilment of needs, or yet the potential of distributive justice through extrinsic motivators.

Although according to Jenkins et al. (2005) and as we will be seeing, the web 2.0 novelties do introduce more distributed and horizontal ways of interaction, it is important to realize that a large part of Internet users might not yet be actively engaged in participating. Considering StackOverflow (a very active, long-running, online community), a 2013 study found that 77% of users only ask one question, 65% only answer one question, and only 8% of users answer more than five questions (Wang, Lo, & Jiang, 2013). Furthermore, analysing Cronin's capture of reputation distribution (which is a direct reflexion of participation) one the same platform, one recognises an accentuated long-tail pattern.

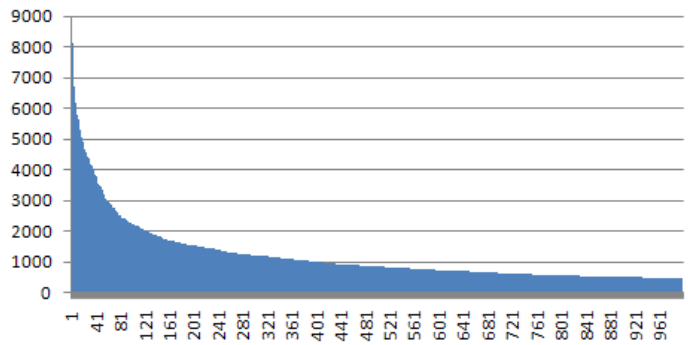

Figure 1 – Reputation distribution through the thousand top active users at StackOverflow (Cronin, 2012)

Testing this idea in 2009, Jokisalo and Riu also concluded that 43% of European citizens were then "non-participants" in the knowledge society. Weighting Europe as a technically enabled sample, in face of such results we might have to look at other non-technological factors to explain the lack of engagement.

Donath (1999) points out the difficulty to assess the reliability of information as one of the main obstacles to the participation in virtual communities of practice. This is due to the fact that social interaction trust is most often established through identity and online identity features are very different, and somehow more limited, than the ones we learned to use in the real world. At the time of the author's writing, an email address' domain often meant the user's affiliation to a bigger organization and as such transported some status. Today this kind of authority has been much diluted and reading identitary traces through language style or an anonymous avatar can be a challenge for beginners (and remains a layer of uncertainty for the rest). Although some authors join Donath (Lai, Pratt, Anderson, & Stigter, 2006), in questioning the possibility of establishing trust online, while others such as Wenger argue in favour of it, we should leave this question open.

The work of Ardichvili et al. (2002) also seems relevant to explore the motivational issues regarding participation in communities. Through semi-structured interviews to members of three different institutional communities of practice (two of which still struggling to find balance, the other being very active), Ardichvili et al. tried to find out the perspective of the members regarding the questions: what is the motivation to participate in this community? Which barriers have they faced? What is the motivation to use that platform as a source of knew knowledge and which are the main obstacles to that knowledge exchange?

Surprisingly the dominant motivation for the exchange of information within these communities came out as the good of the organization as a whole. In fact, the implementation of knowledge management platforms in the shape of communities of practice within organization does serve the intention of retaining the accumulated experience of its collaborators, allowing for it to be reused even after their departure.

The second main response to this question was the intention to establish themselves as experts within the organization. Finally there was the altruistic feeling of sharing experience.

In contradiction with other descriptions (Wasko & Faraj, 2000; Leino & Ovaska, 2008), in Ardichvili et al.'s survey no one pointed selfishness as a barrier to knowledge sharing. Nonetheless, some reluctance to the exposure through such institutional platforms was noted, out of fear for personal attacks or due to sluggish moderation issues.

The increase of perception of the benefits of the usage of such institutional communities also seems to be directly tied to contexts of geographic dispersion. When available, face-to-face relationships will be preferred to virtual platforms. Moreover, some of the interviewees seemed to have failed to gather the information (often very specific) they were looking for in the platform which seemed to be a significant demotivational factor.

Hence the authors conclude that in the case of institutional virtual communities of practice a strong organizational culture (or, in other contexts, belonging feeling) is a crucial requirement. Reconciling this insight with what we have previously approached, it seems that the

establishment of trustful relationships between members in an institutional community of practice much depends on the existing relationship with the host organization itself (Nigani & Hung, 2002) but also on the way members are prepared, trained and engaged into this new structure.

Back to Moore's categories one can see how their impact will vary in more or less positive outcomes. This also seems to justifying the criticism that one such community can "create a profoundly individuated social space that is insulated from others and external reflection, and is merely centred on 'ego casting'" (Riu & Jokisalo, 2009).

On the other hand, those categories also hint the diversity of participation levels and profiles available on such communities of practice. As described by Wenger & Trainer, a community of practice is composed of a core group of members (directing the community), and a number of other layers with different levels of responsibility, participation and engagement.

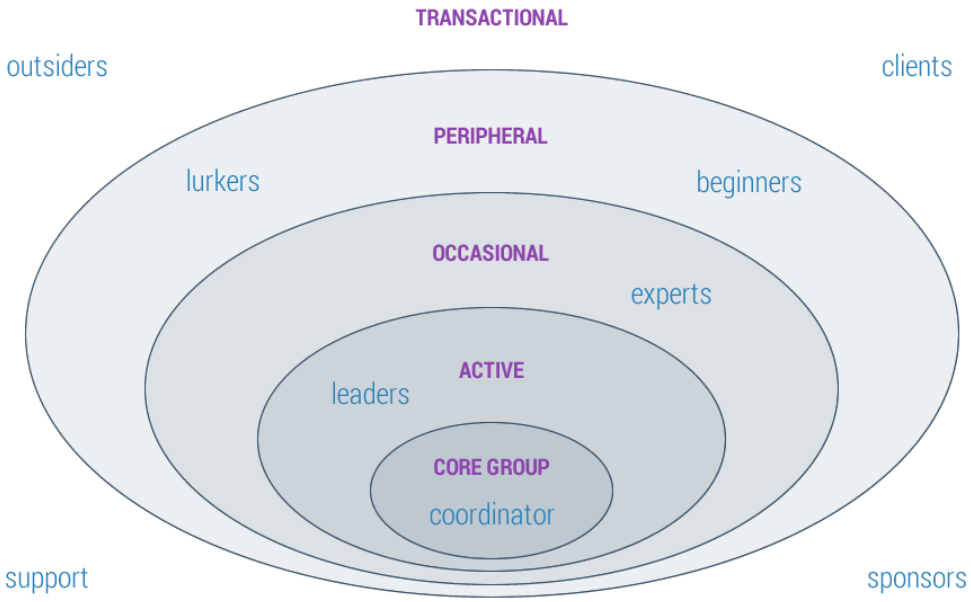

Figure 2 – Different levels of participation, adapted from Trayner & Wenger (2011)

The periphery and boundaries of the community are deemed be Wenger (2010) as important as the core. Boundary objects, interactions and agents are what expose the community to the exterior, allowing for a sustained flow of knowledge and new members.

Wenger and Trayner (2011) will tackle the participation issue in relation with community assessment. A natural membership cycle is recognised within these communities and members may take on new roles within the community as interests and needs arise. When looking at community health indicators, this dynamic of entrances and outings between the

core group of the community and the other layers seems more relevant than simple quantification of contributions. Thus, a community of practice will exist as long as some members believe they have something to contribute to it, or gain from it.

Figure 3 – Membership Life Cycle for Online Communities, adapted from Hinchcliffe (2008)

2.2 Virtual Community of Practice

The widespread access to the Internet popularized a new paradigm, often referred to as the *web 2.0* (Cross, 2004). Amongst other things the web 2.0 is characterized by a focus on relationships established between users and on user generated content. Supporting this shift, there was also a backstage technical shift creating new forms of virtual interaction, including new collaboration tools and new tools to support communities (Leino & Ovaska, 2008).

Despite social networks being the most popular example of web 2.0 platforms, Tim O'Reilly (2007) gives us a more detailed contrast introduced by these innovations. Personal homepages (such as *Geocities* and *Tripod*) are turned into blogs; we go from reading to discussing; from content management systems to wikis; from taxonomies to "folksonomies" (Moore & Serva, 2007); from static references to syndicalisation/aggregators; etc. To testify on this paradigm shift the Time magazine elected "You" (i.e. each individual) as the Person of the Year 2006 – "[...] the World Wide Web became a tool for bringing together the small contributions of millions of people and making them matter".

This evolution in the field information technology made it very interesting for the creation and rooting of Virtual Communities of Practice (Lai, Pratt, Anderson, & Stigter, 2006). To understand how the online context is attractive to communities of practice we should briefly survey relevant tools and patterns.

In the sense that the term "virtual" is a consensual expression to designate some model that we cannot physically interact with but instead experience through the use of electronic tools and technologies, we will be adopting it throughout this dissertation to refer to the computer-

mediated communities of practice in opposition to the traditional, “co-located”, communities. Most often in the context of communities of practice, it would also be interchangeable with “online” and, less commonly, “digital” or “electronic”. The term is not, however, used in opposition to “real”: virtual communities of practice’ are, as we will be seeing, both similar and complementary to co-located communities of practice and their interaction is done by real participants.

2.2.1 Virtual Tools and Communication

Although the web 2.0 boom happened in 2006, virtual communities have been referenced at least since 1993 (Rheingold). The first virtual communities were held through asynchronous communication in the shape of mailing lists and discussion boards (Kollock & Smith, 1999). Asynchronous discussion still seems to be a common way to gather communities, even though different formats naturally arise. StackExchange[1] for instance, which hosts a number of domain-specific online communities (and specifically the very successful programming-oriented StackOverflow community), keeps discussions in a question & answer format instead of the traditional discussion forum.

Synchronous communication tools, in the form of chat rooms, were also available as early as the 80s and IRC networks still gather many communities today. Chat rooms generally translate into more spontaneous participation and socialization. Yet such tools have drawbacks. Firstly there’s the ephemerality of value as there is generally no public registry of the information shared during these conversations. Secondly there seems to be an inherent lack of content structure. In some setups however, the network of online members may constitute a shared repository of files and documents (Wang W. , 2004). Today’s synchronous communication between pairs or small groups is also often complemented by audio and video.

Virtual worlds’ roots can be identified in text-only multiplayer role-playing games from the 80s (e.g. MUDs (Kollock & Smith, 1999)). They should also be mentioned here both because they were present since the start of chat rooms and because they represent the broadness of interaction provided by virtual media. Virtual worlds tend nowadays to offer immersive multimedia experiences. Second Life[2] is today the most popular example of a virtual community hub hosted in a virtual world. Although virtual worlds support most basic communication channels and allow for joint practice (for instance Second Life conferences) (VWBPE, 2014), they seem to require significant time investment to participate and can be

[1] http://stackexchange.com/

[2] http://secondlife.com

considered subject of the same issue of chat rooms: the lack of practical access to a structured repository of information.

Blogs (or online journals), as well as micro publication formats such as the one found in Twitter[3], were also rendered popular inside and outside social networking platforms, often allowing for discussion in the form of comments. Finally, the ease of collaborative writing and editing in the form of wikis is another important breakthrough of the web 2.0 (Leino & Ovaska, 2008).

Considering Facebook's[4] example, one understands social networks are composed of both asynchronous and synchronous communication. The main novelties introduced by social networks are member directories and profiles, and the widespread of folksonomies. The conjunction of these two functionalities allows platforms to suggest people with similar tastes and interests. Moreover, these platforms strive to design interfaces that make it very easy for users to share any type of content (as in blogs), and to create their own private spaces (or groups) inside the platform. In fact, such services even integrate back games as a social platform.

2.2.2 Contrast with Co-located Communities of Practice

Virtual Communities of Practice add to traditional co-located communities the ease of asynchronous interaction (Gray, 2004). Members are no longer restricted to being in the same physical space or even time zone to engage in common activities, reducing, for instance, the sense of isolation in professionals who work alone (Wenger, White, & Smith, 2009).

Furthermore, the new tools available to use through the Internet allow not only for easier organization and consumption of the shared repository but also enable easier collaboration. Kollock explores the changes introduced by virtual communities in relation to face-to-face interaction as a paradigm shift in knowledge economics: it creates opportunities for effort sparing in team coordination but also, in general terms, allows for the value created between two individuals to be amplified ad infinitum (Kollock & Smith, 1999). An example of this effect is the creation of what we came to know as the *Linux* operating system: although it was initiated by a single person, by being shared and improved by many voluntary contributors it reached an important status and dimension in the landscape of information technologies.

[3] http://twitter.com

[4] http://facebook.com

Thus, a large number of specialized, online communities of practice spawned in a more or less spontaneous fashion, most often providing a platform for communal problem solving. Despite the advantages provided by this new technological layer, deeper changes are also produced in these communities' culture. Lai et al. (2006) surveyed the differences introduced in communities of practice by the online medium, which results we can review in the Table 3.

Table 3 — Comparison of Virtual Communities of Practice with Co-located Communities of Practice, adapted from Lai et al. (2006, p. 16)

	Virtual Community of Practice	**Co-located Community of Practice**
Design	Top-down in design, as technological infrastructures are needed to enable communications in communities of practice. Wenger recommends a 'fractal structure'. It is 'built out of local sub-communities or "cells"', with members of the community first belonging to a local community before belonging to the global one. Links between local groups have to be created. Each local community has a coordinator.	Mostly emerges from existing groupings. Can be top-down or bottom-up in design.
Membership	Open membership. Members do not necessarily know each other before becoming community of practice members. A critical mass is needed for the community to function properly. A structure is needed to support both local and global groupings.	Closed membership. Members know each other, at least for the core group members. Mostly organisationally- based. Mainly local sub-groups.
Leadership	Leaders have to be recruited.	Leaders can emerge from the community.
Form of Communication	Primarily text-based, computer-mediated communication, ideally supplemented by face-to-face meetings.	Primarily face-to-face, supplemented by computer-mediated communication.
Time to Develop the Community	Takes longer time to develop.	Can be developed in a shorter time frame.
Technological Support	Essential for the survival of the online community of practice.	Not essential.

Firstly, we must admit that the underlying technological layer in virtual communities of practice creates an obstacle, making at least some level of digital literacy a requirement to

participate. Moreover, it also hints that the creation and maintenance of a virtual community generally requires a higher level of technical competency, which would otherwise be superfluous on a co-located community.

As Lay et al. summarise, the technological dependency means that virtual communities of practice are often top-down, institutionalized initiatives. It also often implies more sustainability planning and financial backup for continued maintenance.

Although Lay et al. also reference Wenger's different levels of participation as natural, and despite the evidence that virtual communities achieve a wider exposure, it is reported that their development cycles are much slower and that dependent on the number of members. This means that getting adoption and engagement is clearly an issue for online communities of practice.

2.2.3 Designing Virtual Communities of Practice

According to Lai et al. (2006), the first step of the community's cycle, the Foundation, consists of the identification of the target group and the community's aim. The core group of leaders and coordinators must also be defined at this stage. Even in situations where this core group already exists, it is important to recognize the characteristic of each founding member and determine roles.

At a second stage, the main characteristics and functions of the community are to be thought out. Summarizing the motivational categories we previously reviewed, Pettenati e Ranieri (2006) argue that the following characteristics have to be present on new community designs for them to naturally induce participation:

- **Perception of significance and utility**, or in other words, helping the user understand how valuable the community can be for his personal development and vice versa;
- **Visibility, reputation** and self-worth, referring to mechanisms allowing for the community to recognize each member's contribution as well as giving the user tools to establish trusty relationships.

Building up on this, in the scope of organizations, Ardichvili et al. (2002) suggest these three main tasks for the implementation of virtual communities of practice:

- Institutional rules and practices to implement an organizational trust, promoting the sharing of information as a norm and moral obligation;
- Institutional initiatives (training and activities), to reduce anxiety and uncertainty towards participation in the community;
- Maintenance of much smaller co-located communities, promoting individual trust relationships.

The Connected Online Communities of Practice (COCP) (2011) suggest that we start from the community domain and actual usual needs to define usage scenarios and functional requirements. Thus, taking Wenger et al. (2009) community examples, we might for instance require support for some or all of the following:

- Online meetings, as group calls or video conferencing;
- Open conversations, as forum threads or chat rooms;
- Project structure, and tools allowing for task management and creation of road maps;
- Content collection and organization;
- Access to expertise, either from other users or facilitators;
- Creation and maintenance of relationships with other users;
- Maintenance of the community tacit value by the creation of synthetized products such as reports.

Another important insight from the COCP work is the common mistake of thinking that the larger the number of community functionalities the better. According to the authors, superfluous functionalities often distract the users from the main value-generating activities. This seems to be particularly true in professional segments, frequently busy and eager to find the quickest route to the resource they are looking for. Moreover, the same phenomena can be explained from a different perspective with a simple metaphor: people tend to feel more comfortable in a smaller cosy room with a few people than on a very large and cold room with the same number of people.

Finally the authors list the main technical patterns that the community might require:

- Content creation and management tools:
    - File repositories;
    - Blogs;
    - Microblogs (or status updates);
    - Collaborative editing tools;
    - Social bookmarks;
    - Multimedia libraries and galleries;
    - Data visualization tools.

- Member interaction tools:
    - Profiles and social networks;
    - User comments;
    - Discussion forums;
    - Webinar tools;
    - Mobile applications or responsive platform.
- User feedback and research
    - Content evaluation tools;
    - Votes, polls and surveys.
- Project coordination
    - Calendars;
    - Task management tools;
    - Decision support tools.
- Utilities:
    - Member notifications (upon different events);
    - Authentication, roles and access levels;
    - Public API;
    - Usage analytics.

However, and in particular for virtual communities of practice, the platform's working prototype alone is probably not enough to get started. Lai et al. (2006) suggest that the founding core group should simultaneously produce and publish a number of valuable artefacts that will attract the first potential members.

2.2.4 Cultivating Communities of Practice

Lai et al. (2006) refer to the second phase of a community's lifecycle as Sustention and Maturation. At this stage new members should be welcomed into the community and new leaders should also naturally take responsibility. Auto-assessment and consideration of external references is also in order as the community's goals or direction might have to be refined or redefined. This analysis takes the community to its third and last lifecycle phase,

which determines either its mutation and expansion (and renewed assessment) or its vanishment and dissolution.

Since by definition communities of practice depend on the spontaneous participation of its members, a big part of a community manager's assessment and analysis is to be directed towards finding ways to keep users motivated. However, in his work "Cultivating Communities of Practice", Wenger (2002) also explores how some indirect measures might have a major impact on the community's health, which we'll synthetize below. These also demonstrate that the sustainability of such communities, particularly online, much depends on their planning as long-term projects.

Design for Evolution

This idea highlights the organicity of a community of practice: its structure must not be an imposition but instead a direct response to the current community needs, fostering an "alive" feel. This also means that not all features might be necessary at all times and it might even be healthy to remove some in the future. As Wenger puts it, "the primary role of design is to catalyse that evolution".

Open a Dialogue Between Inside and Outside Perspectives

Although it is clear that only a community insider can have deep knowledge on the community's inner relationships, Wenger also warns us about the importance of hearing an outside perspective as a way to help members see the full community potential or action possibilities. This might be done either by bringing an outsider into the dialogue or by having members involved in other communities or organizations.

Invite Different Levels of Participation

As we've previously described, not all community members have the same level of participation and that is to be seen as a natural, positive factor. Wenger designates those considered outside of community boundaries but still somehow linked its members as "intellectual neighbours" (e.g.: suppliers or customers). Following the author's exposition, these should not be forced inside but instead made comfortable in these sidelines, as well as allowed for semiprivate interaction. Moreover, the membership lifecycle we previously referred is also to be respected, allowing for dynamic leadership, entrances and quitting members.

Develop Both Public and Private Community Spaces

Following Wenger's view, balancing the private practice with their exposition in public spaces is a big opportunity for communities of practice. Such events will be enriched by the strength of individual relationships and conversely reinforce such relationships.

Focus on Value

Valuable information is the main community fuel. However, Wenger recommends that community members divert their focus from the prediction of value to be created into their actual activities and practice. That will allow value to be created naturally and in unexpected ways. It will also often be difficult to identify the created value as it tacitly lies in the interactions themselves.

Combine Familiarity and Excitement

As with the creation of public and private spaces, it is recommended that the community calendar be balanced between both familiar and exciting events. In Wenger words, "routine activities provide the stability for relationship-building connections; exciting events provide a sense of common adventure".

Create a Rhythm for the Community

Although rhythm is not to be considered as "aliveness" criterion for communities of practice, it seems important that the community finds its natural pace and is able to keep up with it. Practically the community leaders should assess which events are activity catalysts and use that type of activity types as a way to construct an engaging calendar.

In addition to the main idea of focusing in the value-generating activities, taking in Moore's motivational categories (2007) and Pettenati and Ranieri social requirements (2006), some authors clearly defend the need for incentive and acknowledgement mechanisms in virtual communities of practice. The COCP manual (2011) specifically suggests the use of badges, reputation and reputation management systems. In this context the gamification concept seems relevant.

2.2.5 Gamification

Games are another interaction experience greatly dependent on motivation. However, they obviously seem to get a more spontaneous adoption. In fact, they demonstrate a motivational category that Moore did not explore in his survey: fun (Prensky, 2002). However, there's more to games than fun: to Csíkszentmihályi (1990) games produce a *flow*, that is, a mental state of completely focused motivation. Thus, we felt challenged to research whether one could rely on community *gamification* as a way to foster and maintain activity.

One of the most common gamification definitions explains it as the process of applying game mechanics to an interface as means to engage users (Zichermann & Cunningham, 2011). This may consist of defining explicit motivational elements such as user points, levels and leaderboards, achievements and badges (Werbach & Hunter, 2012), or yet virtual currencies redeemable for goods or perks.

The most common critique to this process points the risk of turning game-like interaction into an end in itself which creates no implicit motivation, hence undermining content quality and missing out on the experiential and storytelling dimension of a product or platform. In other words, it interprets rewards in a strictly behaviourist way (Deterding S. , 2010). In fact, helping to make sense of a non-game context, by overcoming this issue, is probably the main objective for gamification (Nicholson, 2012).

Another significant critique to gamification points out leaderboards as inhibiters of newcomers' participation. For Zichermann (2012) however, creating social context is crucial when gamifying a system, producing opportunities for users "to engage with and make new friends". Team play, collaborative action and altruism, as well as unexpected or non-traditional socializing, may also serve this goal.

By using both points and badges, the *StackOverflow* community seems to simultaneous solve at least two issues: on one hand it allows users to have some clear perception of their contributed and gained value, by doing the management of their reputation, on the other it is an incentive to participate and escalate the leaderboards. In practice, this works through the implementation of different classification mechanisms: a general user reputation (the sum of user points gained from useful contributions), the percentage of users with more reputation that another given member (e.g., "you are in the top 12% more reputed users") and a badge system with three levels of difficulty. Thus, for instance, a user who gets more than 100 points from a single question he created will get the golden badge "Great Question"; the novice who for the first time downvotes a question will get a bronze badge with the title "Critic".

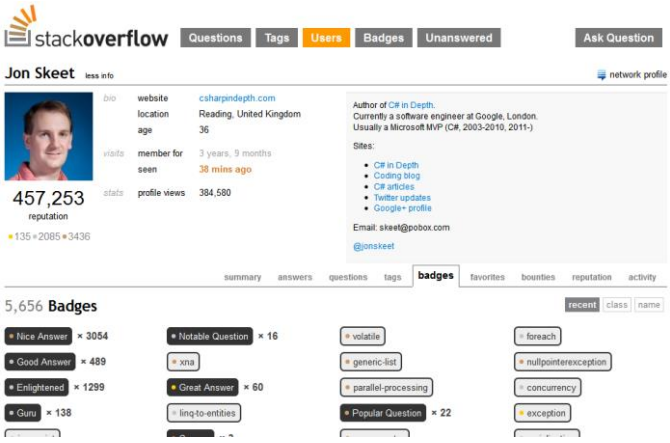

Figure 4 – Typical profile at StackOverflow, demonstrating the numerous gamification elements in a non-gaming context.

In a StackOverflow discussion thread some users observe the tendency for users with more reputation to easily get more points than newcomers (Cronin, 2012). This kind of empathic growth seems common in social behaviour (virtual or not) and may or may not be an obstacle for gamification.

In other non-formal training examples, such as *Khan Academy*[5] or *Duolingo*[6], we can also notice the usage of gamification elements to complement and demonstrate the user's evolution in the courses' paths (cf. Figure 4).

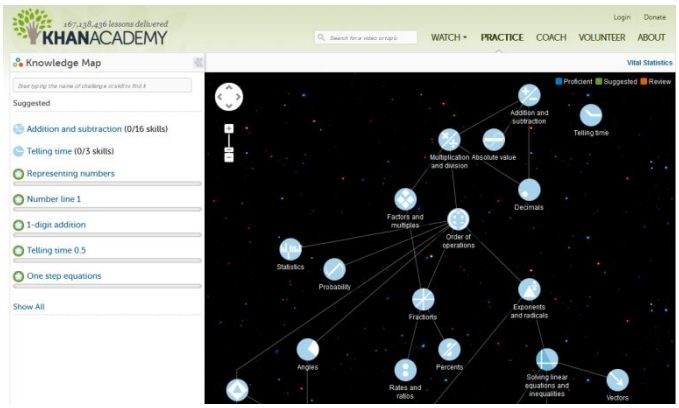

Figure 5 – *Khan Academy*'s interface, on the left the progress in each learning goal, on the right the available learning topics' network

Another approach to gamification was implemented by *Forrst*[7] (a private community for designers and developers). In this example the registration process requires the user to submit some reaction or contribution to some existing platform content. On a second step that contribution is exposed to the private community and only once a minimum number of members validate it, is the registration approved. In addition of filtering newcomers not interest in actively participating it also tries to guarantee that there's at least some correspondence in the exchange. Although this approach is also prone to manipulation, it does represent an interesting gamified peer-evaluation.

[5] https://www.khanacademy.org

[6] https://www.duolingo.com/

[7] https://forrst.com

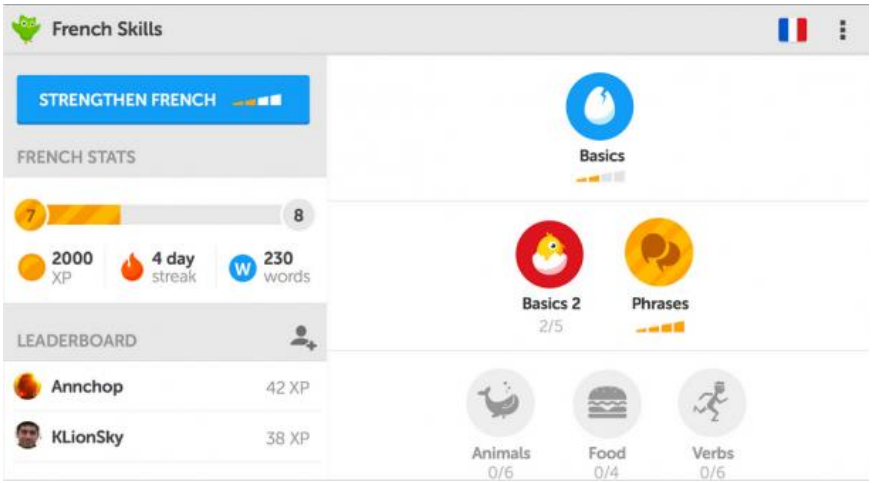

Figure 6 – *Duolingo*'s interface

Different frameworks have been developed for the design of a gamified system. Werbach and Hunter (2012), Marczewski (2012) and Duffy (2012) all suggest a sequence of questions the designer should follow to get directions. Chou (2013) proposes another framework based on what he calls the Octalysis, a chart of eight axes where core drives are related to game mechanics.

Firstly, it is important to know the system to be gamified and who its audience is. Next we need to define goals: what user behaviours do we want to induce and what actions indicate success? For instance, we could focus on content quality over quantity. Rewards should of course be defined according to this priority. This is probably the most important step, forcing the designer to have a clear idea of the gamification target.

The designer then has to find out which mechanics to implement, which extrinsic and intrinsic motivational elements to create and how will the user receive feedback on its actions. Finally, selecting the criteria for analytics and monitoring that data is important not only for user rewards but to continuously assess and/or validate the implemented strategy.

Stressing the importance of both knowing the audience and carefully selecting gamification elements, Duffy (2012) suggests that using attainable achievements as alternative to cumulative user points may be friendlier to newcomers. The author also recommends awarding MVP (Most Valuable Player) status to a select number of users: those will act as role models and, using special perks, may help curate and shape the community.

Despite the criticism and scepticism, company success stories abound (Zichermann, 2011) (2013) and virtual communities of practice have benefited from such process before. The main question seems to boil down to the way gamification is implemented in the community.

2.3 Assessment of Virtual Communities of Practice

Despite its informal context, communities of practice require continuous assessment to be able to validate the achieved results, identify flaws and new opportunities, and thus conserve a healthy evolutionary pace. Often it also allows leaders to "learn how to meet the needs of different types of participants, and in the process, how to attract and retain more of them", as well, as making "a better objective case of value for funders and sponsors" (COCP, 2011).

Furthermore, the assessment of communities of practice allows the understanding of which patterns and mechanisms are the most efficient in each particular context, allowing for community comparison and rendering the process of creating new communities more controlled and predictable (Karrer, 2006). In 2011 Nancy White summarized different assessment methodologies that can be used complementally:

Traditional assessment

White designates this first method as "traditional" for it compares the community's evolution in regards to goals, schedule and plan accordance in relation with the initial proposal. Thus, once identified the three main characteristics according to Wenger's formula (the domain, the community and the practice), they should be taken as referential to evaluate the community's product at a given time.

As in other assessment situations, the quality and efficiency of the assessment process depends on the definition of criteria and on the perspective applied during the evaluation. For instance, the more detailed the domain and goals definition the closest we will be able to assess their fulfilment throughout the community.

Regarding the second main category – the community – one should not exclusively look for quantification but also for an understanding of the relation between those numbers and the quality of the relationships established within the platform: what's the trust level between members? How are cultural differences overcome? In practical terms, this means that technical statistics and analytics should be balanced with proper surveys on the members' perception.

On the practice aspect of the community, the evaluator should look for hints on how the participants are using the available tools and which are the results of the commune practice within the community. Finally and perhaps most importantly, the real impact of the community on the individual's outside practice should also be assessed.

Spidergram

The spidergram is a referential graphic artefact elaborated by Wenger, White and Smith (2009). This technique is based on the perceived value within the community by putting it in contrast with the projected goals and activity plan in a radar chart. In the

diagram, the distance between the initial plan and the community feeling at a certain moment allows the questioning or validation of the directions taken.

Figure 7 – Spidergram assessment example (White, 2011)

In this process the evaluator has first to create an enumeration of the main activities and goals planned. A few criteria examples could be:

- Meetings (co-located or virtual, following a planned agenda);
- Projects (tasks with predetermined deadlines and expected outcomes);
- Access to experts (and learning through direct contact);
- Relationships (sharing, reputation and profile building);
- Context (private, institutional, universal);
- Community cultivation (recruitment, guidance and support to new members);
- Individual participation (allowing for new members to shape their experience, giving them access to the tools and content);
- Content (participation and publishing in the community, such as articles or newsletters)
- Conversation (discussion forums of open scope)

Although in this simplified, yet flexible, format this kind of analysis by itself does not provide either quantification or detail over the community, it does represent an agile

method to go from the plan to the assessment. It could nonetheless be easily adapted to assess factual numbers.

In both cases it has the same drawback, which is the fact that such narrow criteria could prevent other valuable information to be included. Due to its nature, it also provides the advantage of involving the community at large in the assessment process and eventually in the shaping of the future direction.

Perspectival Assessment

Nancy White also suggests that in specific situations it might interesting to establish an assessment system where we take different community roles' perspective in turns. A few interesting points of view might be: the newcomer, the member, the leader or facilitator, the sponsor, etc. Hence, departing from one of these points of view at the time, the evaluator should determine its goals and requirements regarding the community and how they are being fulfilled.

In this process one should be careful not to be biased towards one of the roles but instead to try and find overlapping requirements and perspectives. It will of course, not be possible to satisfy all requests (they might even be opposite), but from this cross dialogue will come up some interesting insight on the community status. This process can also be interesting as a method to prepare more extensive surveys, as it should help reveal the most relevant questions to be asked.

In 2011, Wenger, Trayner and Laat also propose an evaluation framework (Promoting and assessing value creation in communities and networks: a conceptual framework). It focuses on the assessment of the created value within the community of practice through the individual and group narratives.

Since it focuses on narratives (and corresponding open questions), a great level of detail is expected from this kind of assessment while the required data analysis is prone to getting costly. This framework seems to try to adapt to the subjective and continuous nature of the informal learning context by identifying five different phases in the value creation lifecycle.

First cycle. **Immediate value:** Activities and interactions

The first assessment looks directly at interactions: do members get problems solved through their interaction with the group? How's the overall feel in this interactions?

Second cycle. **Potential value:** Knowledge capital

Considering that part of the value created through immediate interactions is only realized at a later time, in this evaluation category one would be looking for which ideas (human), relationships (social), tools (tangible), reputation (intangible) or abilities (learning) have the users gained from the community interaction.

Third cycle. **Applied value:** Changes in practice

In this category one should look for ways in which the values generated and acquired in the second cycle are impacting in the member's practice.

Fourth cycle. **Realized value:** Performance improvement

The forth cycle's evaluation is no longer to look for the utilization of new tools and methods in each member's practice but instead whether there is a real, positive performance impact on the practice.

Fifth cycle. **Reframing value:** Redefining success

Finally the framework looks at how the community's frequency on each member's personal perception and, more importantly, on his ambitions.

In practical terms, the framework suggests that each of these cycles should be investigated through a number of questions. For instance, some starter investigation questions for the first cycle could be: "What were significant events? What happened? How much participation was there? What was the quality of the mutual engagement?" Then the authors illustrate how a number of indicators, reporting and surveying methods would provide the relevant insight to these queries.

Previously Preece (2001) had already considered a sociability criterion for the assessment of communities of practice. His analysis then considered three main sociability topics: purpose (the reason for individuals to interact), people (and roles) and, more interestingly, policies (the social norms, protocols, language and rituals maintained within the community).

Additionally, the same author reinforces that in the context of a virtual community one most also assess the quality of the digital interface as the interaction mediator. Hence, at least technical accessibility and usability evaluations are in order. The author then highlights the dialog and social interaction support (all user feedback elements and the ease with which commands can be executed), the information design (readability and aesthetics), the navigation and the access ease.

As we've seen in Wenger's et al. assessment framework, metrics and analytics are important indicators in different criteria. The COCP (2011) describe three main metrics' levels: basic metrics (e.g., number of members, number of contributions), momentum metrics (e.g., activity trends, membership trends) and simple connectedness/cohesion metrics (e.g., the percentage of forum postings that get no responses, the average number of friends members have in their profiles, the percentage of members who have been members for more than specific time periods and who have no friends, etc.).

The COCP (2011) also report a number of tools to collect this kind of data:

Website analytics can capture a variety of raw metrics time-bond (so community momentum over time is easy to assess).

Online surveys are another important tool to collect the members' perception and experiences. The COCP also describe their advantages as the ability to produce direct queries (over specific issues); to segment the responses from the participating population; to have a wider reach (eventually including potential domain participants who are not yet part of the community); and finally the ability to do anonymous queries, often resulting in more honest and complete responses.

Focus groups are a way to invite some community members to freely interact with other members around certain issues. They often produce richer insight although they also require more preparation and time.

Regarding the community cohesion and connectedness, different approaches might be needed. Firstly, community ownership should assess member's engagement, such as the number of returning visits or contributions over time.

In the community quality category we look for answers regarding the value creation. The ratio between signal and noise, or in other words, the share of topics within the community's domain or practice should, according to the authors, be considered a community quality indicator. The quality perception could also be assessed using user content rating tools. Moreover, the number of external links into the community's contents could be an impact indicator.

Community trust is the most complex to assess and requires the analysis of member narratives as well as interactions. The evaluator should be looking for the proportion of posts in which community members show or express vulnerability, such as a lack of domain knowledge, share personal stories or are emotionally supportive.

On a different perspective, McConnell (2006) proposes a combination of self-assessment and peer-assessment as evaluation methodology. Self-surveys and direct feedback on contributions would thus allow for community-wide insight on value generation. McConnell suggest the following evaluation components:

Table 4 – Assessment of Collaborative Learning: Components and Indicators (2006, p. 100)

Component	Indicator
Product Achievement	1 Contributing to project ideas
	2 Contributing to the research project
	3 Contributing to the analysis of the research
	4 Building on comments and on help received from others

	5	Helping to produce the report, essay or other product
	6	Meeting deadlines
	7	Starting problems or goals
	8	Taking initiatives
Communication Skill	1	Initiating dialogue and discussion
	2	Seeking information from others in the group
	3	Giving information to other in the group
	4	Helping to clarify what is happening in the group
	5	Summarizing the work of the group
	6	Seeking consensus
	7	Describing one's own feelings
	8	Observing others
	9	Being brief and concise
Social Relationships	1	Being sympathetic
	2	Encouraging members of the group
	3	Showing interest in the members of the group
	4	Praising others
	5	Expressing friendship
	6	Dealing with one's own emotions
	7	Sensing and dealing with others' emotions
	8	Coping with conflict and different opinions
	9	Acting dominant
	10	Being protective
	11	Competing with others
Reflective Skill	1	Analysing the group's behaviour

2 Noting reaction to comments

3 Summarizing

4 Learning about oneself

5 Learning about others

6 Sharing knowledge

This method might results in a mixed blessing: in one hand students or members become more conscious of the informal learning going on, on the other, since it requires continuous self-assessment it could inhibit participation and spontaneous participation and activities.

Finally, Probst and Borzillo (2008) made an extensive survey of 57 leaders of communities of practice from which resulted in a best practice guide for these structures. Although not exactly an evaluation framework, the presence or absence of the mechanisms they have observed might also represent a benchmark.

2.4 Platforms to Support Virtual Communities

A number of different approaches are possible to develop a virtual community of practice. For non-technical founders, for instance, opting for a commercial hosted solution is probably the safest path. *Ning*[8], *SocialGo*[9] and *Grou.ps*[10] are all commercial services allowing for the basic community features such as discussion forums, member groups, blog publishing, event calendar and file sharing. Another alternative for starting communities seems to be the creation of groups within existing social networks such as Facebook[11].

The main drawback of such services is the variable flexibility or level of customization. Although some styling is generally allowed, most regularly the administrator will not be able to select which tools are available, create new ones or change their inner workings. For that reason, having someone technically knowledgeable close to the leadership and managing a self-hosted platform is generally the best way to go.

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[8] http://www.ning.com/

[9] http://www.socialgo.com/

[10] http://grou.ps/

[11] http://facebook.com

However, instead of developing a custom community platform from ground up, it seems advantageous to stand on the shoulders of giants or, in other words, build over existing open-source software. Open source software advocates argue some of its benefits are in security and transparency, affordability, perpetuity and interoperability (Casson & Ryan, 2006). Considering its cost and flexibility, using and extending open-source software was from the start, the plan for the development of Virtual Campus' communities.

If discussion forums were enough to support the community we'd be able to select from many free and open-source options, such as *phpBB*[12], *bbPress*[13], *Vanilla*[14] or *Simple Machines*[15]. These however, are very oriented towards the community and, although extendable through add-ons, do not always provide the tools needed for the publishing and easy browsing through diverse types of content, or even project management related tools.

Joomla[16] and *Drupal*[17] are two other popular, generic content management systems that can be turned into a community portal by configuring multiple plugins. Opposite to the forums architecture, they both are designed towards content and not the community. Thus, even using well-tested add-ons, the flexibility and long-term maintenance of the code base could be hindered. Eventually people who are already familiar with such systems could consider this approach.

Another similar case is *BuddyPress*[18], which is a *WordPress*[19] plugin. Until recently WordPress was completely oriented towards blog publishing. Yet, at the time of this writing it cannot only be considered a full-blown content management system but also the most popular of them (BuiltWith, 2014). BuddyPress extends the WordPress providing in addition to the core publishing features, profiles, groups, activity streams, friendships, private messaging and notifications. Additional functionalities can also be enabled by using other plugins.

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[12] https://www.phpbb.com/

[13] http://bbpress.org/

[14] http://vanillaforums.org/

[15] http://www.simplemachines.org/

[16] http://www.joomla.org/

[17] https://drupal.org/

[18] https://buddypress.org/

[19] http://wordpress.org/

Directly oriented towards social networks, three free and open source systems stand out: *Anahita*[20], *Oxwall*[21] and *Elgg*[22]. Anahita core provides profiles, social graphs (friendships), activity feeds and privacy settings. Other functionalities such as groups, discussion topics, photo or task management, are provided through add-ons (which in the Anahita scope are called social apps).

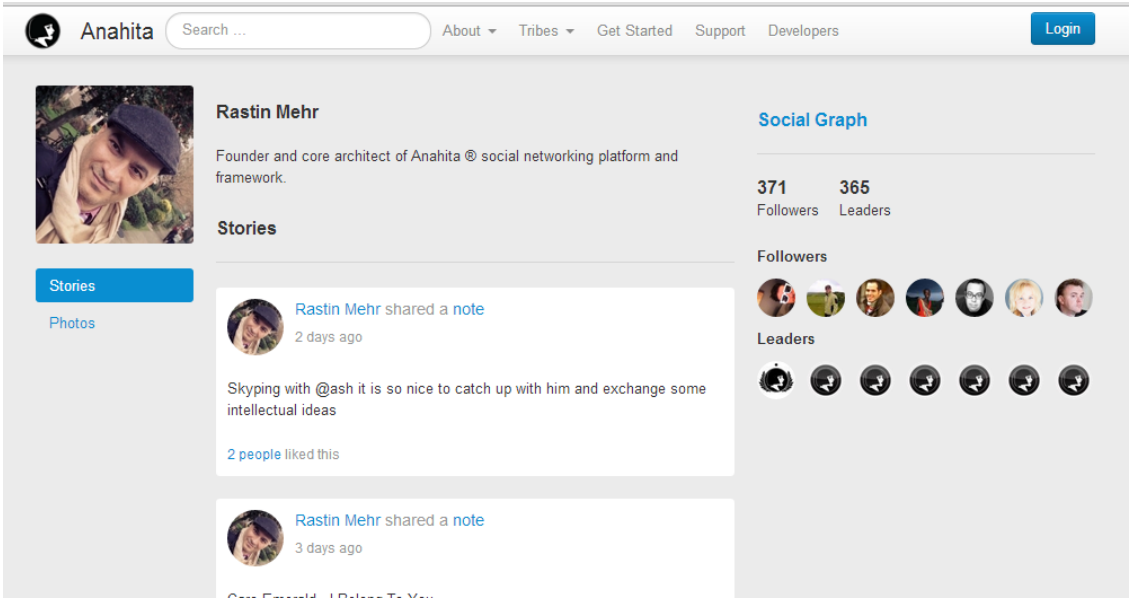

Figure 8 – Anahita default interface: activity stream.

The biggest drawback of the Anahita platform seems to reinforce a common open-source critique: documentation is lacking and sparse at the time of this writing. This means that the learning to extend Anahita must be done by analysing existing code and example add-ons, there being no clear diagram of the system's architecture or reference on its classes.

Oxwall in comparison seems a lot more robust from the start, providing all of those features as well as wikis, events, comments and ratings, collaboration and videoconference tools. Other features can also be provided through add-ons.

[20] http://www.getanahita.com/

[21] http://www.oxwall.org/

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

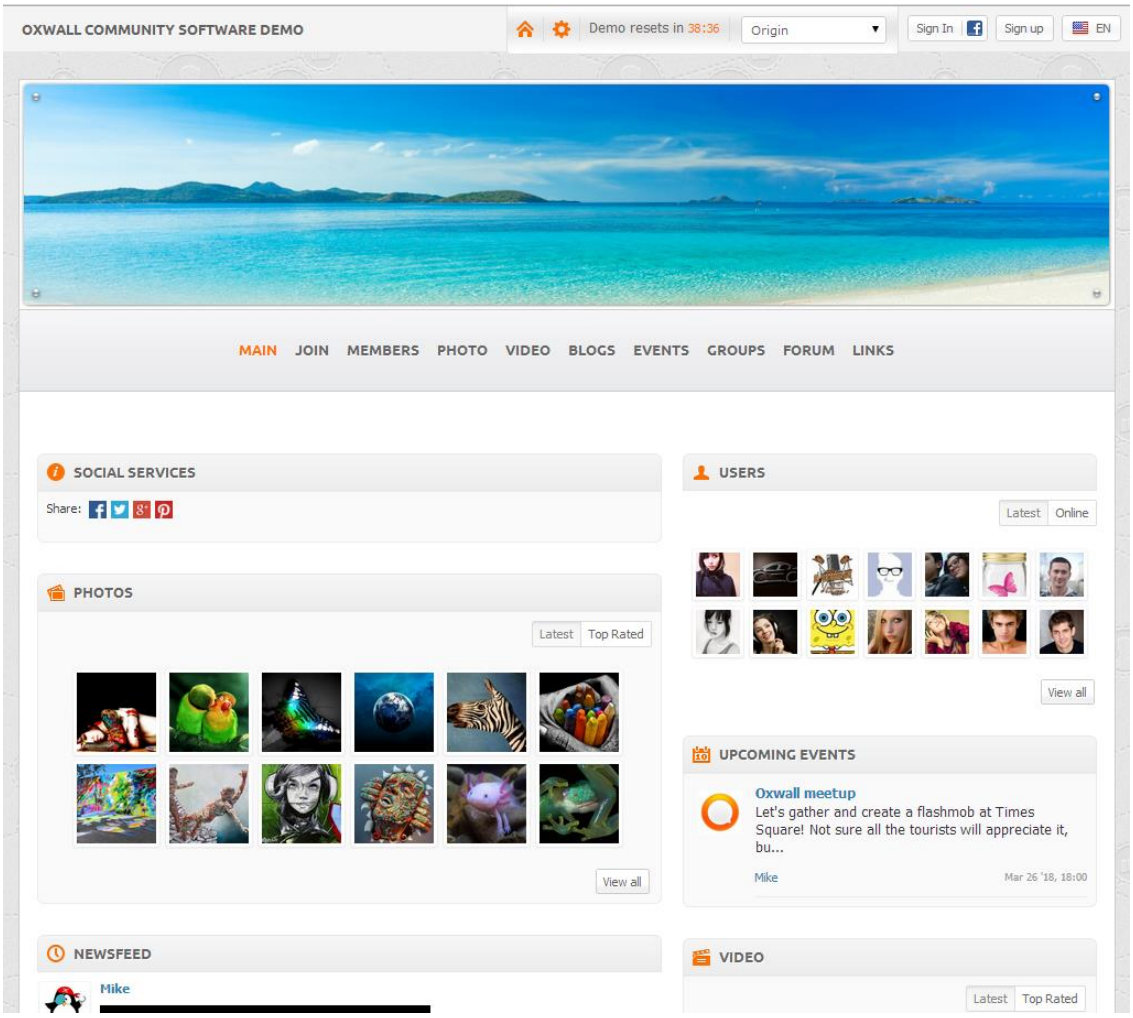

Figure 9 – Oxwall default interface: dashboard.

The platform developers also seem to put a lot of focus on aesthetics, simplicity and ease of use and development is very active. Interestingly, Skalfa LLC, which is the company at the origin of the project and still the major contributors, also provide a hosted solution for non-technical administrators on *Wall.fm*[23]. Oxwall description suggests having clear and evident core code. The project's website does provide a detailed manual on how to setup and use the software and some insight on custom add-on development.

Despite the numerous contestants, in 2004 Elgg seems to be one of the first to tackle a free and open source solution for social networks. This is also reflected on the list of significant

[23] http://wall.fm/

organizations using it, which includes UNESCO, the World Bank and NASA (Elgg, 2014). Elgg describes itself as an engine/framework, focusing on extensibility. Hence, although it provides all of the features we have seen in other platforms, these come in the shape of plugins. For the same reason, aesthetics have not been a priority so far, although they are fully customizable.

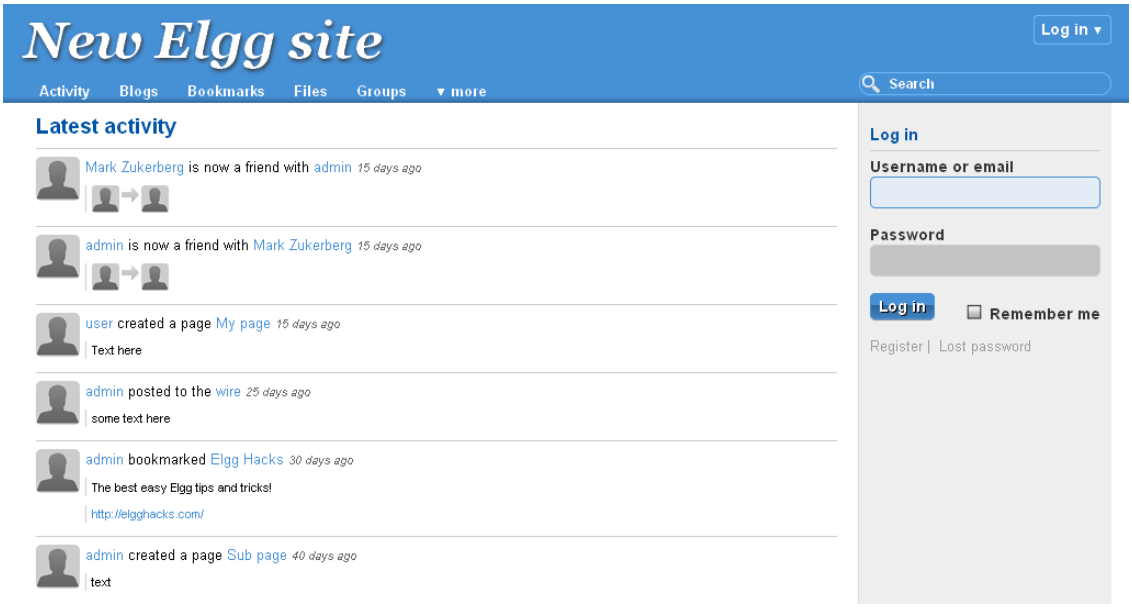

Figure 10 – Elgg default interface: activity stream.

Considering its age, Elgg has gathered a significant community, which also contributed to a solid architecture. This accumulated experience also results in a few major shortcomings: firstly, despite the large number of user contributed plugins they are often out-dated; secondly, some major version upgrades will not support code created for previous versions (at least without significant changes); finally some administrative interfaces do not feel as modern and efficient as in other systems.

Although running out of our initial free and open-source scope, self-hosted commercial software solutions are also worth mentioning. Generally they provide the set of features one would find in hosted solutions but with improved flexibility (although not always open-sourced) and often dedicated support from the vendor. A few notable examples are *PHPFox*[24], *SocialEngine*[25] or *Boonex Dolphin*[26].

[24] http://www.phpfox.com/

[25] http://www.socialengine.com/

[26] http://www.boonex.com/dolphin

At this point we compared the three considered open-source platforms:

Table 5 – Comparison of Anahita, Oxwall and Elgg open-source community platforms

	Anahita	**Oxwall**	**Elgg**
Setup & Environment	Requires the very common PHP+MySQL stack. Setup is rather complex, only through the command line interface.	Requires the very common PHP+MySQL stack. Setup through a web wizard and included in many one-click web installers.	Requires the very common PHP+MySQL stack. Setup through a web wizard and included in many one-click web installers.
Distinctive Core Features (excluding the common resource types such as blogs, file and image sharing, groups, etc.)	RESTful API	Moderator roles Statistics and metrics Advertisement management Appearance building tool Self-update tool for the core and plugins Privacy and permissions management	Flexible data model Granular access control RESTful API
Documentation	Has basic and scattered articles.	Has a wiki covering basic issues.	Has a programmatically generated code reference and a wiki covering most issues and common flows
Extensibility	Extensible through plugins (called apps). Has not a centralized plugin repository.	Extensible through plugins. Has a centralized plugin repository.	Extensible through plugins. Has a centralized plugin repository. By design, most

			functionality is provided through plugins over the core framework.
Community and Support	The project has been public since 2009 but the community itself seems small. Development seems stagnant.	The project has been public since 2010. The community forums are moderately active. There is a "Premium Support" service option. Development seems to continue at a steady pace.	The project has been public since 2004. The community forums are moderately active. Development seems to continue at a very slow pace.
Use Cases	No mentions were found.	No mentions were found.	Many organizations seem to be using Elgg, including many universities, national governments as well as other significant institutions such as UNESCO and NASA.

From the table above Elgg seems to stand out as the long-running solid option. Although it does not currently have the most active pace of development or the richest set of features, it has a proven track of effectiveness. Moreover, the fact that the Elgg core concentrates on providing transversal structure such as user management, access control, relationships and activity streams, leaving the content models to be defined by plugins seemed to prove its data model flexibility and to be the right philosophy to us. Hence, Elgg was the chosen platform as basis for the Virtual Campus' community developments.

2.5 State of the Art Summary

As we have seen, a community of practice is a group of individuals who willingly come together to share experiences and who improve their skills and knowledge through this interaction. Hence, the concept of community of practice builds upon informal learning experiences, socialization and a connectivist way of creating knowledge. Any community of practice may be defined by three fundamental characteristics: the domain, the community and the practice.

The value created by participating in these communities is tacit and, similarly, the motivation to participate and share insights with no direct gain is very subjective. Nonetheless, a community of practice will generally accommodate different levels of participation and

membership progression is often observed as well as the renewing of the core members' group.

The technical evolution of the online environment made it an important platform for the creation of virtual communities of practice. These communities allow for a wider membership and asynchronous communication but, on the negative side, are very dependent on the technological layer, which introduces other issues. One of the main differences pointed by the literature is that virtual communities of practice take much more time to develop when compared to the traditional, co-located, communities. This reinforces other studies that demonstrate that a large share of online users and community users are completely passive ("lurkers").

To counter the issue of lack of participation in online communities, we have also reviewed the concept of gamification. Gamification is the use of game elements and mechanics in a non-game context as a way to foster likeability and engagement. A number of other design principles were also reviewed which mainly highlight the dynamic nature of a community (in terms of scale and rhythm) but also the need for the community platform to provide mechanisms to allow perception of significance, value, reputation and self-worth.

Technically, we reviewed three different free and open-source systems to support virtual communities of practice: Anahita, Oxwall and Elgg. We concluded Elgg is the most interesting not only due to its proven usage track but mostly due to its structure and philosophy: Elgg is the framework providing authentication and an abstract data structure and all features are provided or require development as add-ons.

Finally, the assessment of virtual communities of practice is an important growth mechanism by allowing the identification of threats and opportunities. On one side, the evaluator should compare the expectations and planned activities with the actual results. Actual metrics of the community should be analysed to reveal membership, participation and connectedness trends. The ratio of signal to noise in the community contents (in regards to its domain), for instance, will also provide some measure of "community quality". Thirdly, a more in-depth analysis of these contents will allow the evaluator to perceive the level of trust imbued in the community: how many times do member resort to the community for help or how much do members share personal stories?

3 Communities Development

In this chapter we will review the technical development of three different virtual communities of practice and particularly focus on one of them. From the results of the analysis previously done the Elgg framework was chosen as the foundation for our platforms. Although it does provide many essential features, a number of additional functionality is to be implemented in the form of add-ons.

3.1 Community Models

Within a short time, the company Virtual Campus Lda. got involved in three different European Lifelong Learning projects all having as one of the main goals the foundation of a virtual community of practice (for which the company was technically responsible).

The first of these, the "Training in Innovation, Entrepreneurship and Design for the Footwear Industry" (TIED Shoe) project tackled the need for modern approaches in training solutions in this sector:

> "The leading reputation of the European footwear industry is due to the high level of competitiveness based on the superior quality of the product and a very high capacity for innovation. (…) However, the trade deficit in the footwear sector has more than doubled in five years to €7.0 billion (EU-27, 2007). "Reasons contributing to the large trade deficit are the growing difficulty of EU industry to compete with countries with low labor costs and less regulation and the strength of the Euro" (EU, 2011).
>
> To reduce the trade deficit but keeping the high level of added-value and increase the volume of sales there is the need to train staff in several areas like innovation, entrepreneurship and new design tools. In a global economy where enterprise sustainability and employability is uncertain it requires the best knowledge,

> application of good practices and the mastery of the most advanced methodologies in design and enterprise management to survive. However, most footwear companies are small and medium sized. (…) For this reason most of the companies cannot create an internal training department and are very much dependent on external offers. New vocational training methods, using new technological solutions, with certified qualifications (like ECVET) are required for just-in-time and recognized qualifications. Assessing the web sites of the major European and International organizations (INESCOP, UITIC, CEDDEC, EVS, EURIS) it is clear that there are still relatively few online training programmes" (TIED Shoe, 2012).

Hence, the TIED Shoe project was a Transfer and Innovation LEONARDO project that aimed to create a virtual training center for the development of the footwear industry. Its main goals are to (TIED Shoe, 2012):

- Provide a training center to share the best practices in footwear design;
- Improve and upgrade competences and skills of VET (vocational education and training) colleges and schools;
- Extend the common educational qualifications and accreditation of skills and knowledge for professionals in the footwear industry.

The second project was the "European Marketing and Innovation Centers" (EMIC). From the projects description:

> "The EMIC project addresses the adoption of a culture of integration of Marketing and Innovation best practices for business excellence amongst stakeholders from innovative companies and the higher education sector – university students and teachers in Marketing and related areas like Business and Entrepreneurship. The goal of the EMIC (…) project was to create a set of new tools to ensure that universities, students and companies work together to achieve and incorporate this new relationship between Marketing and Innovation.
>
> These tools were/will be explored through a network of MICs - Marketing and Innovation Centres, each located in each partner University, with different but complementary competencies, according to the local and national demands and capabilities. Their mission – encouragement of entrepreneurial motivation and capabilities, were/will be implemented in a local and transnational perspective" (Vieira, 2013).

Thus, EMIC's specific goals are (EMIC, 2012):

- To create an observatory for national good practices;
- Good practice implementation in companies;

- To set up new forms of training for Marketing & Innovation;
- To support students in the translation to the professional world;
- To support student research.

The third community Virtual Campus was to develop built on the opportunity for improved recognition of serious games' potential. Games are believed to be a potential learning medium. Their enjoyable context and interactivity enhance retention, cooperation and competition skills, strengthen social competences while the fun factor can continuously feed motivation into the learning process (Vaz de Carvalho & Fernandez-Manjon, 2013). However, looking at the current impact that can be observed from the use of games and simulations as informal medium or optional course support material, serious games have not been explored to their full extent.

The "Serious Game Network" (SEGAN) project had the intent of systematizing "the European approaches to serious games, combining theory, research and practice in a way that promotes Europe as the leader in this field" (SEGAN, 2012). In fact, more than half hundred projects funded by the European Commission under this thematic have been realized to date and this convergence seems now fundamental to increase the awareness of the benefits and impacts of serious games.

The SEGAN community was mainly aimed at academic researchers, game producers and serious games' users but it is also to be open to any individual interested in the domain of SG and their implementation. SEGAN practice should consist of the compilation of serious games resources in the online platform supporting the community as well as the open discussion of related topics, working towards annual publications on the design, development, delivery and evaluation of serious games. Face-to-face events were also to be part of the activities, namely an annual conference and summer school. Monthly open webinars are another important part of the planned community practice. Its specific objectives are (SEGAN, 2012):

- The creation of an online social portal that establishes and supports the Community of Practice on Serious Games. The Community is organized in Special Interest Groups that produce annual reports on the design, development, delivery and evaluation of Serious Games and their use in specific contexts;
- The development of a repository with products and projects related to Serious Games;
- The production of reference documents concerning the design, development and evaluation of Serious Games;
- The setting up of small-scale, local events on the design and development of Serious Games;

- The setting up of a series of periodic (annual) European conference and Summer School;
- The preparation of an academic programme on Serious Games and a set of training modules derived from that programme;
- Finally, create a European association that, through fees, ensures the continuation and expanding of the network after the project is finished.

Although not exclusively, the SEGAN community will be our focus throughout this work. In fact, in a posterior analysis and in comparison with the two other communities, the SEGAN community is the one that experienced more adjustments throughout its evolution.

After having formally gathered each project's consortium (corresponding the community's core leader group) and following the definition of each community's domain and specific goals, it is important to plan the technical requirements and design the model to be implemented.

3.1.1 TIED Shoe

The TIED Shoe training center was planned to be built in two layers. The first layer, the community of practice itself, should welcome every interested participant, keeping the interaction open. The second should support e-learning courses.

The first layer, as an open social portal, is to provide tools for spontaneous publication and sharing. Specifically, the following is required:

- Blogs, microblogs and comments on content;
- The ability to upload and share files;
- Organization of website bookmarks;
- Creation of groups and group discussions;
- Networking between members to be supported through private messaging.

The second layer is intended for assigned students only, supporting e-learning courses ("New Design Tools", "Materials", "Innovation", "Internationalization" and "Entrepreneurship"). A different content management system – Moodle – was employed here as it provided trainers with tools which are both familiar and powerful. Nonetheless, the transition from the social portal to the e-learning platform and back was to be made seamless by the implementation of a single sign-on system.

Considering only the social layer of the TIED Shoe platform, we came to understand its design was the most atomic we would get. In fact, the other two project's communities will, at least initially, build upon it.

3.1.2 EMIC

Similarly to the TIED Shoe virtual community of practice, two seamless layers were required: one for the open social portal and a second for private e-learning courses. However, the EMIC project's goals also required supporting students' integration in the labour market by providing the ability to relate enterprises and students looking for jobs or internships. Thus we needed to extend the social portal to consider these two extra roles: 'student' and 'enterprise'.

As a user with a 'student' role, one would be able to manage a new private profile section that would contain a resume and the possibility to upload and attach a complete curriculum document. Additionally, a 'student' will also need to be able to browse placement proposals submitted by 'enterprise' users, as well as have the chance to register his interest on a given placement. Notice that, the resume and curriculum section of a 'student's profile are intended to be visible only to 'enterprises' to which the 'student' has registered interest.

On the opposite perspective, a user with an 'enterprise' role is to be able to create placements. These can be job or internship openings and are only visible to 'student' users. Once 'students' submit their interest to these placements (upon which the 'enterprise' is notified), the placement author is able to browse the list of interested users, as well as consult their curriculum. From this section, the 'enterprise' must be able to contact the 'student' by private messaging. Note that the final application selection process is left open.

Taking into account the local MICs plan, providing an internal tool that enables them to design and carry out online surveys was another requirement. Producing such surveys would allow them to easily identify local practices and trends (the planned observatory).

3.1.3 SEGAN

A particularity about SEGAN's community is that, immediately after the project's approval and before any formal planning or implementation, a Facebook group was created. This initial unstructured approach had a few advantages. Firstly, the familiarity and acquired experience using Facebook's interface, then the integration within such a popular leisure channel, which creates a tendency for viral membership. Overall, this made participation in the group a natural flow in member's daily routines and by the time the project's team started working on planning the implementation of the self-hosted community the Facebook had naturally reached more than two hundred members and a healthy, spontaneous activity pace.

However, using Facebook as the basis of the community also had negative implications that could harm its sustainability in the long term. On the top of the list were:

- The lack of administrative and organizational control;
- Issues related to content ownership;

- The complete lack of independency from a community identitary point of view;
- The single and dynamic flow of information which lead to members with different visit frequencies to miss important information.

Thus, SEGAN's initial model for the self-hosted community was planned to be very similar to TIED Shoe's: allowing the discussion between members as well as the sharing and categorization of resources (blogs and bookmarks). Events were another important part of this community's practice so a calendar was to be additionally provided.

Months into its original deployment, and according to discussion within the core leading group, we concluded the community structure needed to be restructured. The main argument behind this reasoning was that at that point the platform did not really communicate its focus and intentions, i.e., skimming through the website's navigation did not highlight the community's valuable points. In other words, the platform's interface should focus less on its inherent tools and more on the contents.

In practice, on the first SEGAN's version the main navigation entries pointed to "Blogs", "Bookmarks", "Files" and "Groups". For the new version we intended to put more focus on public content publishing while keeping forums for long running discussions. To design this new model we started by considering the main focus groups of the community and for each the main resources of interest. In this sense, we came up with the following content structure:

- **Teachers**
    - **Basics**, introductory articles for the use of serious games
    - **Stories**, articles on serious game usage case studies
    - **Tutorials**, practical guides and resources for serious game implementation in the classroom and related activities
    - **Group Discussion Boards**
- **Developers**
    - **Tools & Game Engines** directory
    - **Game Assets** directory, such as 3d models, graphics, sounds, etc.
    - **Tutorials**, practical development guides for novices or specific technologies
    - **Articles**, generic articles and news on the professional culture of the serious games market
    - **Companies** directory
    - **Group Discussion Boards**

- **Researchers**
    - **Project** directory
    - **Research Articles** directory
    - **Journal** directory
    - **Research & Development Groups** directory
    - **Group Discussion Boards**
- **General**
    - **Games** directory
    - **Events** directory/calendar
    - **Group Discussion Boards**

Ideally, in the long run the articles in each of these sections would be spontaneously exchanged by the community (and this ability would be present since the beginning). Nonetheless we were also aware that the core group would have to put some effort into creating and publishing some starting material: as we have seen before, providing valuable content is paramount to attract new members.

3.2 Development

As we have defined before, the Elgg core only provides the frontend backbone structure (activity stream, relationships and settings) for the community platform. Nonetheless a number of basic content providing add-ons are supplied with the official distribution. These support all the generic features one would expect in a social portal (blogs, pages - which may be edited by all users in a wiki-like behaviour, private messages, files, groups, etc.).

While some of these generic content types are of course useful in their original shape, other requirements justify the development of custom functionality. In this section we will go through the custom functionalities that were developed in the scope of the three presented communities.

3.2.1 Elgg Structure

Before getting into our implementation details it might be interesting to provide a technical overview of the Elgg framework. Elgg is based on a PHP and MySQL stack. The core engine on its own only provides a small number of visible frontend functions: user relationships, user settings and the river (an activity stream). All the expected content types are delivered in the

form of add-ons, which seems to allow for streamlined setups. At version 1.8, its top directory structure is the following:

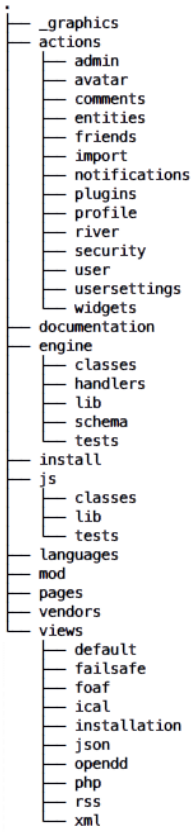

Figure 11 – Elgg 1.8 directory structure.

The Data Model

Although many of the engine functions are procedural, the data model is strictly object-oriented. As we can suspect from observing Figure 7, most data inside the Elgg engine is considered an entity, and inherits from the class `ElggEntity`. Users, posts and groups all are entities.

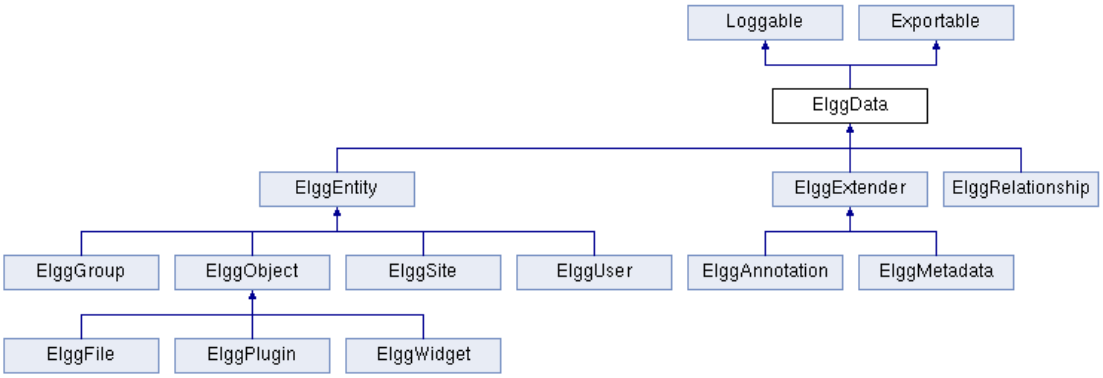

Figure 12 – Elgg data model classes' hierarchy.

In addition to this atomic data unit, we have two important helper classes. Firstly we have the `ElggExtender` which is always used either in the form of `ElggAnnotation` or `ElggMetadata`:

- `ElggMetadata` associate simple data to an `ElggEntity`, such as tags into a post.
- `ElggAnnotation` associates a piece of data owned by one `ElggEntity` to another `ElggEntity`. This is the case with comments for instance, which are owned by an `ElggUser` and are attached to some `ElggEntity`.

`ElggRelationship` is the other main helper class, which instance represents a relationship between two entities. For instance, an `ElggUser` might is a "friend" of another `ElggUser`; an `ElggUser` might "like" an `ElggObject`, etc.

As the official documentation summarizes, an `ElggEntity` has the following core properties:

- A numeric Globally Unique Identifier (GUID);
- Access permissions (for when a plugin requests data it never gets to touch data that the current user does not have permission to see);
- An arbitrary subtype; "blog", "forum" and "pajama" are all valid subtypes;
- An owner;
- The site that the entity belongs to;
- A container, usually used to associate a group's content with the group.

The `ElggEntity` then specializes into `ElggSite`, `ElggUser`, `ElggGroup` and `ElggObject`. The latter is the one we will be using most to create new content types. In addition to the previous properties, and `ElggObject` also has the core properties "title" and "description". Any further property will be stored (and retrieved) as metadata (`ElggMetadata`), behind the scenes. This

structure should be flexible enough to host diverse types of content that should be grouped under the developer-specified subtypes.

Extensibility

The common practice when using such engines is not to modify the core engine code but instead extend it through plugins. There are a few thoughts behind that reasoning: modifying the core will potentially impact on functionalities other plugins depend on; it will make future upgrades very difficult and, all in all, makes it harder to get help from the community since it is impossible for others to now whether changes on a custom system are to blame. Extensibility of existing features is provided in Elgg mainly by two interfaces: `events` and `plugin hooks`.

Elgg `events` are triggered at specific stages of the application lifecycle and, particularly, on the creation, update or deletion of an entity. Thus, plugins may register handlers to listen to particular events, with a given priority:

```
// $event is the event name
// $object is the object type (e.g. “user” or “object”)
//    or ‘all’ for all types on which the event is fired.

// $handler is the callback handler function
// $priority where 0 is first and the default is 500

// elgg_register_event_handler($event, $object_type, $handler, $priority);

elgg_register_event_handler(‘login’, ‘user’, ‘myPlugin_handle’, 400);
```

Those function will then be called in priority order, at the corresponding time and with three parameters: the event name, the entity type and the entity itself. Upon being called, events are expected to return a boolean. If a `false` value is returned, the event will be halted and any further event handlers cancelled. That means that an event handler may cancel the deletion of an entity.

```
/**
* @return bool if false, the handler is requesting to cancel the event
*/

function event_handler($event, $object_type, $object) {}
```

Events should be triggered inside plugins in the following fashion:

```
// triggering event

if (elgg_trigger_event($event, $object_type, $object)) {
  // proceed with doing something.
} else {
  // event was cancelled. Roll back any progress made before the event.
}
```

Elgg plugin hooks behave much like events although with a few significant differences. Firstly, a plugin hook can be triggered with any array data and not only the entity an action is being taken on. Secondly, all plugin hook handlers are called regardless of the value returned by previous hooks; in fact, each plugin hook handler is also passed the return value of the previous handler and can choose to modify it.

```
// registering handler for plugin hook
elgg_register_plugin_hook_handler($hook, $type, $handler, $priority);

// filtering $value by triggering the plugin hook handlers
$value = elgg_trigger_plugin_hook($hook, $type, $params, $value);
```

The Elgg core code provides a number of plugin hooks and events but it is important to note that plugin authors are also strongly encouraged to the best practice of providing as many event triggers and action triggers as reasonably useful. That would allow for plugins to be extended, to interact with behaviours and to build upon existing functions.

Actions and Forms

Elgg actions refer to endpoints on which the user might act upon content. In practice that might mean that when, by using a form, the user POSTs some content to http://example.org/bookmarks/new, he is in fact using the “bookmarks/new” action (which code, we assume, should validate the entered data and create a new entity).

```
// registering an action
// __DIR__ corresponds to the current file's directory, this is expected to
be the root of the plugin

elgg_register_action(“example”, __DIR__ . “/actions/example.php”);
```

The __DIR__/actions/example.php script will now be run whenever a form is submitted to http://example.org//action/example.

Actions are closely coupled with form helpers. Form helpers certainly are a light way to create a form corresponding HTML output but, more importantly, they support you in creating security measures to protect your users from cross site request forgeries (CSRF). CSRF

is a common web vulnerability exploitation, which consists on redirecting a user request from the Website A into Website B endpoint (for instance, submitting a comment on Website A would get it posted on Website B, in a user-transparent manner). This kind of vulnerability is potentially very destructive and the common remedy is to make every HTML form unique.

```
// To output a form elgg_view_form should be used:

echo elgg_view_form('example');

// Doing this should generate something like the following markup:

<form action="http://localhost/elgg/action/example">
   <fieldset>
      <input type="hidden" name="__elgg_ts" value="1234567890" />
      <input type="hidden" name="__elgg_token" value="3874acfc283d90e34" />
   </fieldset>
</form>

// Elgg does some things automatically
// for you when you generate forms this way:

// * It sets the action to the appropriate url based
//   on the name of the action you pass to it
// * It adds some anti-CSRF tokens (__elgg_ts and __elgg_token)
//   to help keep your actions secure
// * It automatically looks for the form in the forms/example view.


// We can now create our form fields:

### __DIR__/views/default/forms/example.php

echo elgg_view('input/text', array('name' => 'example'));
echo elgg_view('input/submit');

// Now when you call elgg_view_form('example'), Elgg will produce:

<form action="http://localhost/elgg/action/example">
   <fieldset>
      <input type="hidden" name="__elgg_ts" value="...">
      <input type="hidden" name="__elgg_token" value="...">

      <input type="text" class="elgg-input-text" name="example">
      <input type="submit" class="elgg-button elgg-button-submit"
      value="Submit">
   </fieldset>
```

```
</form>
```

Output

Elgg's basic pages (each corresponding to a page_handler which we'll see later on) are stored in the `pages/` directory. The reusable output templates, however, are called `views` and stored in the directory of the same name. Each of these files contains only an atomic presentation element. `Views` can be included from inside other views and their files are kept in a hierarchical directory structure.

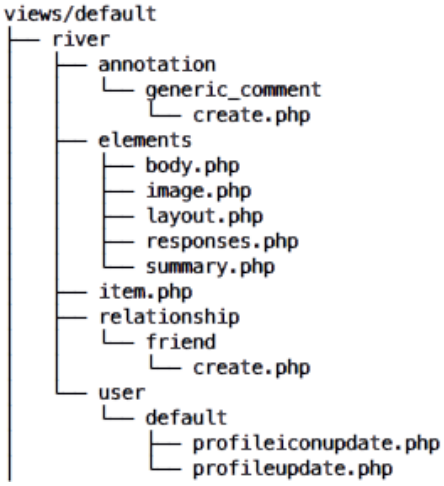

Figure 13 – Elgg views hierarchy for the river entities.

Furthermore, Elgg implements the concept of `viewtypes`. The default `viewtype` is HTML but other `viewtypes` can be JSON, RSS, etc. As such, depending on the context, an entity can be represented using an HTML view or a JSON view. The same directory structure is thus expected inside each `viewtype` root.

Plugins

Plugins are the modules inside of which we might extend Elgg. Thus they might serve very diverse purposes, from simply intercepting some specific behaviour, provide a new complete theme or create the required structure for a new `ElggEntity`. Plugins are activate on the administration panel and can be reordered. This plugin's list sorting also defines the order in which plugins are executed.

Figure 14 – Elgg plugin administration.

Each plugin consists of a folder inside the `mod/` directory with at least two files: `manifest.xml` (which provides the plugin description, metadata and dependencies) and `start.php`, which is the entry point into the plugin functionality. The basic plugin skeleton is as follows:

```
### start.php

function yourplugin_init() {
   //register actions
   //set up pretty urls
   //add menu items
   //etc.
}

elgg_register_event_handler('init', 'system', 'yourplugin_init');

### manifest.xml

<?xml version="1.0" encoding="UTF-8"?>
```

```
<plugin_manifest xmlns="http://www.elgg.org/plugin_manifest/1.8">
    <name>Example Manifest</name>
    <author>António Andrade</author>
    <version>1.0</version>
    <blurb>This is an example manifest file.</blurb>
    <description>This is a simple example of a manifest file. In this
example, there are many options used, including screenshots, dependencies,
and additional information about the plugin.</description>
    <website>http://www.elgg.org/</website>
    <copyright>(C) António Andrade 2014</copyright>
    <license>GNU Public License version 2</license>

    <category>3rd_party_integration</category>

    <!-- All plugins must require either elgg_version or elgg_release. -->
    <requires>
        <type>elgg_version</type>
        <version>2014010401</version>
    </requires>

    <!-- The path is relative to the plugin's root. -->
    <screenshot>
        <description>Elgg profile.</description>
        <path>screenshots/profile.png</path>
    </screenshot>

    <provides>
        <type>plugin</type>
        <name>example_plugin</name>
        <version>1.8</version>
    </provides>

    <suggests>
        <type>plugin</type>
        <name>twitter</name>
        <version>1.0</version>
    </suggests>
</plugin_manifest>
```

In addition to this two required files, the plugin structured replicates the one found at the root of the Elgg directory. Another interesting feature of this structure is the fact that views defined inside a plugin will replace core views in the same hierarchy (or, from other plugins executed earlier than the current). Hence, selectively overriding views is one of the common techniques when developing a new theme.

Another common requirement is the creation of new endpoints that are not actions. To that end page handlers should be registered. Then, once the registered URL is requested, the page handler will be called with the URL segments as parameter:

```
// registering page handler for http://example.org/my_blog/

elgg_register_page_handler('my_blog', 'my_blog_page_handler');

// then defining the page handler

function my_blog_page_handler($segments) {
   if ($segments[0] == 'add') {
      include elgg_get_plugins_path() . 'my_blog/pages/my_blog/add.php';
      return true;
   }
   return false;
}
```

Finally, since we discussed action events and hooks, it might be interesting to note that if in rare occasions it is not possible to intercept a given action, we might also replace it:

```
// replacing "groups/edit" action with our own

elgg_unregister_action('groups/edit');
elgg_register_action("groups/edit", "$new_action_path/groups/edit.php");
```

Internationalization

The Elgg core also provides internationalization features. New languages can thus be provided by plugins.

Translations are stored in the form of PHP arrays, inside the languages directory, and can then be invoked using the `elgg_echo($key, $args, $language)` method. The $language parameter defaults to the current session language and the `$args` array may transport data to be interposed in the string in a sprint fashion.

```
### mod/example/languages/en.php

return array(
   'example:text' => 'Some example text',
   'welcome' => 'Welcome to %s, %s!'
);
```

```
### anywhere else, outputting our localised and formatted string

echo elgg_echo('welcome', array(
   elgg_get_config('sitename'),
   elgg_get_logged_in_user_entity()->name,
));
```

Web Service

Although most communities will not require a public API, Elgg core does provide all the structure needed to support one (including API authentication). This might be interesting if you plan on letting other websites interact with Elgg's setup or, for instance, if you wish to develop a mobile client for the website. A sample (and useless) public method might consist of the following:

```
// We first define our method

function my_echo($string) {
   return $string;
}

// Then expose it to be consumed

expose_function("test.echo",
   "my_echo",
   array(
      "string" =>
         array(
            'type' => 'string'
         )
      ),
   'A testing method which echos back a string',
   'GET',
   false,
   false
);
```

With this code in place, we can access
`http://example.org/services/api/rest/xml/?method=system.api.list`
for a list of the available API calls.

To test the exposed method from a web browser, we should request the URL
`http://example.org/services/api/rest/xml/?method=test.echo&string=testing`
and see the following result:

```
<elgg>
   <status>0</status>
   <result>testing</result>
</elgg>
```

3.2.2 Themes

The first requirement upon the setup of an Elgg website is to customize the look of the interface. After the creation of the plugin skeleton, one has to create `./views/default/` directory structure. Inside this directory at least one `.php` file should be created to host our custom CSS code. It might be surprising to use a `.php` file to host a stylesheet. In fact, in Elgg's perspective the stylesheet is a template like any other. Additionally this allows us to use some PHP variables inside the CSS code.

Since Elgg core stylesheet provides formatting for a lot of important controls, most of the time one will not want to completely replace it but instead append to it custom styles. To that end our theme plugin might use the following function:

```
// appending our css to the one from Elgg core
elgg_extend_view('css/elgg', 'mytheme/css');
```

Note that in the above code `'css/elgg'` refers to `/views/default/css/elgg.php` while Elgg templating engine will cascade until it finds `/mod/my-elgg-theme/views/default/mytheme/css.php`.

In other cases we needed to completely replace part of the HTML code. For instance, to replace the website's shortcut icon, the best approach is to copy the original file from `/views/default/page/elements/shortcut_info.php` into `/mod/my-elgg-theme/views/default/page/elements/shortcut_info.php`, and then make the needed changes. Plugin views always take precedence over the core's.

Through the use of these techniques the following plugins were developed:

- `elgg_theme_emic`
- `elgg_theme_segan`
- `elgg_theme_tied_shoe`

The TIED Shoe community required mostly the application of a branding layer (logos, background images and colours) as the overall structure seemed to suit the community. The same principle had to be applied to the Moodle platform used for the e-learning layer of the community (which uses a different templating system).

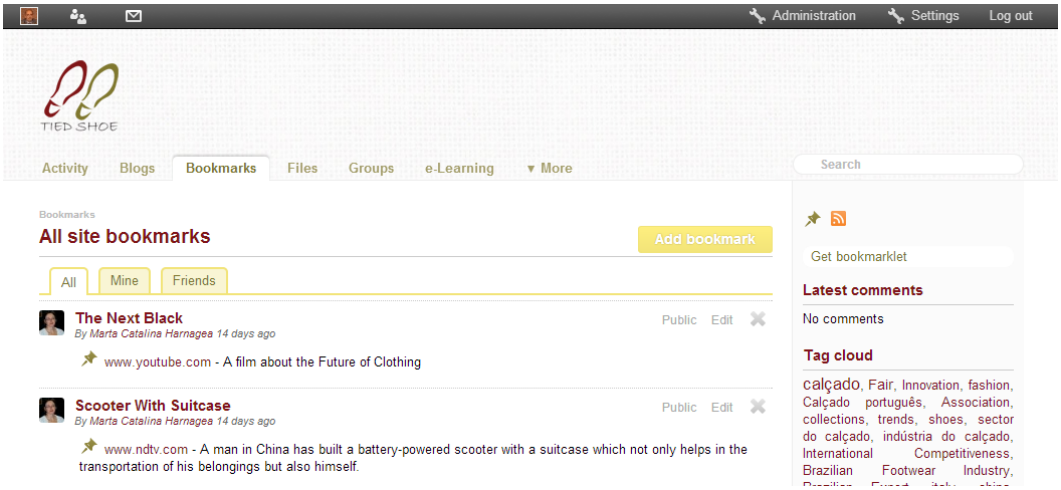

Figure 15 – TIED Shoe Elgg Theme

Since the community's main portal was using WordPress as content management system at the moment of the community's inception, in EMIC's case we had to replicate the existing layout. Although this does not generally represent an issue, some dynamic elements' layouts, such as the navigation menus, were particularly challenging to synchronize.

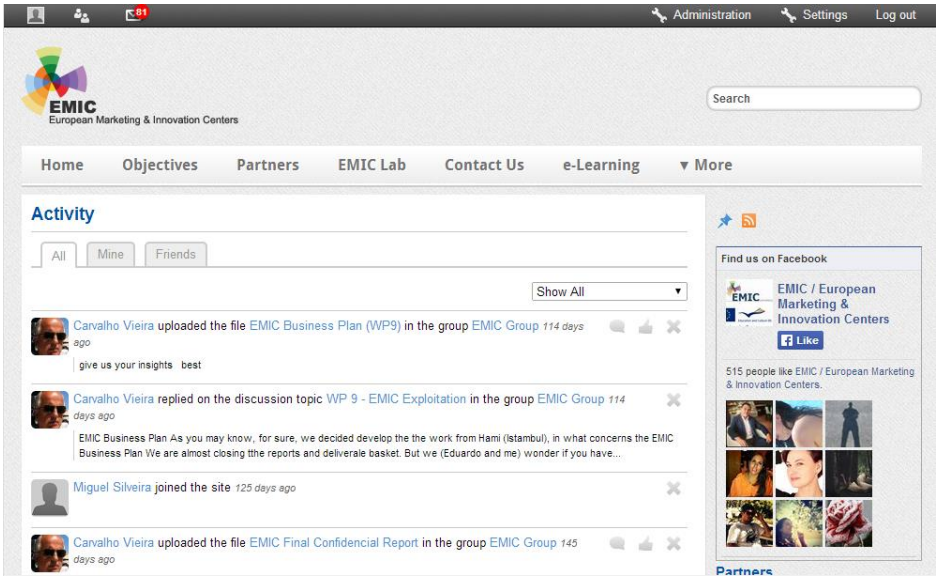

Figure 16 – EMIC Elgg Theme

As we have presented, SEGAN has gone through a major restructuring a few months after its initial deployment. Our first though was that making it look somehow similar to Facebook would induce some familiarity and thus make people more prone to join in. Hence, we forked an existing Elgg theme that produced a Facebook-like structure, and then made the required aesthetic adjustments.

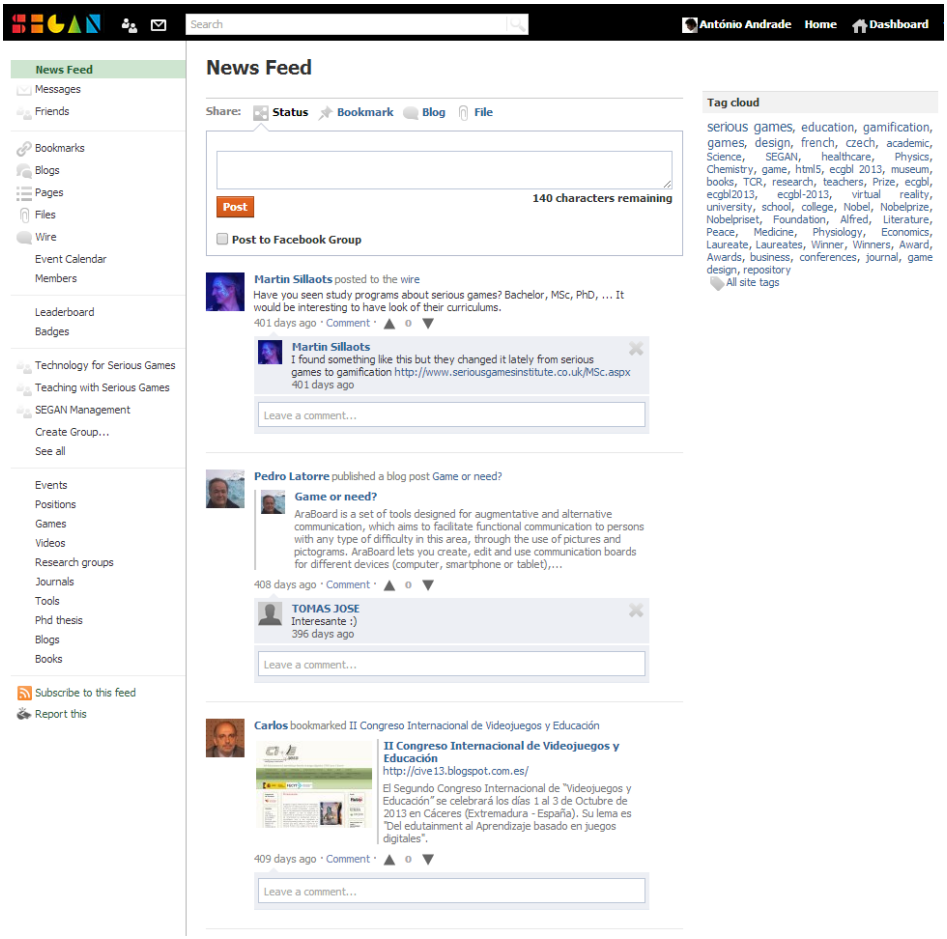

Figure 17– Legacy SEGAN Elgg Theme

After defining the new content structure for SEGAN, we also understood that we had to step away from the Facebook similarities if we wanted to diverge from its typical fast and fading interaction and establish a strong identity. Thus, the second SEGAN structure was designed from scratch.

Figure 18 – SEGAN's latest Elgg theme

Implementing the new SEGAN theme involved overriding most of Elgg core views. We did, however, opt to use a CSS framework that would provide the essential layout grids. At that moment Gumby[27] seemed to be good compromise between size and features. Having gained experience from other projects, Bootstrap[28] would have been a better choice if we were starting the same project today, not only due to the much bigger community support but also considering its feature set, style defaults and development pace. Nonetheless, the framework choice did not impact negatively on the development process and instead proved to be a good scaffold.

3.2.3 Authentication

While both statistical and anecdotal data seem to point to social sign-on option as a factor in the increase of website visitor conversion (Tzeng, 2013), considering that at least in SEGAN's case the founding members were already active in Facebook, to provide options to register and login using such platforms was deemed necessary. With this aim we tested an Elgg plugin freely provided by the HybridAuth[29] vendor, which integrated authentication with dozens of social platforms. We quickly realised, however, that not only had that open-source project

[27] http://gumbyframework.com/

[28] http://getbootstrap.com/

[29] http://hybridauth.sourceforge.net/

been silently abandoned for a couple of months (and up to this date), but it also was left with a number of standing issues that rendered it unusable. Since HybridAuth tried to provide so many integrations we decided it would probably be beneficial to implement the features we required instead of fixing the whole library. Fiddling with HybridAuth was however valuable in an educational perspective.

As previously described, in TIED Shoe's and EMIC's cases Moodle was to be used to support e-learning courses in parallel with the community. This meant we had to make signing in through either interfaces (the community or the learning portal) as seamless as possible, as well as make user profiles were kept in sync.

Hence the following plugins were developed:

- `elgg_facebook_login`
- `elgg_moodle_auth`

To allow signing in or registering through the use of Facebook authentication (or any other use of platform's API) requires the previous creation of a Facebook app. Then, using the Facebook JavaScript SDK, the procedure logic is as follows:

1. Clicking the Facebook button spawns a Facebook popup window;
2. If the user is not authenticated against Facebook, a Facebook login form is presented.
3. Once the user is authenticated, Facebook requires user permission for the app we previously created to access his personal information.
4. Once permissions are confirmed a callback is sent from this popup window into the original window, which is then handled by the Facebook SDK.
5. At this point our JavaScript code has access to the user's Facebook profile data and posts it to specific PHP endpoint on Elgg.
6. The PHP code will first check whether there is any existing user associated with that Facebook User ID or using the same email. If there is a match, the user will be associated to the Facebook User ID and authenticated.
7. If there is no match a new user will be created, populated using the Facebook data, (i.e. email, full name and avatar) and authenticated. The newly created Elgg user is expected to keep signing in using Facebook as the randomly generated password generated during creation is kept secret. Alternatively, he can also request a password by accessing the "Forgot My Password" procedure.

Note that steps 2 to 4 are handled on Facebook's domain and we have little control over them, except for the level of permissions required.

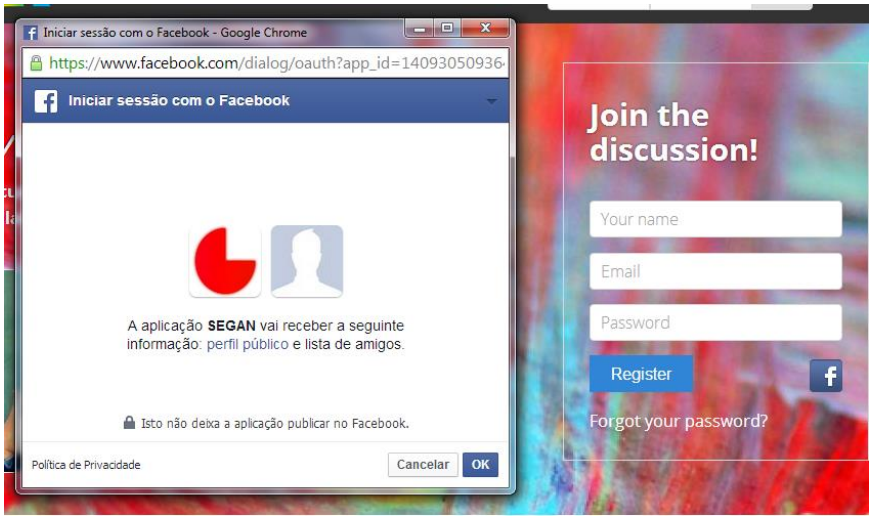

Figure 19 – Elgg Facebook Login

To address the Moodle seamless authentication, for simplicity sake and given that we had control over both platforms, our approach avoided the creation of new endpoints or APIs. Instead we used direct database access to authenticate user credentials on either systems and create new users when needed. Additionally we tried to keep user data on both platforms in sync by adding replicating logic upon login and profile updates on either platforms. This also required the creation of a Moodle plugin.

3.2.4 Interoperability

Continuing to try to shorten the bridge between the first version of the self-hosted community and the Facebook group, two other plugins were developed:

- `elgg_facebook_feed_pull`
- `elgg_facebook_link`

Since one of the main sources of frustration regarding the SEGAN's Facebook group was the difficulty to browse and organize postings, the former plugin had the task of parsing the SEGAN group wall posts, using the Facebook PHP SDK, and add them to our community. In the process both the Facebook users were mapped to community users as well as each type of post into specific sections of the community website. Once implemented this procedure was automatically executed daily and synched new posts and corresponding comments in the previous twenty four hours.

The `elgg_facebook_link` plugin was meant to work in the inverse direction: replicating posts made on the self-hosted community into the Facebook group wall. To that end, the logic created in the `elgg_facebook_login` had to be reused with the request for additional permissions (wall publishing). Hence, on every content creation form users would be presented with a checkbox allowing the automatic replication of the content into the

Facebook group. If the users enabled it and were still authenticated on Facebook, the setting would remain active.

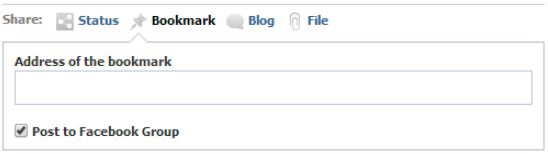

Figure 20 – Elgg Facebook Link

3.2.5 Curriculum management and job board

The EMIC community required the creation of some interface for students to contact companies on work or internship opportunities, as well as for companies to publicize their openings. In other words we needed very simple curriculum management and job board (which was names "Student Support"). The plugins developed to this end are:

- `elgg_curriculum`
- `elgg_jobs`

Following the nature of Elgg's data model, supporting these two new content types meant the extension and refinement of the `ElggObject` class as well as creating the corresponding views. Part of the requirements, however, was to distinguish `company` users from `student` users and use that as a simple access control. The administrator had thus, initially, to manually set the appropriate role for each Elgg user.

The custom `ElggCurriculum` content type allowed for each user of the type `student` to submit and update their resume as well as attach the full version of their curriculum as a file. Apart from each own profile, student curricula were only visible to users of the type `company` and only when that student applies for a placement opportunity.

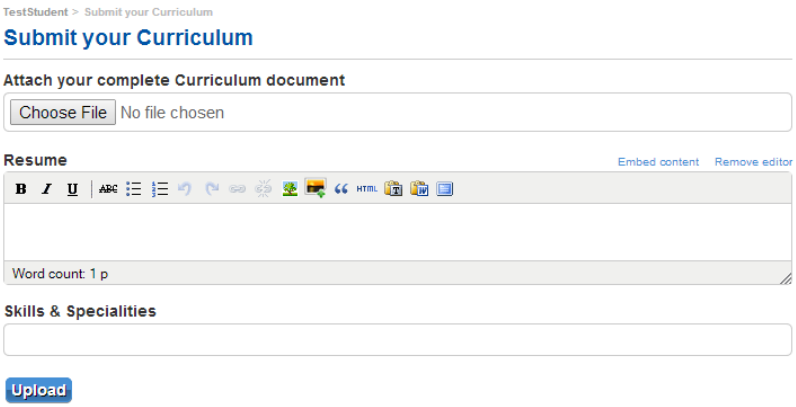

Figure 21 – EMIC Student Support Submitting Curriculum

Users of the type `company`, on the other hand, were able to create `ElggJob` opportunities. Each company can only see its own placements and students are able to see all placements on the website.

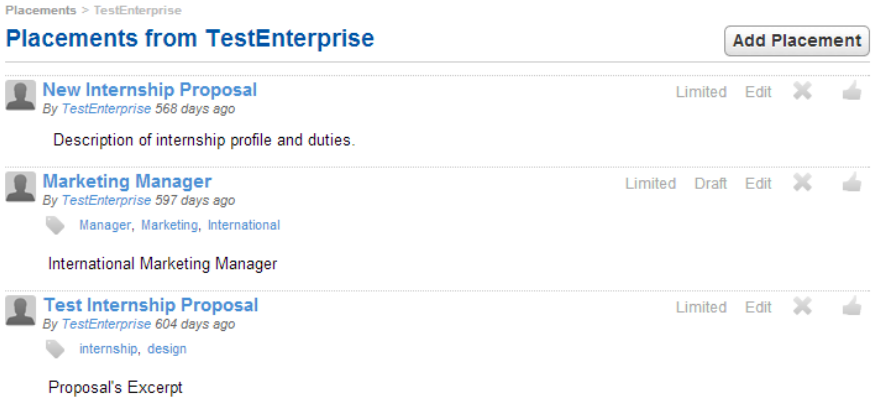

Figure 22 – EMIC Student Support placements index

Inside the detail view, students can apply for a placement to demonstrate their interest. For each application the responsible company is notified by private message (and email if enabled)

The list of interested students is showed privately to the company, which can then consult each student's curriculum. Any further discussion is supported through private messaging or taken offline.

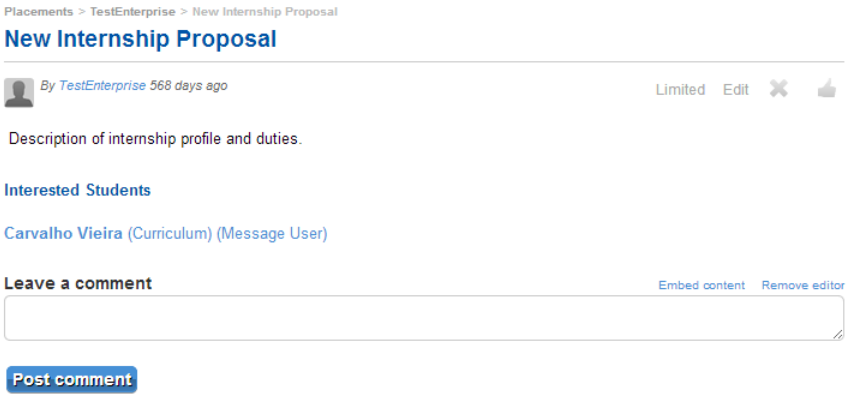

Figure 23– EMIC Student Support placement detail

3.2.6 Content rating and gamification

Once the SEGAN self-hosted community platform was ready, the migration was made in a way where users would see their previously created contents mapped to the new platform. This was rendered possible by both the `elgg_facebook_feed_pull` and `elgg_facebook_login` plugins previously described.

Despite that, only part of the users effectively followed the community to the new platform and, with the exception of days surrounding webinars and meetings, visits and participation dropped. This seemed to be the best timing to apply some gamification aspects to the SEGAN community.

Many of the common gamification techniques seemed to make sense in SEGAN's case and would potentially inject some motivating fun factor. Content quality was a priority but beforehand it was important to engage members. Trying not to overwhelm newcomers was another important factor taken into account in SEGAN's gamification design and thus it was decided to use both *badges* and user *experience point* (XP) leaderboards. As a general rule, experience points tend to value quantity (and long term engagement) while achievement badges value quality.

Figure 24 — Elgg Gamification leaderboard

Visit recency and frequency are commonly accepted engagement measurements (Zichermann & Cunningham, Gamification by Design, 2011). Thus for each day the user would log into the platform he would get 1 XP. However, if a user would manage to log in for thirty consecutive days, he would get the "Enthusiast" badge and the respective XP prize.

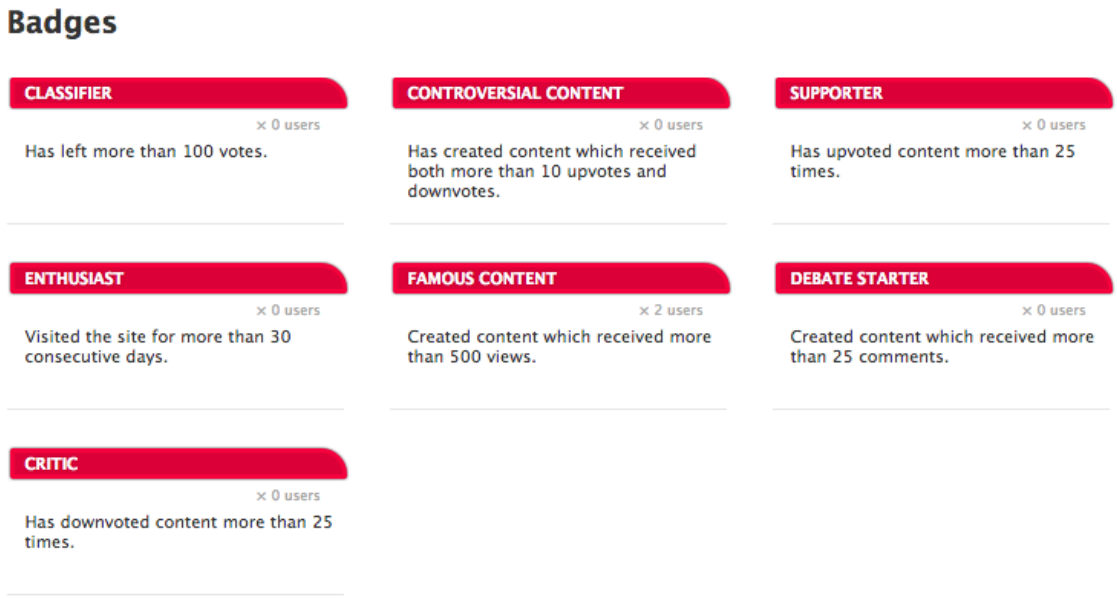

Figure 25 — Elgg Gamification Badges

Contributing contents was also rewarded. A blog post would be awarded 10 XP, the double of the prize for creating a bookmark, which generally does not create much value by itself. Later in the process we came to understand that interesting, on-going discussions are probably one of the best ways to keep members coming back to a topic or blog post. As such, comments should be rewarded at least as much as the original topic.

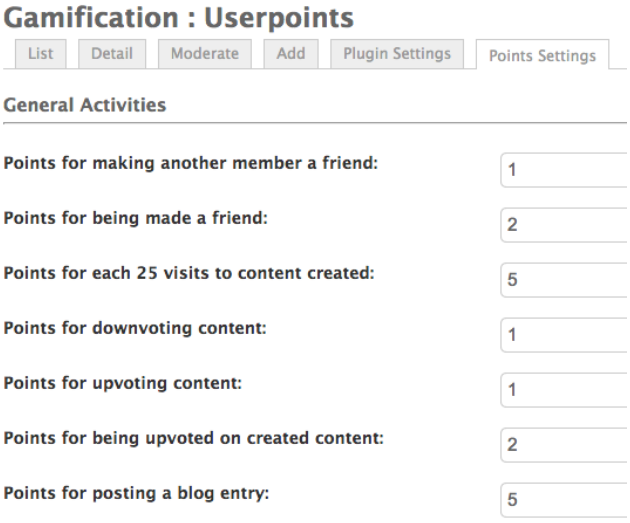

Figure 26 — Elgg gamification administration panel

If a user happened to create a blog post that received more than twenty-five comments she would be awarded the “Debate Starter” badge. Ideally this duality between achievements and XP would allow for multiple ways to feel recognition inside the community.

Content quality is provided by peer review through the use of up and down votes. Again, both the voter and the content author are awarded XP and eligible for specific achievement badges.

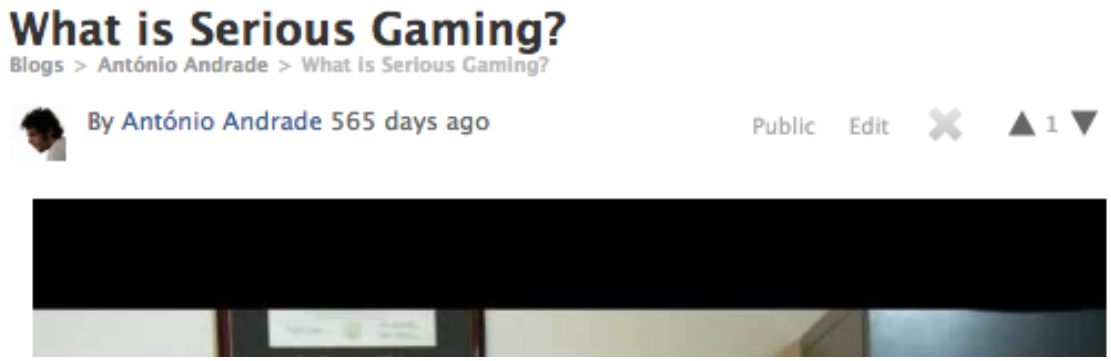

Figure 27 — Up and Down vote buttons from `elgg_content_rating`

Data resulting from this gamification was to be used throughout the platform to expose interesting users and content. Leaderboards (which stress monthly gain over all time totals) and badge pages would allow assessing overall community performance. Each user's profile was also to be enhanced with their total XP and badge listing.

Figure 28 — Elgg Gamification: Experience Points on User Profile

"Top Rated Content" and "Top Influencers" (users who created most textual content, such as blogs and comments) blocks are also products of this gamification. Finally, perks for most valuable users and prizes were to be implemented at a future stage.

Technically the gamification layer resulted in two Elgg plugins:

- `elgg_content_rating`
- `elgg_gamification`

The `elgg_content_rating` plugin provided raw access statistics over individual contents and up and down voting functionality. To track access statistics we simply increment an entity's metadata value each time it is output, by extend the default entity view. User votes on the other hand are stored as an `ElggAnnotation` (ie., they have an entity, an owner and value which in this is case is -1 or 1). To that end the default entity view was also extended with the

total votes as well as up and down buttons. The corresponding actions were also registered in the engine.

The `elgg_gamification` plugin mainly consists of three logic blocks:

- the backend interface to manage rewards for each action,
- the frontend pages and widgets which display gamification data and leaderboards
- the observer block, with methods to listen and handle most user events, applying any set rewards.

For instance, the plugin has to listen to any object or annotation creation, any user login or any user invited.

```
elgg_register_plugin_hook_handler('permissions_check', 'all',
'gamification_userpoints_permissions_check');
elgg_register_plugin_hook_handler('action', 'invitefriends/invite',
'gamification_userpoints_invite');
elgg_register_plugin_hook_handler('action', 'register',
'gamification_userpoints_register');
elgg_register_plugin_hook_handler('action',
'uservalidationbyemail/validate', 'gamification_userpoints_validate');
elgg_register_plugin_hook_handler('action', 'friends/add',
'gamification_userpoints_friend');
elgg_register_plugin_hook_handler('elgg_content_rating:view_update','all',
'gamification_userpoints_content_visits');
elgg_register_event_handler('login','user','gamification_userpoints_login')
;
elgg_register_event_handler('create','object',
'gamification_userpoints_object');
elgg_register_event_handler('delete','object',
'gamification_userpoints_object');
elgg_register_event_handler('delete','entity',
'gamification_userpoints_object');
elgg_register_event_handler('create','annotation','gamification_userpoints_
annotate_create');
elgg_register_event_handler('create','group','gamification_userpoints_group
');
elgg_register_event_handler('delete','group','gamification_userpoints_group
');
```

The creation of the backend settings was also straightforward. Each reward option was stored using `elgg_set_plugin_setting()` as simplified below:

```
foreach ($_POST_params as $option_key => $option_value) {
    elgg_set_plugin_setting($option_key, $option_value,
'elgg_gamification');
}
```

The gamification system was implemented in the first version of the SEGAN self-hosted community but was not included in the revised structure.

SEGAN version 2.0

As we previously described, the SEGAN community structure was revamped a few months after its initial deployment. In addition to the content architecture and navigation, we took advantage of the opportunity to also revamp the technical structure. Although not taking a pure Model-View-Controller (MVC) approach we chose to create model classes for each type of content so we could fine tune them.

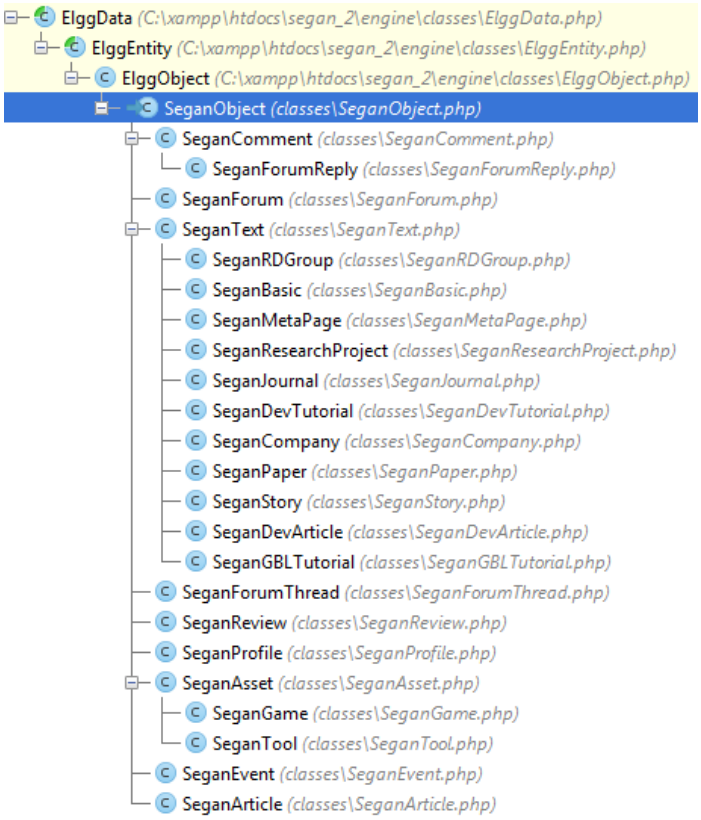

Figure 29 – SEGAN v2 content model classes

The `SeganObject` class is where the structure is defined for the most part. Following the MVC paradigm, it defines both the model feature registration (each subclass then has to declare its features) and the generic controller (which can then be inherited or overridden). In practice, it defines:

- Registration of the model pages and actions (URLS), taxonomies (if used) and menus;
- View selection (and improved selection fallbacks, as explained below);
- Form generation (for submitting content) according to the model's features.

As we have also seen, Elgg views are defined in `/views/default/object/{objectType}.php`. The drawback of these views is that, through a wrapping conditional, they define both the full and excerpt (and any other format) views. `SeganObject` overrides this behaviour and looks for the views at `/views/default/object/{objectType}/{format}.php` before falling back to the default Elgg schema.

Other features implemented in the new technical base include drag-and-drop file upload and management, HTML emails for notifications (Elgg emails are text-only by default), automatic video embeds (for Youtube URLs) and improved user profiles.

3.2.7 Other Tools and Enhancements

Along the deployment of all three communities, a number of other of enhancement requirements rose up. First of all, the default content WYSIWYG editor did not allow for image uploads. Hence we expanded the core TinyMCE[30] editor (by developing the `elgg_better_tinymce` plugin) with a new button providing that feature through the combination of a popup form and an Elgg action.

Secondly, although the Elgg core provides a very basic `categories` plugin as a closed taxonomy (unlike user contributed tags), it does not by itself create menus or category-based content indexes as the ones found for tags. Thus, we created the `elgg_categories_enhancer` plugin to produce those structures.

Similarly, when using the community powered `event_calendar` we found some important features missing. The latter did not provide a simpler view of the upcoming events, to be used as a sidebar widget. Therefore we implemented it as the `elgg_event_calendar_enhancer` plugin.

The core `bookmarks` plugin also required some improvements for us as the plain URL presentation it provided seemed too plain when compared to the dynamic interfaces we usually find in other platforms such as Facebook. We wanted our community to also present a screenshot of the URL as well as some information on the website. To that end we developed the `elgg_bookmarks_enhancer` plugin that extends the bookmark submitting form in a way where as soon as the user pastes in the URL, through a combination of JavaScript asynchronous requests and a background PHP HTML parser, the description field is prepopulated with information fetched from the destination website. Once posted, the

[30] http://www.tinymce.com/

bookmark resource is also complemented with a website screenshot which is automatically provided through the use of a third-party API (PagePeeker[31]).

One important technical feature of virtual communities of practice is their ability to be searchable and queryable. In addition to help existing members find information internally, the ease to find community information through external search engines such as Google also serves as a way to lure new members in. With that in mind, two other tools were implemented. `Elgg_google` extends Elgg views to included Google Webmaster Tools and Analytics codes (which corresponding ids could be managed on the administration panel). That allows community administrators to have external access logs (with information on the most used search terms, etc.), as well as a continual diagnostic on how well the website updates are being tracked by search engines. On the other hand, the `elgg_sitemap` plugin provides a search-engine-friendly index of all the resources and contents existing in the websites, which is one of the main recommendations to get visibility in search results.

Having a growth in visibility also increases the chances of being targeted by spammers. Either driven by real people or by computer programs, these malicious visitors will follow simple procedures: create as many accounts as possible and post as much (undesirable) content as possible. To counter this phenomenon we deployed a combination of custom and community provided solutions:

- Content submitted by users who did not already have a number of previously published contents was automatically audited by the third party service Akismet[32]. This stopped a large share of spam but unfortunately resulted in a some false positive when users posted shorter messages including links.

- The registration form has a special field which aimed to implement the “honeypot” technique: the field was rendered off the website viewport through some CSS rules and would be named something common such as “username” or “email”; since only robotic users (bots) would “see” this field and try to fill it excluding them during signup was rendered easier.

- The registration form is timed through the use of JavaScript and users submitting registration details faster than a predefined threshold are deemed automatic spammers and discarded.

---

[31] http://pagepeeker.com/

[32] http://akismet.com/

- Lastly, on occasions where we were able to identify a particular aggressor as being the source of a large share of the website accesses we would blacklist its IP server-wide. Although the effects of such spam trials might not be getting visible due to the other filters, the continuous hammering of the website often results in the deterioration of service to the other users.

On the administrative side we also faced the need for specific tools. The `elgg_notification_tools` plugin, for instance, was developed so we could manage the default notification tools for all upcoming users as well as update notification settings for existing users in bulk. In fact, although notification settings were available to all users through their account management panel, we found out most users did not configure them and ended up missing on important notifications. Since the account management panels did not include such a set of options that made it worth educating users to use it, or change its structure, we concluded that the best approach would be to simply administrate this option ourselves, allowing users to change it if when needed.

Another important administrative plugin we developed was the `elgg_user_manager`. Although the Elgg administrative panel does provide some user lists, they are all quite limited in insight and provide no productivity at all. A few months after the communities' deployment, and although the counter-spam measures we had in place were blocking most of the harmful content, our member had already accumulate a large number of false-users which at least difficulties the access to the real ones. Hence we developed this plugin that allows us to take bulk actions over users, such as deleting, whitelisting and listing emails. Eventually new features would be implement as needs arose.

Two other tools were developed inside the Elgg framework which were intended to be used by a select group of members: `elgg_newsletter` and `elgg_survey`. The former provides a drag and drop editor where users can select from existing community contents and reorder them in a linear layout, which is then exportable in HTML format to any newsletter manager. The idea was for the core group members to take turns in the creation of periodical newsletters. Although the tool was functional, we quickly concluded that this system was too limited as for the most part users would customize all the selected contents. Thus we ended up not activating this tool and instead using the Mailchimp[33] newsletter manager for the content editing.

As the name suggests, the latter tool intended to create a very simple survey system within Elgg. For similar reasons this plugin was abandoned in favour of the open-source LimeSurvey[34]: the initially planned and implemented features proved to be insufficient when put to practice and the effort to continue development was not worth the gains.

[33] http://mailchimp.com/

[34] https://www.limesurvey.org/

Finally, it is worth mentioning that in the context of the EMIC community, a complete and detailed offline Elgg User Manual was created, in the perspectives of both administrators and end-users.

4 Assessment

As we have seen, periodically assessing the health of a community of practice is crucial for its sustainability allowing detecting weaknesses and, more importantly, opportunities for growth. In this dissertation we will concentrate on the SEGAN community as out of the three presented communities it is the only one which did not exist as a complement to other online courses, therefore having been the most worked on and tailored towards sustainability.

To make this assessment we will take advantage of the theoretically survey we have previously done, particularly White's informal approach followed by the COCP metrics' dimensions. The formal elements of analysis will be website analytics gathered trough the combined use of Google Analytics and the community database information, the Facebook Graph API for the Facebook group data, an online survey and semi-structured focus group interviews. The interviewed focus group was composed of four members of the community and the full content is transcript at the end of this dissertation.

4.1 Expectations

Making a perspectival assessment, following Nancy White proposal, means taking turns to try to understand whether each role involved in the community is having its expectations satisfied. Thus the first step is to ensure the community domain and "formal" goals are clearly identified. Hence we should identify the archetypal players within the community and the corresponding expectations. Then, as the COCP suggests, we will try to gather a notion of where the community stands on the following three dimensions: the basic connectedness/cohesion metrics; community quality and community trust.

Since the SEGAN formal project has been financed by the European Lifelong Learning Programme and has thus undergone several assessments and analysis before approval, its goals have been very clearly stated since its inception. To summarize, its purpose is to

promote a community of practice for the exchange of ideas and experiences related to the Serious Games domain, which, in practice, means the online compilation of resources and support for discussion, as well as the production of physical events.

Table 6 — SEGAN key roles' expectations

Key Group	**Expectations**
Sponsors, the European Commission through the European Lifelong Programme	Establishment of links between people, institutions and countries towards an improved "European Dimension" for education and training – and, in general terms, the assertion of Europe as a leader in the education and creative industries. Fulfilment of all the planned activities in the scope of the funded project Visibility for the European Lifelong Learning Programme and other funded projects Sustainability for the outcomes of the funded project or, in other words, for the community to gain an autonomous structure that keeps going after the end of the grant
Core Group	Gather and sustain the interest of the core group itself into developing, disseminating and expanding the project Produce a viable online platform to support the community of practice Produce a viable structure for the planned physical events (conferences, summer schools and workshops) Engage members into the virtual community Engage members into the physical events Achieve to support the creation of valuable information and relationships through the community Reach a natural, self-sustained, pace for the community activities and have a "second generation" of leaders Formalize a medium-term sustainability plan
Teachers * (Members)	Get general information Discuss serious games' implementation ideas Get (free) resources to use in the classroom Get training opportunities
Developers *	Discuss ideas and technologies

(Members)	Network and establish partnerships Job boards Self-promotion
Researchers * (Members)	Discuss ideas and disseminate results Network and establish partnerships Research funding opportunities
Outsiders *	Get general information Get training opportunities
* These are the untested expectations we had foreseen and the community's foundation.	

In terms of the planned activities, the following was expected:

- Supporting an annual international conference on the domain;
- Supporting at least an annual summer school;
- Supporting multiple local workshops;
- Supporting an online community and an online resource repository/directory;
- Publishing annual SIG (special interest group) reports, corresponding to the latest findings and resources for teachers, developers and researchers;
- Become a European association that ensures the continuation and expansion of the network after the funded project is finished.

Over the deployment of the community, a number of other activities were planned:

- Publishing a periodic newsletter;
- Supporting webinars on the domain;
- Periodically supporting "Topics of the Month" in the discussion forums.

4.2 Trends and Results

The SEGAN community of practice planned physical activities were all produced with a relative success. Between January 2012 and January 2014, the core members held 42 workshops in different European institutions. Three international conferences were held (in Zaragoza, Tallinn and Cork), accounting for hundreds of attendees. In each of these conferences a parallel weeklong summer school on design of serious games was organized, gathering up more than 50 students.

In contrast with the physical events, the digitally mediated events were not so successful. Despite being well disseminated in the community and social channels, both the webinars and the "Topic of the Month" gathered close to no traction at all.

Using the Facebook Graph API we were able to calculate that the SEGAN Facebook group had slightly more than 500 members by June 2014, more than 835 content entries and 210 comments. This equates to approximately 34.8 entries per month and their distribution across time seems even as the figure below demonstrates.

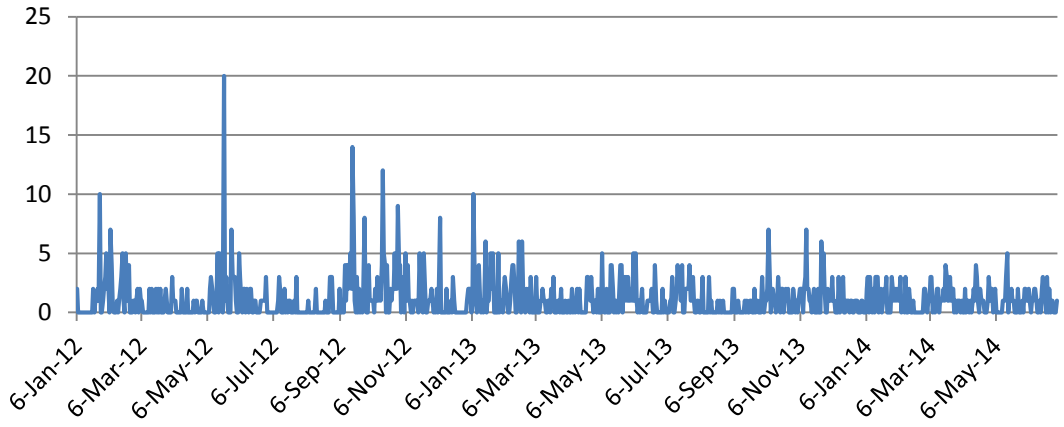

Figure 30 — Distribution of entries and comments created in the SEGAN Facebook group across time

Despite the large number of group members, at the same date only 101 users (20.2%) ever contributed to the discussion in the Facebook group. Within that group of active users, the distribution of entries created is also unbalanced: while two users create more than 160 entries, the majority of them created less than 20 entries or comments.

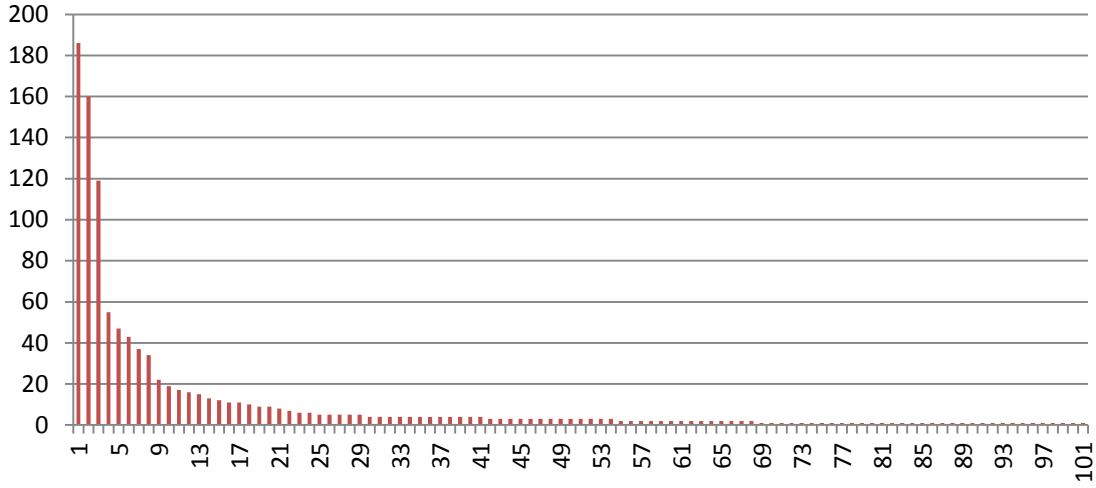

Figure 31 — Number of entries and comments created by each active user in the SEGAN Facebook group

To have a notion of the depth of discussion generated within the SEGAN Facebook group we measured the number of entries that effectively produced comments as well as their distribution. In total, out of the 835 entries only 31 generated any comments. Of those entries only 17% had more than three comments and more than one third had only one comment.

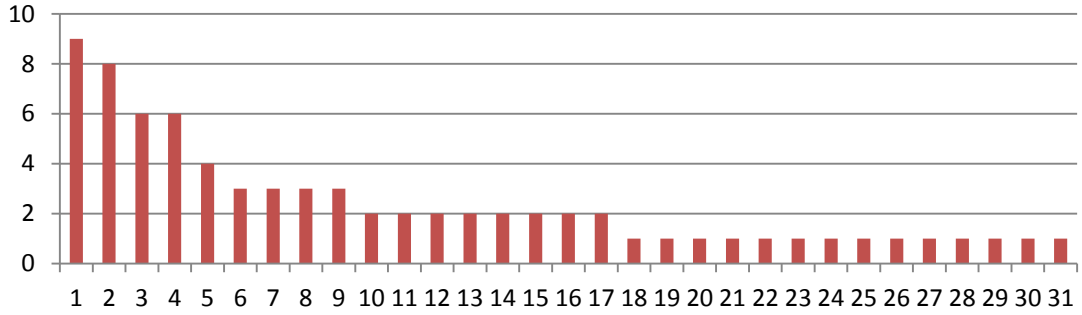

Figure 32 — Comments per entry on the SEGAN Facebook group

Finally we measured the amount of likes per entry. Out of all the entries, only 71 had at least one Facebook “like”, which equates to 8.5% of the posts.

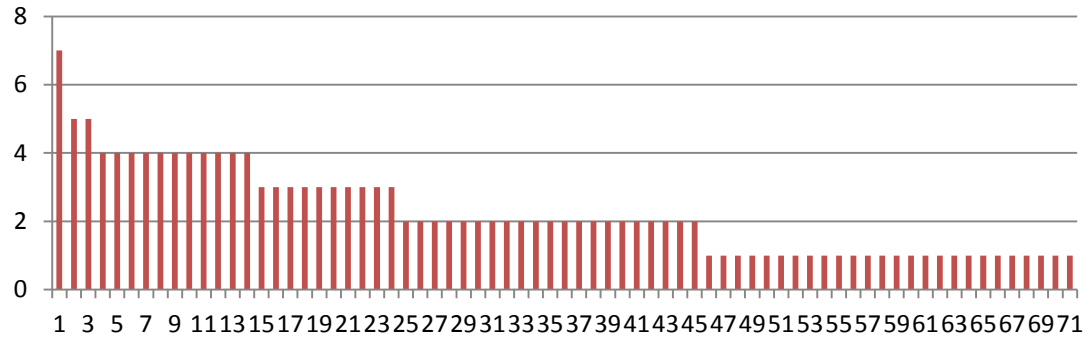

Figure 33 — Likes per entry on SEGAN Facebook group

At the same time, the self-hosted community had 218 members and 324 entries. When compared to the Facebook group, the percentage of active users is also slightly inferior at 16%. The balance of participation within this active group is similar to the one observed in the Facebook group.

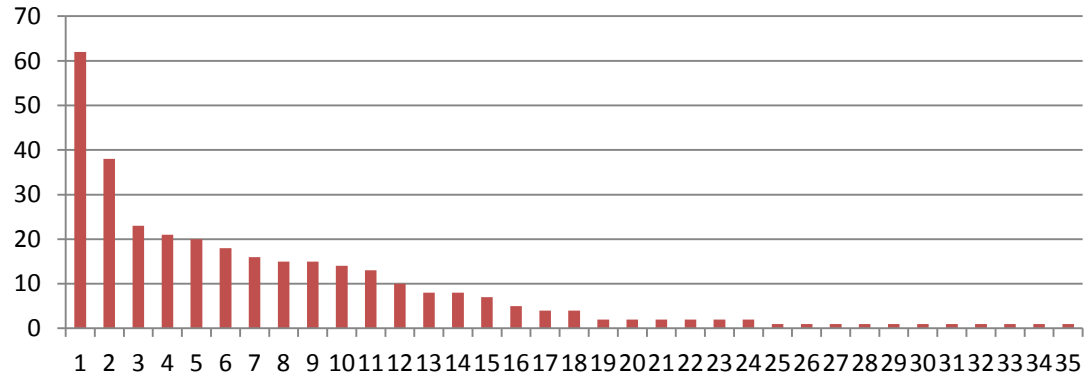

Figure 34 — Number of entries and comments created by each active user in the SEGAN self-hosted community

The second version of the SEGAN self-hosted community was planned with the previous table in mind, thus trying to address and organize the potential interests of each particular group of members. The single objective left out was the job board as we realized we would not be able to populate it from the beginning and such opportunities could still be announce on the discussion boards and initiate some informal conversation.

The core community group also took charge of initially creating content for each of these sections. This effort was, however, very much concentrated around physical events or meetings, and never really gained a naturally sustained pace.

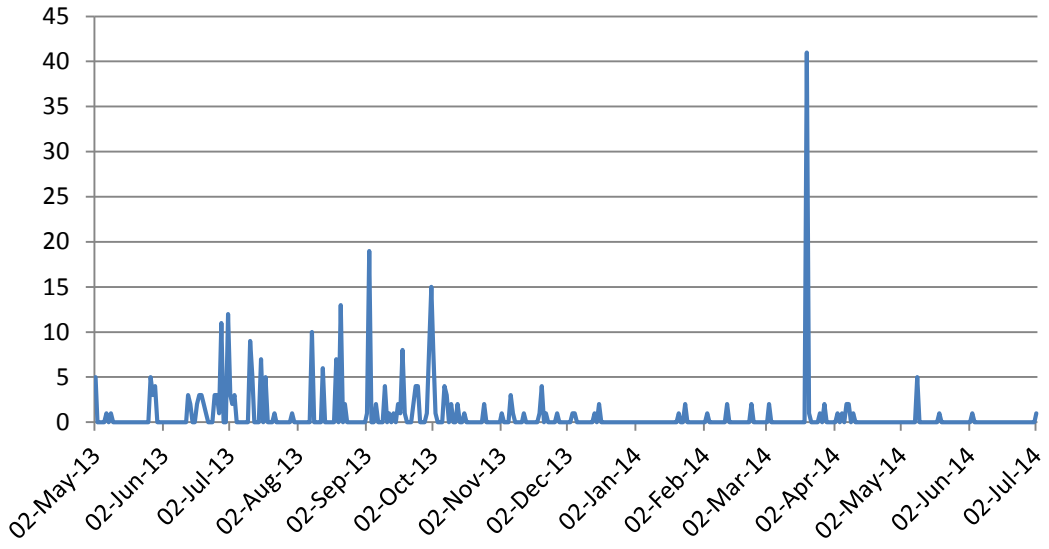

Figure 35 — Distribution of entries and comments created in the SEGAN self-hosted community across time

Using Google Analytics[35] we were also able to gather some insight over the community's website accesses over time. Since the deployment of its latest version, on the 28th of May of 2013, the SEGAN website received a total of 13598 sessions (each browsing session may have many page views).

[35] https://www.google.com/analytics/

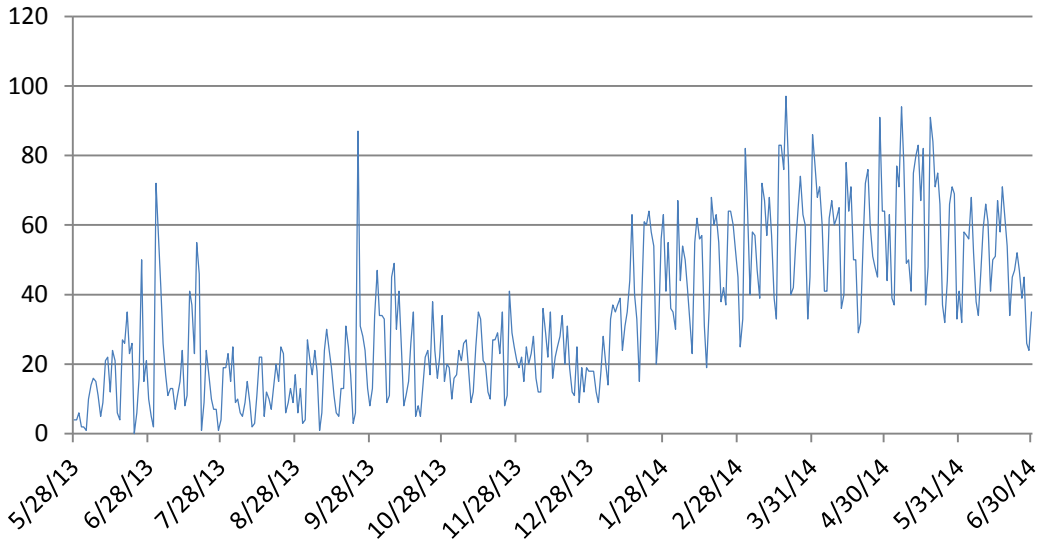

Figure 36 — Number of browsing sessions over time for the SEGAN self-hosted community.

The total number of page views is 47391, which gives an average of 3.45 pages per session. Over the same period of time, 29% of the visits are returning users. Out of the total, 1120 sessions were from logged in users.

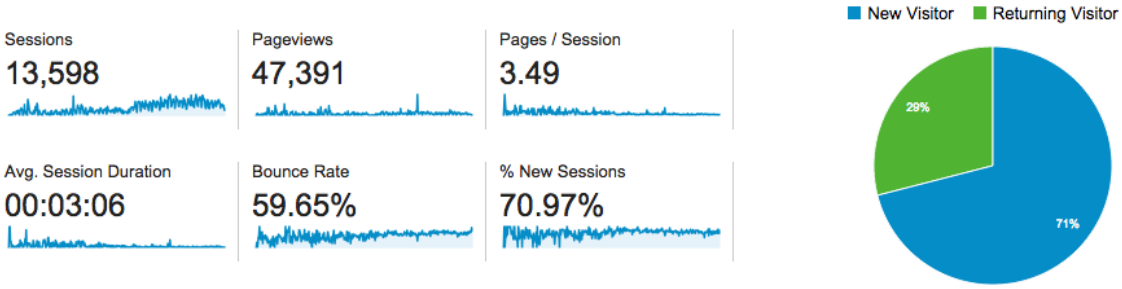

Figure 37 — Google Analytics access statistics for the SEGAN self-hosted community.

Another goal set for the SEGAN community is the production of a periodical newsletter. After some initial fluctuation, its periodicity was set to bi-monthly. The sending list is composed of people who people who were ever registered to the SEGAN community or events. The average percentage of people opening these issues is 14.4% and the percentage of readers engaged into following any of the included links is rarely superior to 3% with an average 2%. According to Mailchimp, the industry ("Education and Training") average for opens is 17.6% and the average engagement is 2.9%.

Figure 38 — Mailchimp statistics for SEGAN newsletters.

In addition to these metrics, an online survey was produced in order to get some more comprehension over SEGAN members. The online survey was created using LimeSurvey and publicized on the main SEGAN social channels (Facebook, Twitter and internal communication platform).

The survey gathered 16 complete responses. Only 10 of these were ever SEGAN members (and only those were used for SEGAN specific inquiries). Of the SEGAN members, 6 were researchers, 3 were game developers and the remaining person presented herself as curious about the Serious Games' domain.

Firstly, all the respondents claim to regularly use online specialized communities (such as Facebook Groups, StackOverflow, Reddit or other discussion forums). When asked what they perceived as their main motivation for that, learning was always considered, although with different degrees of focus.

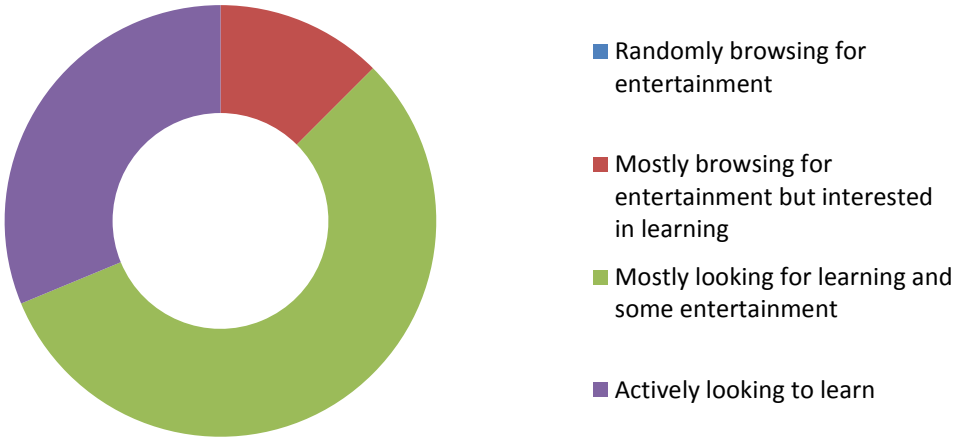

Figure 39 — SEGAN survey: intent when browsing online communities.

Then, we tried to understand whether these people access these communities to look for help in solving problems, which 81.25% claim to do. In contrast with this, when asked whether they actively participate in those communities by contributing any kind of content, only 37.5% responded positively.

Looking to have a notion of the perceived learning actually happening through the use of online communities, we questioned respondents on how they felt the community browsing and participation was impacting or improving their outside activities. Most users revealed the learning was related with keeping up to data with news, techniques and tools. Nonetheless, the acquisition of new perspectives and the improvement of soft skills was also pointed out by a minority. When queried, half of the respondents also claimed to have at least once created new relationships through the use of online communities.

Figure 40 — SEGAN survey: perception of outcomes.

These trends were also confirmed during the focus group interviews, with members stating the usefulness of such communities to find information relevant to their activity, specific solutions or answers, as well as on upcoming parties and events. One particular member stated that although he used Twitter, he favoured community discussions in places such as blogs or MOOCs. He does not use Facebook that often since he feels he cannot trust it:

> *I don't use Facebook because... I really don't like it. I don't like the idea that I'm being exploited in a way. Because if it's free, you are the subscription so to speak.*

On these interviews, getting news on different subjects in a rather passive way is also the top motivation join online communities. The goal of networking and finding opportunities for new projects or joint publication also came up. The member who previously pointed his preference for discussion in places such as blogs and MOOC forums, further explorer the common difficulty of finding discussions in platforms such as Facebook:

> *You know, you post a link, and no one ever discusses that link, they just post it and someone else reposts it, but the actual debate about it doesn't happen to the depth that you want...*
>
> So what do you think motivates people to participate and put their voice down?
>
> *I think the thing is... because... that's the way Facebook is pernicious, because Facebook does not promote discussion, Facebook promotes reposting of stuff, so all you do, you share and share and share, but no actually says anything, they just bounce it on, it's like you pass it on, pass it on, pass it on...*

We also wanted to know what the perception of these users was regarding status being associated with participation and visibility in online communities. More than 80% of the respondents seem to think it does, at least in some conditions.

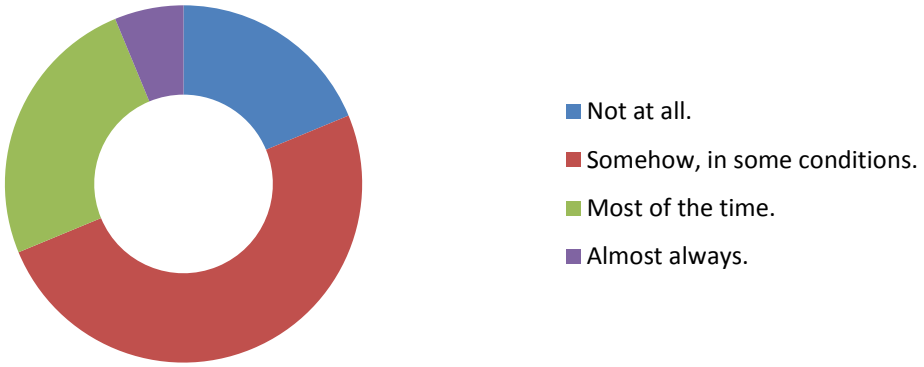

Figure 41 — SEGAN survey: perception over status creation through participation in online communities.

Regarding the SEGAN community itself, the first idea we wanted to test was whether the community domain and goal were of potential interest. All respondents confirmed it, although in the free-entry comment field two reactions came up. The first one states the importance of providing value to visitors:

> *If proper tools and materials are offered it could be very beneficial to teachers*

The second one seems to suggest a different structural focus:

> *It is hard to say. It should be somewhat more flexible. I had a feeling that communication in FB group was more active. When it was moved to portal, it died. I recommend to keep the communication in FB because this is the place where all user are. And for storing the data posted by different users, community needs a moderator who is storing and organizing all more valuable information in the portal. And advertise the portal and its additional value in FB group.*

We then asked users to rank their expectations in terms of content. The resulting answers seem to reinforce the expectation for the community to be a reference source for news, tools and games, rather than a hub for peer help. In fact, when asked whether they visited the SEGAN community to solve specific issues, 70% of the respondents also replied they did not.

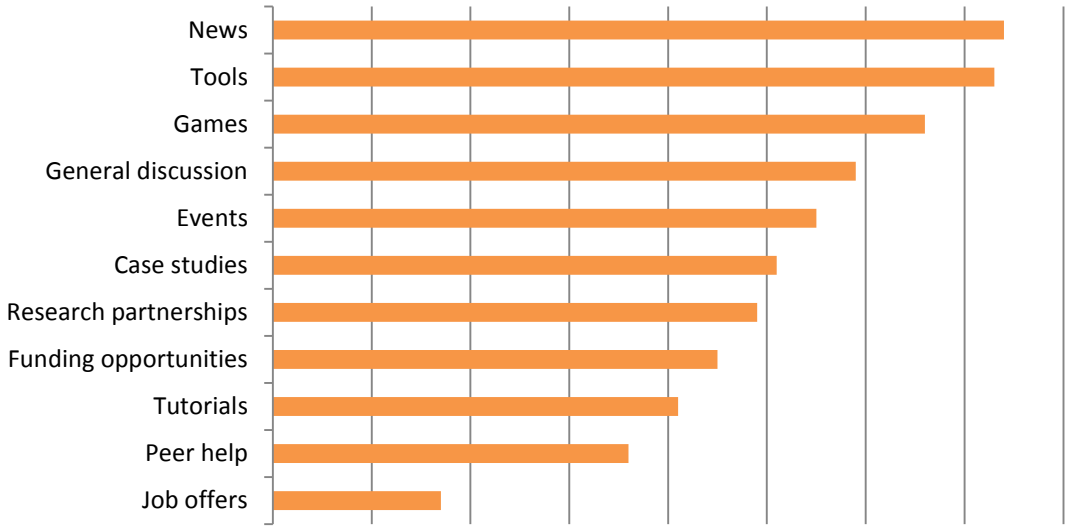

Figure 42 – SEGAN survey: content expectations.

Since in the previous question on content expectations the categories were given to the respondents, who then just had to rank them, we also asked them what seemed to be missing in the community. This was an optional and free entry field. We gathered the following responses:

- *links to a research portal of stuff*

- *Linking to other platforms, and a bit "gamification" for "brand royalty"*
- *It would be nice to find funding opportunities and project partnerships through the portal although I have not found it jet. Is this information available there?*
- *It is missing participation*

Despite the observed lack of expectation over peer help, 50% of the respondents did contribute that they created new relationships or partnership opportunities through SEGAN. Moreover, 60% of users claim that resources or information found on SEGAN could help their activity or improve their performance at work; and 50% think SEGAN had some impact on their perception and/or ambitions. Finally, we also surveyed whether users perceived participation in the SEGAN community as a possible status influence. Almost all participants agreed with the hypothesis.

Figure 43 – SEGAN survey: could participation in SEGAN somehow represent reputation/status?

On a second section of the survey we also tried to assess the perception of the users over the structure change. Ninety per cent of the respondents actually experienced the “SEGAN structure before its current shape” and all of them agreed there was a “significant improvement over the previous structure”, being aesthetics and the ease of navigation the main improvements pointed out.

Finally we tried to get a small comment from these users on what they perceived as the biggest challenges and opportunities the SEGAN online community would be facing. In regards to challenges, we gathered the following responses:

- *sustaining content*
- *sustainable lively community*
- *Attract users.*
- *reaching the critical member mass*

- *Promoting participation*
- *To develop*
- *Consistent communication*

Regarding opportunities for the community, the following was submitted:

- *the change to put content in one place*
- *a very good start and member participations*
- *Storing valuable information (conferences, articles, ...) for the experts*
- *The rise of the serious games as a widespread solution*
- *Providing actual usable tools and materials for teachers. Showcasing games for developers. Exchange of ideas for all.*

When asked about his expectations during the interviews, one of the users described his feelings as follows:

> *I think... Basically the setup of SEGAN, the website, the structure is really good, the only thing is it's always difficult, you can't just build a social community, it grows. So that's going to be a challenge to reach a critical mass, where people are coming back and find interesting things. So, I think the idea itself is great, the structure is great, but we are kind of stuck with the question that you need critical mass.*
>
> And do you think there is a way? Or a better path to reach that?
>
> *I'm not sure... what normally happens is that you create information before you ask for participation. And once your information is interesting enough, then step by step you build up this participation, first by likes, then by comments, then by maybe someone writing an article, but it has to grow. You can't just "VROOOM"... That's what Google tried with Google+ and it doesn't work. So... that's the difficult part.*

4.3 Gamification

From the process of implementation of gamification rose some interesting ideas. For instance, despite our focus on content creation on the setup of the point awarding rules, we soon understood that to foster interaction between members through gamification one should balance quantity with the quality of the discussion, as perceived by the community (e.g. through content rating).

The online survey we produced also included a few questions looking to gather opinions on the use of gamification to foster participation. The first question simply inquired whether

respondents felt the use of game elements (gamification) can foster participation in virtual communities. None of the respondents rejected the hypothesis.

Figure 44 – SEGAN survey: can the use of game elements (gamification) foster participation in virtual communities?

The following are the comments we gathered on this question:

> *It can foster because it turns the communities more engaging. Besides, people are social by nature the some gamification elements such as badges and points help people develop a sense of status achievement*
>
> *Maybe. But it does not have to be competition (although this is the easiest way to implement game elements). It should be game like activity or game based on collaboration or competition against personal goals.*
>
> *A little, and only partial and the effects disappear over time*

We then asked the participants who experienced the gamification experiment on the SEGAN community (5 people out of 10) whether they felt it did provide or could potentially provide a stimulus to participate more. Hence we found out that out of the five users who experienced the SEGAN gamification, one of them did not find it to be stimulating. Comments included: “Only for a short amount of time to begin with though” and “It motivated me in some level. But yes it could be easy to score with publishing crap. Maybe the competition should be based on cross ratings and quality?”

Figure 45 – SEGAN survey: did the SEGAN gamification provide or could it potentially provide a stimulus to participate more?

Finally we asked respondents to rank gamification elements in the order they felt was more motivating. Reward points and content rating clearly came up as the preferred elements.

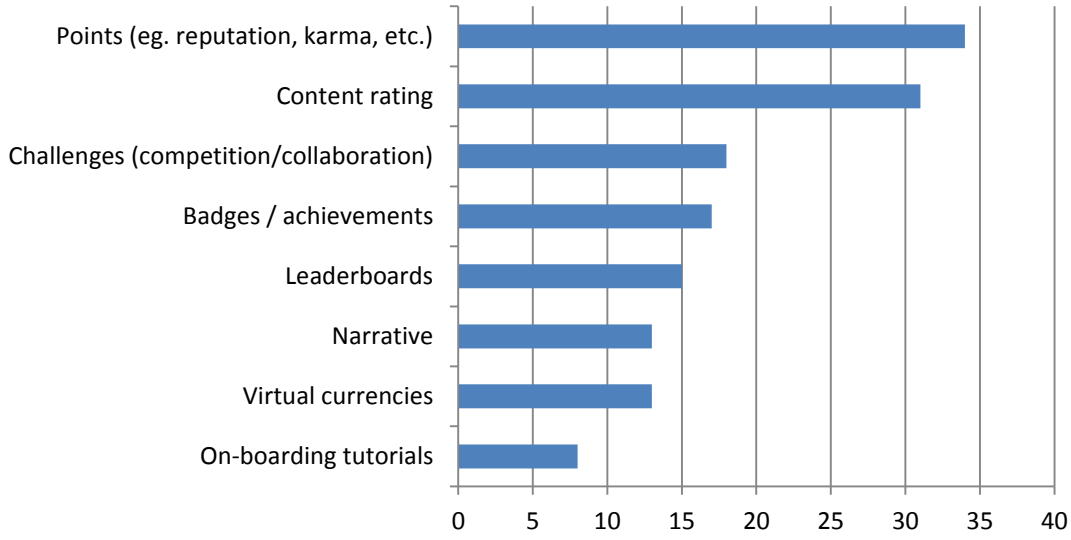

Figure 46 – SEGAN survey: gamification elements ranked by perceived motivation produced.

After the implementation of the gamification system, some users reacted quite strongly to this process, arguing that leaderboards presence was too overwhelming. Others tried to game the system and make it to the top of the leaderboards as easily as possible.

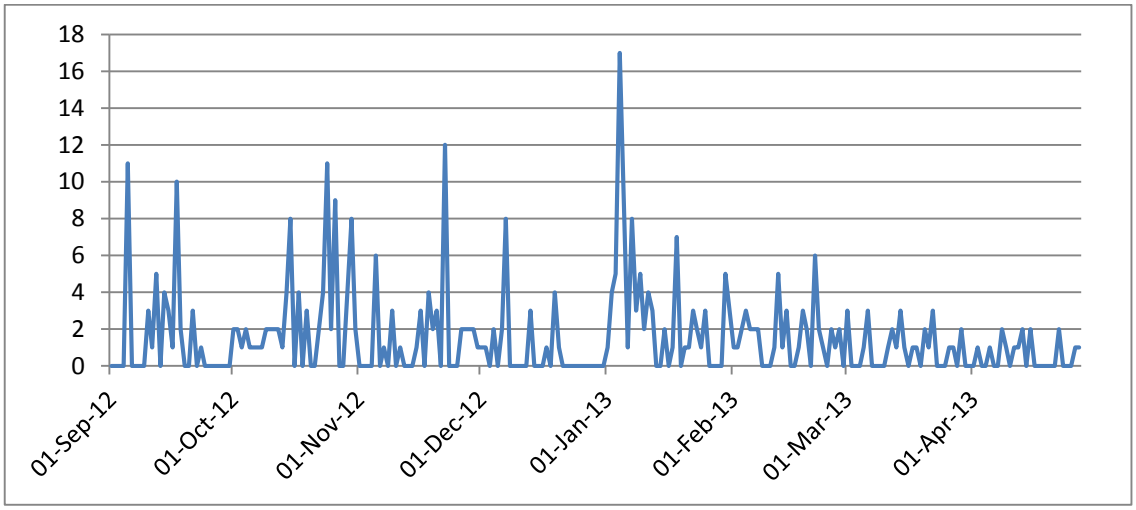

Figure 47 – Activity on the SEGAN self-hosted community between September 2012 and May 2013

A few users, curious of these updates, participated a little more than usual during a couple of days. During this moment a few suggestions were made such as the use of negative points and/or loosing part of the accumulated points to keep fading users engaged in the long term. Other users put the system to question, as we found out during the interviews:

> *Gamification was invented to address the symptoms of a broken system, but it doesn't address the breakage of the system. Because, gamification is invented to motivate people to participate, but if you have to motivate people to participate then there's something basically wrong (laughs). I mean, it's like, if your bridge is broken, gamification is a rope bridge but you should actually be trying to rebuild the bridge.*
>
> *(…)*
>
> *…but one of the problems with gamification is that some people aren't motivated by having more points then somebody else. Some people just aren't, they just don't give a monkey about that. So it might not work for everyone. And it may be that... I mean I've seen it happen a lot of times where we go to a system where, unless it's very subtly built, with a lot of counterweights, and so on, what you get is people gaming the gamification system, so that... I mean I played with that, i experimented with it, and I posted a whole lot of stuff without really looking at it, because you got points for posting so... and I drove it up and I got myself to the top of it! But I don't think that I improved the conversation; I've proved my point! (Laughs) That is quite hard to measure... and the gamification would be... how do you measure someone's contribution to a conversation, that is, in a really valid way. And that is incredibly... because it's qualitative, it's really hard to build a point system into that...*

Ultimately, it is interesting to notice that although the gamification implementation received a rather cold reception in the community, activity seems to have slightly thickened, at least temporarily, after its introduction in January 2013. All in all, the SEGAN community is now a little more active than the other two, non-gamified, virtual communities of practice.

4.4 Community Assessment Summary

Reporting back to our evaluation model, we will start by comparing the key roles' expectations and outcomes in the following table.

Table 7 — SEGAN key roles' outcomes

Key Group	**Outcomes**
Sponsors, the European Commission through the European Lifelong Programme	All of the community and project communications referenced the European Lifelong Learning Programme and the community website had a directory of previously funded projects, thus contributing to the visibility of the Programme. All of the planned activities were implemented. The international conferences and summer schools were particularly successful contributing both to the visibility and the underlying goal of asserting Europe as a leader in education and creative industries. As of June of 2014 the SEGAN funded project evolved into an association, thus gaining an autonomous, sustainable structure.
Core Group	The core group organization of the physical events (conferences, summer schools and workshops) was overall very successful and did engage participants. The formalization of a medium-term sustainability plan was also successful. The core group succeeded to produce a virtual community platform and to attract a significant number of members. Despite the dissemination and animation efforts from the core group, members were mostly passive and not engaged in the virtual events. The core group produced some information on the community platform but perhaps it could have done more and better. The core group did not succeed in producing a natural and self-sustained pace of participation in the community.
Teachers * (Members)	Teachers had plenty of training opportunities through the physical events. The teachers got little information and resources to use in the classroom.

	There was almost no teaching related discussion.
Developers * (Members)	The SEGAN community hosted much development related information but there was little discussion (although the platform supported it). Developers had opportunities to self-promote (through discussion or profiles) and according to the survey results some relationships were established through the SEGAN platform. The job-board was not implemented yet as there seemed to be no amount of offers justifying it.
Researchers * (Members)	According to the survey results some relationships were established through the SEGAN platform. Although there was big highlight regarding Horizon2020 for instance, research-funding opportunities were very little discussed. The platform hosted some information on domain-related projects and publications.
Outsiders *	Overall outsiders had much information through the community and plenty of training opportunities.

Looking at the basic SEGAN website metrics, the result seems rather positive: hits have been rising since the community inception and more significantly in 2014. Unfortunately, around 70% of these sessions do not convert into returning visitors or even members.

The most serious issue on the community seems to be the content contribution pace which clearly follows the opposite trend. As a condition for success, the core group should sustain and increase the contents on the platform as a way to attract new members.

In comparison, attendance and engagement on all the physical events of the community is much higher. This brings us to the main trend in the SEGAN online community: membership and participation peaks are mostly found around the physical events or core group meetings.

As we have seen reaching a naturally sustained participation pace has been the biggest challenge: although there are some content contributions, the reactions that follow (comments or “likes”) are in general very small or inexistent. Nonetheless, in terms of community quality or, in other words, the ratio between signal-and-noise, all the participation seems to be in line with the community’s domain.

Finally, in respect to what the COCP designates as community trust, so far there have been a very small number of forum topics looking for input, either regarding on-going research development or funding partnership opportunities. Though, again, the response was rather

cold, this seems to indicate that the community does already convey some sense of trustfulness or authority in the domain.

Overall respondents seemed happy with the second version of the SEGAN online community, as comments regarding the interface and information architecture were rather positive.

5 Conclusions

Either as a response to fast-paced domains, requiring continuous learning, or as an alternative to formal learning environments, informal learning value has come to be increasingly recognised. Building up on the concept of situated learning and materializing the connectivist theory, communities of practice are important platforms to support such learning experiences.

Although the value communities of practice generate is tacit and subjective, their potential and actual impact is validated by their exploitation by significant companies such as Siemens, IBM, Xerox, Mitsubishi, etc. Communities of practice can be more or less spontaneous but in such contexts, the implicit motivation is probably clearer, both from the core group and sponsor, and the members: to make work easier by keeping up to date with the best practices and to achieve better results. As we found out on our cases, non-organizational communities seem to be more fragile, depending on individual motivations.

Translating the traditional, co-located, communities into the online space is relevant, allowing for improved range and ease of access. After evaluating a number of platforms to support online communities of practice, we concluded Elgg was the most appropriate.

To meet the requirements we had defined for each of the communities we were implementing, many features of the community website had to be developed as plugins of the framework. Overall Elgg did not place any obstacles in these tasks and the framework demonstrated a good balance between resourcefulness and flexibility.

Firstly, we observed in SEGAN's case (and the improvements introduced by its second version) the importance of the community platform's architecture. Not only does it improve navigation and readability but a stronger aesthetic identity will also gather more interest from members.

Secondly, we confirmed what we had previously found in the literature: virtual communities of practice take much more time to develop than their co-located counterparts. Taking SEGAN's example, while all the organized physical events (conferences, summer schools and workshops) got a numerous and spontaneous attendance, engaging online members into

participating proved to be a challenge. Furthermore, in face of this lack of engagement the core group itself seems to have lost some momentum in the rate of content production.

Thirdly, although the implementation of gamification on the community website sparkled some activity, in the long run its effect seemed to fade. It also seemed to create some controversy, dividing member. Since it was not very effective we decided to remove it from the second version of the SEGAN platform. Considering some of the user feedback, we still think a different configuration, more focused on promoting challenges (cooperation and competition), could potentially yield more positive results.

On a technical perspective, our expectations regarding the Elgg framework were thoroughly met. Each of the three communities had its custom theme developed. As we have already noted and as users confirmed, it is very important to achieve a differentiating aesthetic. On the other hand we also achieved the planned interoperability by allowing users to authenticate through the Facebook platforms but also, in SEGAN's case, to have their content automatically imported and exported from and to the Facebook group.

Furthermore, after a period of more than twelve months, it seems likely that any interface or usability issues impacting on participation would already have come up and been naturally reported. This seems to reinforce the approval of Elgg and the extensions described in this work as valid and efficient community supporting tools.

Despite its fading effect on the users' motivation, the gamification system was successfully implemented. Other specific community requirements, such as EMIC's curriculum and job board management's development also corresponded to the specification. Overall, we were able to create and provide all the required functionalities within Elgg's abstract layer and no surveyed user or community posting expressed technological difficulties. That seems to confirm the viability of Elgg to support a virtual community of practice and virtual communities of practice at large.

Despite the lack of participation encountered on the online interface for the SEGAN community, it did amass a large quantity of valuable information, which is now freely available for any newcomer. The surveys confirm it, as well as pointing the creation of new relationships and opportunities through the community. However, it is on its physical events, gathering a large following, that the relevance of this community is fully recognisable. This makes us conclude that, with a renewed and continued effort from the core group to feed in value into the online platform, it will eventually start getting more traction.

5.1 Future Work

The community supporting tools described in this dissertation – Elgg and developed extensions – met our requirements and have proved effective. Hence the priority of developments at this stage will be to maintain the current structure and functionalities.

Nonetheless, having identified participation and motivation as the biggest challenges for these communities, we plan future work to focus on improving engagement levels. Thus improving and designing new strategies to attract and retain new members in the community platform is a priority.

Finally, we also plan to research, design and implement a mobile strategy for the SEGAN community. The current widespread access to mobile devices seems to constitute an opportunity to further engage users but also constitutes a different pace of activity, composed of smaller bits of information exchanged much faster than on traditional browsing. The question seems to be if it would be possible to streamline the current website for mobile consumption or if it would require a ground up developed interface? How could we deliver an online community experience to such users? What impact would that have on the community's engagement levels and value creation?

5.2 Published Articles

The following articles have been published in the scope of the work presented in this dissertation:

Andrade, A. & Vaz de Carvalho, C. (2013). *Gamification: a new tool for the development of effective communities of practice.* Proceedings of the International Conference on Business Sustainability (BS'13)

Andrade, A. & Vaz de Carvalho, C. (2013). *Using Gamification to Animate a Virtual Community.* Proceedings of the European Conference on Game-Based Learning (ECGBL 2013), Academic Publishing International

Andrade, A. & Vaz de Carvalho, C. (2013). *Gamifying a Serious Games Community.* Proceedings of the International Conference on Computer, Networks and Communication Engineering (ICCNCE 2013), Atlantis Press

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7 Attachments

A1. SEGAN Focus Group Interviews

A1.1 Subject A

[Do you browse online communities and what do you look for?]

...Actually I'm not sure how to answer this question because... sometimes it's difficult to me to make differences to what kind of sites is a community and what's not so I'm not aware of what I'm doing. Probably I'm using, but what I'm looking for...

Is it general peer help or..? Static information? News?

Well... usually I'm looking for some answers to some specific questions... for example if we talk about this SEGAN community then... I had one very nice case where I got very rich feedback from different experts but it was through the Facebook group... so I was for example asking what are the books you must read among game designers... and I got a very nice list of books. But then again I had another question, I don't even remember what was the question, in the same style, what do you think about this... and I got only very few responses so it was not so successful. But this kind of responses I'm looking for in communities. And I also just passively read the news feeds, about conferences, interesting games, interesting articles; usually I don't have time to... (Interruption) More like a passive user.

So you generally don't participate in discussions?

I sometimes participate if it is engaging but mostly in Facebook sites. If you talk about the SEGAN network... I visit more frequently the community website after meetings (laughs) but for some reason this information just doesn't reach to me. I don't know.

And what do you think makes people participate in such communities, in general? What makes people want to participate? Do they want to show off or just to share ideas or find..? What kind of feelings do you think are..?

It's difficult to say what are the... objectives for different people. To me it's to find... useful information to find contacts, to find information about interesting games, conferences, possibilities to start new projects, project proposals...

...so networking mostly?

Yes... and also joint publications, so those are my major concerns.

Regarding SEGAN what were your expectations in terms of content? What would you... mostly expect to find? And is it there?

In the beginning I thought it could be nice to have, like a... ordered list of like best games, best articles, most important names. But now I think maybe it's a bit complicated to achieve because you know there are too many articles, too many experts. How can we say, among a small group, those are the most prominent experts that we need to... Maybe it's possible, but... so I think it's... I have my own lists and my own tables but to share this with other experts... I don't know, maybe it's mission impossible although in the beginning of the network I was expecting something like this. So let's say I'd like to be a serious games designer, what are the most important resources to read, let's say. I wanted to have a support for a "dummy" game designer.

Finally, regarding gamification: is there any system you use which implements gamification and which seems to work well for you? I mean, does it motivate you?

So, yes, in the middle we had a gamification...

...not only in SEGAN...

Yes, ok. So i think the easiest method to implement gamification it's... competition among the users... but, yes, I agree that this can lead to producing crap, like a huge amount of content with low quality. So, I'm not aware of very good structures to implement collaboration, so this gamification should somehow be based around collaboration, or, game like activities. But the meaning, it's not the goal, but the flow, the engagement, is important. So, yes, I strongly support gamification in any field, and the easiest method is to try to use competition but the more intelligent method is to implement collaboration. So if you have found a good way how to implement this let me know (laughs).

So, there's no specific example you know of, which works really well for you?

Teamwork, let's say, teams competing somehow against each other, or maybe setting personal goals so I'm competing against myself not against some other people. I try to achieve as many evidence to share that I'm worth of something. So those are the kind of examples. Or

maybe not only publishing news but also making links between news, or artifacts, or commenting other's work, so it's... or rating the content, so let's say the scoreboard it's not only generated based on the number of publications but the quality of publications.

A1.2 Subject B

Do you usually use online communities and what do you look for if you do?

I participate in two or three actively at the moment, but it varies, I'm currently in a couple of communities that I'd say are twitter communities which are just groups of people that have come together around certain subjects who exchange twitter messages and sometimes go deeper. And I'm also involved in a couple of communities that have developed out of MOOCs. I've been in a couple of cMOOCs in the last six nine months, one of which was in Spanish language, it was run out of Colombia and... Its structure is a MOOC and it's an eight week activity but it's a very loose activity and the conversation is carried on beyond... And the same happens with... the MOOC on Rhizomathic Learning that happened at the end of the year... That's actually carried on for some time... although less actively where I... I tend... I don't use Facebook because... I really don't like it. I don't like the idea that I'm being exploited in a way. Because if it's free, you are the subscription so to speak. And I just don't trust it, so I don't use Facebook really, but I use twitter for most of those kinds of activities and... blogs. That you read people's blogs, people read your blog and...

...and what do you look for, is it mostly news? Or peer... networking?

It's more of... I'm really interested... The news you can sort of... I get most of my news just by following certain key blogs. People like Audrey Watters, Stephen Downes, etc. But, in the field I'm in, sort of e-learning if you want to call it that, there's sort of Mike (?), Phil Hill, Downes... those are the people I follow for the news. I'm in these communities more for the discussions that arise, and they're often quite fragmented discussions. I mean one particular discussion, it's a discussion about online communities and whether they are of any use... because we had this experience in Rhizo14 that, an awful lot of the discussion didn't go deep enough... and it was sort of, it had that Facebook post, twitter post dynamic where it stays at that kind of very superficial, very... post a link and leave it at that. You know, you post a link, and no one ever discusses that link, they just post it and someone else reposts it, but the actual debate about it doesn't happen to the depth that you want...

So what do you think motivates people to participate and put their voice down?

I think the thing is... because... that's the way Facebook is pernicious, because Facebook does not promote discussion, Facebook promotes reposting of stuff, so all you do, you share and share and share, but no actually says anything, they just bounce it on, it's like you pass it on, pass it on, pass it on...

Why do they do this? Do they just want to show up...?

I think it's just the nature of the beast. In Facebook you cannot actually have an in-depth discussion, because Facebook is a river, so it's always moving on, it's always moving on, so you can't actually... you have to really do some archeology to actually see the whole discussion. But that's where people are... And the nature of the spaces that you use defines the kind of

conversation that you're going to have. And actually I find that... I'm sort of inclined to... I find that in the courses that I do, using old fashioned forums, actually it's still producing better conversation than Facebook. Facebook has it's uses, and I think it's great for keeping in touch, and sort of... and starting conversations, but you can't really finish a conversation there. The same is true in Twitter actually, and we found in Rhizo actually that we were actually talking about going back to research in depth again what actually is a really good conversation, what is an in-depth conversation. We are going back to offline spaces to look at that and then see how we can take that back into the online spaces, that's what we are researching at that moment, a couple of people in that course we came together around that.

...and regarding SEGAN, what were your expectations in terms of content, and is there? or, I mean... in terms of relationships?

It's ok. I found the gamification experiment was very interesting in SEGAN, because... there's a very useful quote I found the other day and I have to use it in the topic of the month, which says... Gamification was invented to address the symptoms of a broken system, but it doesn't address the breakage of the system. Because, gamification is invented to motivate people to participate, but if you have to motivate people to participate then there's something basically wrong (laughs). I mean, it's like, if your bridge is broken, gamification is a rope bridge but you should actually be trying to rebuild the bridge. Gamification is a temporary... it can probably do some motivating but it doesn't really address the basic problem which is that people aren't motivated to participate in that way... And I think that's very interesting because the thing that actually... the concept of online community is quite fragile and there's no one to talk "we'll make an online community and see ..." (?) But actually, communities that work, they happen, you don't really build them, they happen, and maybe you can cultivate them, and you can promote activities, but it's an uphill struggle all the way. I think that's true in SEGAN, that... you need quite a lot of events that people find successful before there's a spontaneous conversation going to happen. And that's the difficulty with any kind of activity of this kind. So it's good to have a symposium, and it's good to have conferences, and it's good to have online activities such as the topic of the month, but one has to be realistic and think A) it's just hard to get people involved because they are busy... but I think the MOOC will now change that, because MOOCs are fashionable now, so I won't join online communities for a conversation but I will join a MOOC, which is a community which has a conversation. So it's sort of like a cosmetic (?) symptom. But the... I think it's really good to have those topics of the month, though one has to recognize people are no long used to actually have discussions of that kind so, what you get is serial monologue, because that's what Facebook promotes, people are used to online communication is what you do in Facebook, which is basically you tell the world about yourself, but there's very rarely a considerable at length reply. What you might get is a like, or a little comment, but a proper conversation rarely develops... and that means that we're all used to serial monologues as a default way of communicating online. So that when you say let's have a dialogue, let's have a conversation, people are a bit lost, you know...

So when you say the gamification experiment was interesting, do you not think there are legitimate uses for it, for instance, learning systems, platforms and so on?

I think it has its place, it think what it can't do is solve a problem it's not built to solve. It can make it... I think it's useful to get people sort of involved at the beginning of something, for example...

...does it make the system more addictive in some way...?

I think that very often it's gamification, it's not actually a game. It's like you're applying notions of game to something that isn't actually a game, so there's kind of artificiality about it that... I don't know, if the rewards are good then people will do it and some... but one of the problems with gamification is that some people aren't motivated by having more points then somebody else. Some people just aren't, they just don't give a monkey about that. So it might not work for everyone. And it may be that... i mean I've seen it happen a lot of times where we go to a system where, unless it's very subtly built, with a lot of counterweights, and so on, what you get is people gaming the gamification system, so that... I mean I played with that, I experimented with it, and I posted a whole lot of stuff without really looking at it, because you got points for posting so... and I drove it up and I got myself to the top of it! But I don't think that I improved the conversation; I've proved my point! (Laughs) That is quite hard to measure... and the gamification would be... how do you measure someone's contribution to a conversation, that is, in a really valid way. And that is incredibly... because it's qualitative, it's really hard to build a point system into that...

(later, discussing the Like button with another member)

...because if you like something that's not even positive but then you like it...

Well some people seem to use the like button as a sort of favorites, like something you save to find it again later... you don't necessarily "like it", it's just interesting, I mean, is it "like" because it's good, "like" because it's interesting, "like" because you're my friend, "like" because you asked me to like it...

...I use it on Twitter, I favorite my favorite things because I want to read it later, it's like an interesting article, it's like, let's put a star on it and so later on I'll find it...

So in the end the number of likes something has got on it is like a very fussy measure... all it says is that a bunch of people have found some reason...

...to press the button.

A1.3 Subject C

Do you usually participate in online communities and what do you look for if you do?

Usually... you mean social communities? or... like Facebook or..Twiter?

Yes, any kind of social...

Yes, harshly, which means that I try not to use all the time. Because... well I threw away my smartphone, I have a simple Nokia again, because of, you know, social communities...

And what do you look for? Mostly news or networking or entertainment?

The main reasons are... first it's a tremendous source of information, when it comes to new things for my work and my fields of interest and also a very simple... like parties and events like things like that. And you know where people are going...

Do you usually participate? I mean, do you contribute content and so on...?

Some yes... I organize a Tango evening every month and it's what I use for instance to promote.

And what do you think generally makes people want to participate? Do you think they just want to show off or to network?

Everybody wants to hear gossips. It's a natural reflex; you want to... everybody's wants to, like, peep into other's lives. Curiosity, I think.

Regarding SEGAN, what were your expectations, in terms of content, and do you think it is there? Or what is not there, what is missing?

I think... Basically the setup of SEGAN, the website, the structure is really good, the only thing is it's always difficult, you can't just build a social community, it grows. So that's going to be a challenge to reach a critical mass, where people are coming back and find interesting things. So, I think the idea itself is great, the structure is great, but we are kind of stuck with the question that you need critical mass.

And do you think there is a way? Or a better path to reach that?

I'm not sure... what normally happens is that you create information before you ask for participation. And once your information is interesting enough, then step by step you build up this participation, first by likes, then by comments, then by maybe someone writing an article, but it has to grow. You can't just "VROOOM"... That's what Google tried with Google+ and it doesn't work. So... that's the difficult part.

Regarding gamification, do you think it works on any platform, not specifically SEGAN? Do you know of any example where it works for you, where it motivates or it makes the product more addictive?

Oh, yes it does, I mean, I really believe in gamification but for very specific situations. Especially social situations, language, things like that. Things that are hard to, let's say explain theoretically.

What do you mean, gamification in social..?

For example, I remember gamification in a serious game which was actually built by a Flemish government, where there was a simulation of somebody who at the age of 18 leaves home and he has to try and find his way, and all the paperwork, and if you don't have a job you don't have a home, and if you don't have a home you don't have a job, etc. And that works. And that works. As for history for example, I doubt it. It's just too slow.

And for social networks? No? Imagine Facebook gamified? Is the like system gamification?

It is already... I mean, you have this Farmville, all the games... I don't know, that's not for me! (Laughs)

A1.4 Subject D

Do you usually participate in online communities? What do you look for if you do? These can be social networks, Twitter, etc.

Yes, I do participate in quite a lot of social networks, actually, like, Twitter, Facebook. You could call me an early adopter for the medium. What exactly do I need to find there? I don't know, it's a way of communicating. It has changed how we communicate nowadays, like, if you want to reach a friend, I can reach him more easily via Twitter or Messenger, than by texting him, because it's cheaper too, or by email. Email is a slow paced medium, and then you have Facebook and Twitter, they are very fast paced and immediate responses.

And do you publicly create content?

Yes, I'm also kind of old school, as I have a blog since 2001 so it's thirteen years by now. I do publish content, mainly on my blog and then I spread it out using Twitter, using Facebook, to get more reach.

And what do you think makes people want to participate in such ways? What's the main feeling or objectives?

Well, participation is not that high, sometimes you get responses, now I do know I have some specific followers on my twitter feeds that follow the blog mainly.

What's your main intent when sharing information through your blog?

Spread the knowledge.

Spread the knowledge, yes?

Yes, that's it. It's as simple as that, and then people...

Do you meet people also?

No, I meet people... I also go to conferences quite a lot, so there I meet people in real life, which is... Twitter is actually an extra to reach the people, and then I see them at conferences and I talk to them in real life. So it's a combination of both, one complements the other.

Regarding SEGAN, what were your expectations, in terms of content?

Well, I'm more of the developers so... development is more of my thing. I expected some more development tasks that could have been done by us, but you only have a limited set of tasks that are already divided by amongst the participants, then you just get along, you try to help where possible.

You refer to the project? The tasks you talk about are about the project not about the community, right?

Yes. And regarding the community it's like, whenever I find a link, I could post it on my blog too, and I do post it on my blog, but then if it's relevant to the project I also post it on the website, on the community.

Sure. And what about gamification? Do you know of any platforms using it on a positive manner? What did you think of the experiment at SEGAN? I mean, Gamification at large, do you think it's positive to increase participation?

Gamification it's bit of a special kind of thing, it can work but it also can't work somehow. When I see all those post on Facebook by other people playing games and they just reached level this and level that, by doing this and that...

... but those are games right?

Those are games but they also...

But do you know Duolingo for instance, the language learning platform?

No.

It's a gamified system where you learn...

...where you earn badges and you score points, and this and that...

Yes.

It can help, but in the end, if I see in my feed, for example, (?), that kind of stuff, I always hide it, immediately. So it's a bit... It the beginning it's nice to lure people in but then in the end, in the long run... people who can see through the system, they're like yeah, it's put in there due to that reason.

A2. elgg_gamification Plugin Excerpt

A2.1 manifest.xml

```
<?xml version="1.0" encoding="UTF-8"?>
<plugin_manifest xmlns="http://www.elgg.org/plugin_manifest/1.8">
    <name>Gamification</name>
    <author>António Andrade (Virtual Campus Lda); adapted from iionly's
elggx_userpoints</author>
    <version>1.0</version>
    <description></description>
    <copyright></copyright>
    <website></website>
    <requires>
        <type>elgg_release</type>
        <version>1.8.0</version>
    </requires>
</plugin_manifest>
```

A2.2 start.php

```
<?php
require_once dirname(__FILE__) . "/lib/userpoint.php";

function gamification_init() {
    global $CONFIG;

        elgg_register_plugin_hook_handler('expirationdate:expire_entity',
  'all', 'elggx_userpoints_expire');
        elgg_extend_view('css/elgg', 'css/userpoints');
        elgg_register_page_handler('leaderboard',
  'elgg_gamification_leaderboard_page_handler');
        // CSS
        elgg_extend_view('css/elgg', 'css/gamification');
        // VIEWS
        elgg_register_admin_menu_item('configure', 'userpoints',
  'gamification');
        // REGISTER UserPoint ENTITY
      elgg_register_entity_type('object', 'userpoint', 'UserPoint');
        // USERPOINT HOOKS
        elgg_register_plugin_hook_handler('permissions_check', 'all',
  'gamification_userpoints_permissions_check');
        elgg_register_plugin_hook_handler('action', 'invitefriends/invite',
  'gamification_userpoints_invite');
```

```
        elgg_register_plugin_hook_handler('action', 'register',
    'gamification_userpoints_register');
        elgg_register_plugin_hook_handler('action',
    'uservalidationbyemail/validate', 'gamification_userpoints_validate');
        elgg_register_plugin_hook_handler('action', 'siteaccess/confirm',
    'gamification_userpoints_validate');
        elgg_register_plugin_hook_handler('action', 'friends/add',
    'gamification_userpoints_friend');
        elgg_register_plugin_hook_handler('elgg_content_rating:view_update',
    'all', 'gamification_userpoints_content_visits');
        elgg_register_event_handler('login','user','gamification_userpoints_
    login');
        elgg_register_event_handler('create','object',
    'gamification_userpoints_object');
        elgg_register_event_handler('delete','object',
    'gamification_userpoints_object');
        elgg_register_event_handler('delete','entity',
    'gamification_userpoints_object');
        elgg_register_event_handler('create','annotation','gamification_user
    points_annotate_create');
        elgg_register_event_handler('create','group','gamification_userpoint
    s_group');
        elgg_register_event_handler('delete','group','gamification_userpoint
    s_group');
        elgg_register_event_handler('profileupdate','user','gamification_use
    rpoints_profile');
        elgg_register_action("gamification_userpoints/settings", $CONFIG-
    >pluginspath . "elgg_gamification/actions/settings.php", 'admin');
       elgg_register_action("gamification_userpoints/delete", $CONFIG-
    >pluginspath . "elgg_gamification/actions/delete.php", 'admin');
       elgg_register_action("gamification_userpoints/moderate", $CONFIG-
    >pluginspath . "elgg_gamification/actions/moderate.php", 'admin');
       elgg_register_action("gamification_userpoints/add", $CONFIG-
    >pluginspath . "elgg_gamification/actions/add.php", 'admin');
    elgg_register_action("gamification_userpoints/reset", $CONFIG-
    >pluginspath . "elgg_gamification/actions/reset.php", 'admin');


    elgg_register_event_handler('pagesetup', 'system',
    'elgg_gamification_menu_setup');
}

elgg_register_event_handler('init', 'system', 'gamification_init');

/* XP and Level */
function gamification_calculate_level($XP){
    $lvl=.4 * sqrt($XP);
    return ($lvl>1) ? floor($lvl) : 1;
    }

function gamification_calculate_non_leveled_xp($xp){
    $current_level=gamification_calculate_level($xp);
```

```
    if($current_level<2)
        return $xp;
    else
        return $xp - gamification_calculate_next_level($current_level-1);
    }
function gamification_calculate_next_level($current_level){
    return floor(pow(($current_level+1)/.4, 2));
    }
function gamification_calculate_next_level_needed($current_level){
    if($current_level<2){
        return gamification_calculate_next_level($current_level);
        }
    else
        return gamification_calculate_next_level($current_level) -
gamification_calculate_next_level($current_level-1);
    }

/* CACHE */

function gamification_cache_exists($filename, $interval = 2592000){ //12
hours
     global $CONFIG;
     if(!$filename){
          $filename = $_SERVER["REQUEST_URI"];
       }
     $cache_filename = $CONFIG->dataroot."gamification_cache/".basename(
     rtrim( $filename, '/' ) ).".cache";
         if (file_exists($cache_filename) and (time() < (filemtime(
     $cache_filename ) + $interval) )){
        return $cache_filename;
        }
    else {
        @unlink ($cache_filename);
        ob_start();
        }
    return false;
    }

function create_gamification_cache($filename){
     global $CONFIG;
     if(!is_dir($CONFIG->dataroot."gamification_cache/"))
        mkdir($CONFIG->dataroot."gamification_cache/");

     if(!$filename){
        $filename = $_SERVER["REQUEST_URI"];
     }
```

```
        $cache_filename = $CONFIG->dataroot."gamification_cache/".basename(
        rtrim( $filename, '/' ) ).".cache";
        $buff = ob_get_contents();
        $file = fopen( $cache_filename, "w" );
        fwrite( $file, $buff );
        fclose( $file );
        ob_end_flush();
    }

/* MENU */
function elgg_gamification_menu_setup(){
    if (elgg_is_logged_in()) {
        $generic_contexts=array("dashboard","event_calendar","bookmarks",
"file", "thewire", "pages","blog","category","tags", "discussion",
"leaderboard");
        elgg_register_menu_item('page', array(
            'section' => 'default_z_gamification',
            'name' => 'leaderboard',
            'text' => "Leaderboard",
            'href' => "/leaderboard",
            'contexts' => $generic_contexts,
            ));
        }
    }

/* LEADERBOARD PAGE HANDLER */
function elgg_gamification_leaderboard_page_handler($page){
    if (elgg_is_logged_in()) {
        switch($page){
            default:
                require_once dirname(__FILE__) . '/pages/leaderboard.php';
                return true;
            }
        }
    }

/**
* Add pending points to a user
*
* This method is intended to be called by other plugins
* that need to add points pending some future action.
*
* An example would be inviting friends but the points are
* awarded pending registration. The plugin calling this
* method is responsible for calling userpoints_moderate()
* when the points should be awarded.
*
```

```
* @param integer $guid User Guid
* @param integer $points The number of ppoints to add
* @param string $description Description for these points
* @param string $type The entity type that the points are being awarded for
* @param integer $guid The entity guid
* @return object The userpoint object
*/
function userpoints_add_pending($user_guid, $points, $description,
$type=null, $guid=null) {
   $points = (int)$points;

   // Create and save our new UserPoint object
   $userpoint = new UserPoint(null, $user_guid, $description);
   $userpoint->save();

   // Add the points, type, and guid as metadata to the user object
   $userpoint->meta_points = $points;
   $userpoint->meta_type = $type;
   $userpoint->meta_guid = $guid;
   $userpoint->meta_moderate = 'pending';
   return($userpoint);
}

/**
* Add points to a user
*
* @param integer $guid User Guid
* @param integer $points The number of ppoints to add
* @param string $description Description for these points
* @param string $type The entity type that the points are being awarded for
* @param integer $guid The entity guid
* @return Bool Return true/false on success/failure
*/
function userpoints_add($user_guid, $points, $description, $type=null,
$guid=null) {
   $points = (int)$points;

   // Create and save our new UserPoint object
   $userpoint = new UserPoint(null, $user_guid, $description);
   $userpoint->access_id=2;
   $userpoint->save();
   // Just in case the save fails
   if (!$userpoint->guid) {
      return(false);
   }
```

```
    // Add the points, type, and guid as metadata to the user object
    $userpoint->meta_points = $points;
    $userpoint->meta_type = $type;
    $userpoint->meta_guid = $guid;

    if (!elgg_trigger_plugin_hook('userpoints:add', $userpoint->type,
    array('entity' => $userpoint), true)) {
       $userpoint->delete();
       return(false);
    }

    // If moderation is enabled set points to pending else they are auto
    approved
    if (elgg_get_plugin_setting('moderate') && $type != 'admin') {
       $userpoint->meta_moderate = 'pending';
    } else {
       $userpoint->meta_moderate = 'approved';
       userpoints_update_user($user_guid, $points);
    }

    // Setup point expiration if enabled
    if (elgg_get_plugin_setting('expire_after')) {
       if (function_exists('expirationdate_set')) {
          $ts = time() + elgg_get_plugin_setting('expire_after');
          expirationdate_set($userpoint->guid, date('Y-m-d H:i:s', $ts),
    false);
       }
    }


    // Display a system message to the user if configured to do so
    $branding = ($points == 1) ? elgg_get_plugin_setting('lowersingular') :
    elgg_get_plugin_setting('lowerplural');
    if (elgg_get_plugin_setting('displaymessage') && $type != 'admin' &&
    $user_guid == $_SESSION['user']->guid) {
       $message = elgg_get_plugin_setting('moderate') ?
    'gamification_userpoints:pending_message' :
    'gamification_userpoints:awarded_message';
       system_message(sprintf(elgg_echo($message), $points, $branding));
    }
    $userpoint->save();
    return($userpoint);
}

/**
* Subtract points from a user. This is just a wrapper around
* userpoints_add as we are really just adding negative x points.
*
```

```
* @param integer $guid User Guid
* @param integer $points The number of points to subtract
* @param string $description Description for these points
* @param string $type The entity type that the points are being awarded for
* @param integer $guid The entity guid
* @return Bool Return true/false on success/failure
*/
function userpoints_subtract($user_guid, $points, $description, $type=null,
$guid=null) {
   if ($points > 0) {
      $points = -$points;
   }
   return(userpoints_add($user_guid, $points, $description, $type=null,
$guid=null));
}

/**
* Called when the expirationdate:expire_entity hook is triggered.
* When a userpoint record is expired we have to decrement the users
* total points.
*
* @param integer $hook The hook being called.
* @param integer $type The type of entity you're being called on.
* @param string $return The return value.
* @param string $params An array of parameters including the userpoint
entity
* @return Bool Return true
*/
function gamification_userpoints_expire($hook, $type, $return, $params) {
   if (!$params['entity']->subtype == 'userpoint') {
      return(true);
   }
   $user = get_user($params['entity']->owner_guid);
   // Decrement the users total points
   userpoints_update_user($params['entity']->owner_guid, -
   $params['entity']->meta_points);
   return(true);
}

/**
* Given a user id, type, and entity id check to see if points have
* already been awarded.
*
* @param integer $user_guid User Guid
* @param string $type The entity type that the points are being awarded for
* @param integer $guid The entity guid
```

```
* @return Bool
*/
function userpoints_exists($user_guid, $type, $guid) {
   $entities = elgg_get_entities_from_metadata(array(
      'metadata_names' => 'meta_type',
      'types' => 'object',
      'subtypes' => 'userpoint',
      'owner_guid' => $owner_guid,
   ));

   foreach($entities as $obj) {
      if ($obj->meta_type == $type && $obj->meta_guid == $guid) {
         return(true);
      }
   }
   return(false);
}

/**
* Returns a count of approved and pending points for the given user.
*
* @param integer $user_guid The user Guid
* @return array An array including the count of approved/pending points
*/
function userpoints_get($user_guid) {
   $points = array('approved' => 0, 'pending' => 0);
   if ($entities = elgg_get_entities_from_metadata(array('metadata_names'
=> 'meta_points', 'types' => 'object', 'subtypes' => 'userpoint',
'owner_guid' => $user_guid, 'limit' => 0))) {
foreach($entities as $obj) {
      if (isset($obj->meta_moderate)) {
         if ($obj->meta_moderate == 'approved') {
            $points['approved'] = $points['approved'] + $obj->meta_points;
         } else if ($obj->meta_moderate == 'pending') {
            $points['pending'] = $points['pending'] + $obj->meta_points;
         }
         } else {
            $points['approved'] = $points['approved'] + $obj->meta_points;
         }
      }
   }
return($points);
}

/**
* Deletes a userpoint record based on the meta_guid. This method
* should be called by plugins that want to delete points if the
```

```
* content/object that awarded the points is deleted.
*
* @param integer $user_guid The user Guid
* @param integer $guid The guid of the object being deleted
*/
function userpoints_delete($user_guid, $guid) {
   if (!elgg_get_plugin_setting('delete')) {
      return(false);
   }
   $points = 0;
   $entities = elgg_get_entities_from_metadata(array('metadata_names' =>
   'meta_guid', 'metadata_values' => $guid, 'types' => 'object', 'subtypes'
   => 'userpoint', 'owner_guid' => $user_guid,));
   foreach ($entities as $entity) {
      $points = $points + $entity->meta_points;
      delete_entity($entity->guid);
   }
   $user = get_user($user_guid);
   // Decrement the users total points
   userpoints_update_user($user_guid, -$points);
}

/**
* Deletes userpoints by the guid of the userpoint entity.
* This method is called when administratively deleting points
* or when points expire.
*
* @param integer $guid The guid of the userpoint entity
*/
function userpoints_delete_by_userpoint($guid) {
   $entity = get_entity($guid);
   // Decrement the users total points
   userpoints_update_user($entity->owner_guid, -$entity->meta_points);
   // Delete the userpoint entity
   $entity->delete();
   delete_entity($guid);
}

// Update the users running points total
function userpoints_update_user($guid, $points) {
   $user = get_user($guid);
   $user->userpoints_points = $user->userpoints_points + $points;
   if (!elgg_trigger_plugin_hook('userpoints:update', 'object',
   array('entity' => $user), true)) {
      $user->userpoints_points = $user->userpoints_points - $points;
```

```
        return(false);
    }
}

/**
* Deletes userpoints by the guid of the userpoint entity.
* This method is called when administratively deleting points
* or when points expire.
*
* @param integer $guid The guid of the userpoint entity
*/
function userpoints_moderate($guid, $status) {
 $entity = get_entity($guid);
 $entity->meta_moderate = $status;
 // increment the users total points if approved
 if ($status == 'approved') {
  userpoints_update_user($entity->owner_guid, $entity->meta_points);
 }
}

/**
* This very cool method was contributed by Alivin79 to the Goolge Elgg
Development group
* http://groups.google.com/group/elgg-
development/browse_thread/thread/30259601808493f1/b66ce5aa2f48b921
*
* @global Array $CONFIG
* @param Array $meta_array Is a multidimensional array with the list of
metadata to filter.
* For each metadata you have to provide 3 values:
* - name of metadata
* - value of metadata
* - operand ( <, >, <=, >=, =, like)
* For example
* $meta_array = array(
* array(
* 'name'=>'my_metadatum',
* 'operand'=>'>=',
* 'value'=>'my value'
* )
* )
* @param String $entity_type
* @param String $entity_subtype
* @param Boolean $count
* @param Integer $owner_guid
* @param Integer $container_guid
* @param Integer $limit
```

```
* @param Integer $offset
* @param String $order_by "Order by" SQL string. If you want to sort by
metadata string,
* possible values are vN.string, where N is the first index of $meta_array,
* hence our example is $order by = 'v1.string ASC'
* @param Integer $site_guid
* @return Mixed Array of entities or false
*
*/
function userpoints_get_entities_from_metadata_by_value($meta_array,
$entity_type="", $entity_subtype="", $count=false, $owner_guid=0,
$container_guid=0, $limit=10, $offset=0, $order_by="", $site_guid=0) {

   global $CONFIG;
   // ORDER BY
   if ($order_by == "")
      $order_by = "e.time_created desc";
      $order_by = sanitise_string($order_by);
      $where = array();

      // Filetr by metadata
      $mindex = 1; // Starting index of joined metadata/metastring tables
      $join_meta = "";
      $query_access = "";
      foreach($meta_array as $meta) {
            $join_meta .= "JOIN {$CONFIG->dbprefix}metadata m{$mindex} on
            e.guid = m{$mindex}.entity_guid ";
      $join_meta .= "JOIN {$CONFIG->dbprefix}metastrings v{$mindex} on
      v{$mindex}.id = m{$mindex}.value_id ";

      $meta_n = get_metastring_id($meta['name']);
      $where[] = "m{$mindex}.name_id='$meta_n'";

      if (strtolower($meta['operand']) == "like"){
         // "LIKE" search
         $where[] = "v{$mindex}.string LIKE ('".$meta['value']."') ";
      }elseif(strtolower($meta['operand']) == "in"){
         // TO DO - "IN" search
      }else{
         // Simple operand search
         $where[] =
         "v{$mindex}.string".$meta['operand']."'".$meta['value']."'";
      }
      $query_access .= ' and ' . get_access_sql_suffix("m{$mindex}"); // Add
      access controls
```

```
            $mindex++;
        }

        $limit = (int)$limit;
        $offset = (int)$offset;

        if ((is_array($owner_guid) && (count($owner_guid)))) {
            foreach($owner_guid as $key => $guid) {
                $owner_guid[$key] = (int) $guid;
            }
        } else {
            $owner_guid = (int) $owner_guid;
        }

        if ((is_array($container_guid) && (count($container_guid)))) {
            foreach($container_guid as $key => $guid) {
                $container_guid[$key] = (int) $guid;
            }
        } else {
            $container_guid = (int) $container_guid;
        }
        $site_guid = (int) $site_guid;

        if ($site_guid == 0)
            $site_guid = $CONFIG->site_guid;
        $entity_type = sanitise_string($entity_type);
        if ($entity_type!="")
            $where[] = "e.type='$entity_type'";

            $entity_subtype = get_subtype_id($entity_type, $entity_subtype);
            if ($entity_subtype)
                $where[] = "e.subtype=$entity_subtype";
            if ($site_guid > 0)
                $where[] = "e.site_guid = {$site_guid}";
            if (is_array($owner_guid)) {
                $where[] = "e.owner_guid in (".implode(",",$owner_guid).")";
            } else if ($owner_guid > 0) {
                $where[] = "e.owner_guid = {$owner_guid}";
            }
            if (is_array($container_guid)) {
                $where[] = "e.container_guid in (".implode(",",$container_guid).")";
            } else if ($container_guid > 0)
                $where[] = "e.container_guid = {$container_guid}";
            if (!$count) {
                $query = "SELECT distinct e.* ";
            } else {
```

```
      $query = "SELECT count(distinct e.guid) as total ";
   }

   $query .= "FROM {$CONFIG->dbprefix}entities e ";
   $query .= $join_meta;

   $query .= " WHERE ";
   foreach ($where as $w)
      $query .= " $w and ";

   $query .= get_access_sql_suffix("e"); // Add access controls
   $query .= $query_access;

   if (!$count) {
      $query .= " order by $order_by limit $offset, $limit"; // Add order
      and limit
      return get_data($query, "entity_row_to_elggstar");
   } else {
      $row = get_data_row($query);
   if ($row)
      return $row->total;
   }
   return false;
}

// Methods for awarding points
function gamification_userpoints_permissions_check($hook_name,
$entity_type, $return_value, $parameters) {
   if (elgg_get_context() == 'userpoints_access') {
      return true;
   }
}
/**
* Elevate user to admin.
*
* @param bool $unsu Return to original permissions
* @return bool is_admin true/false
*/
function gamification_userpoints_su($unsu=false) {
   global $is_admin;
   static $is_admin_orig = null;
   if (is_null($is_admin_orig)) {
      $is_admin_orig = $is_admin;
   }
   if ($unsu) {
```

```
        return $is_admin = $is_admin_orig;
    } else {
        return $is_admin = true;
    }
}

// Add points for various actions
function gamification_userpoints_object($event, $object_type, $object) {
 if (function_exists('userpoints_add')) {
  if ($event == 'create') {
      $subtype = get_subtype_from_id($object->subtype);
      if ($points = elgg_get_plugin_setting($subtype)) {
          return userpoints_add($object->owner_guid, $points, $subtype,
      $subtype, $object->guid);
      }
   } else if ($event == 'delete') {
       userpoints_delete($object->owner_guid, $object->guid);
   }
 }
 return(true);
}

function gamification_userpoints_annotate_create($event, $object_type,
$object) {
   if ($points = elgg_get_plugin_setting($object->name)) {
      if (function_exists('userpoints_add')) {
         $description = $object->name;
  userpoints_add($object->owner_guid, $points, $description, $object_type,
 $object->entity_guid);
   }
 }

 if(elgg_get_plugin_setting("upvoted") and $object->name=="upvote"){
    $original_obj=new ElggObject($object->entity_guid);
    $description = "Upvoted at ".$object->name;
    userpoints_add($original_obj->owner_guid,
    elgg_get_plugin_setting("upvoted"), $description, $object_type,
    $object->entity_guid);
 }
 return(true);
}

function gamification_userpoints_friend($hook, $action) {

   if (function_exists('userpoints_add')) {
      if ($action == 'friends/add') {
         $user = get_user(get_input('friend'));
         if ($points = elgg_get_plugin_setting('friend')) {
```

```
            userpoints_add($_SESSION['user']->guid, $points, 'Making
            '.$user->name.' a friend');
            return(true);
         }
         if ($mpoints = elgg_get_plugin_setting('friended')) {
            userpoints_add($user->guid, $mpoints, 'Being made a friend by '
            . $_SESSION['user']->guid);
            return(true);
            }
         }
      }
}

function gamification_userpoints_content_visits($event, $object_type,
$object, $params){
   if(elgg_get_plugin_setting('visits_25') and $params['entity']->visits %
   25 == 0)
      userpoints_add($params['entity']->owner_guid,
      elgg_get_plugin_setting('visits_25'), "<a href='".$params['entity']-
      >getUrl()."'>Object ".$params['entity']->guid."</a> has 25 views.");
}

function gamification_userpoints_profile($event, $type, $object) {
   if ($points = elgg_get_plugin_setting('profileupdate')) {
      if (function_exists('userpoints_add')) {
            userpoints_add($_SESSION['user']->guid, $points, $event, $type,
   $object->entity_guid);
         }
   }

   return(true);
}

function gamification_userpoints_group($event, $object_type, $object) {
   if (function_exists('userpoints_add')) {
      if ($event == 'create') {
         if ($points = elgg_get_plugin_setting($object_type)) {
         userpoints_add($_SESSION['user']->guid, $points, $object_type,
         $object_type, $object->guid);
         }
      } else if ($event == 'delete') {
         userpoints_delete($_SESSION['user']->guid, $object->guid);
      }
   }
   return(true);
}
```

```
function gamification_userpoints_login() {
   // Check to see if the configured amount of time
   // has passed before awarding more login points
   $user = get_user_by_username($_SESSION['user']->username);
   $diff = time() - $user->userpoints_login;
   if ($diff > elgg_get_plugin_setting('login_threshold')) {
      // Check to see if the user has logged in frequently enough
      $s = (int) elgg_get_plugin_setting('login_interval') * 86400;
      $diff = time() - $user->prev_last_login;
      if (($diff < $s) || !$user->prev_last_login) {
         // The login threshold has been met so now add the points
         userpoints_add($_SESSION['user']->guid,
         elgg_get_plugin_setting('login'), 'Login');
         $user->userpoints_login = time();
      }
   }
return(true);
}

/**
* Hooks on the register action and checks to see if the inviting
* user has a pending userpoints record the invited user.
*/
function gamification_userpoints_validate($hook, $action) {

 $access_status = access_get_show_hidden_status();
 access_show_hidden_entities(true);

 $guid = (int)get_input('u');
 $user = get_entity($guid);
 $code = sanitise_string(get_input('c'));

 gamification_userpoints_su();

 // This is a siteaccess validation.
 if ($action == 'siteaccess/confirm') {
  if ($code && $user) {
   if (siteaccess_validate_email($guid, $code)) {
    gamification_userpoints_registration_award($user->email);
   }
  }
 }

 if ($action == 'uservalidationbyemail/validate') {
  if (uservalidationbyemail_validate_email($guid, $code)) {
  gamification_userpoints_registration_award($user->email);
  }
```

```
 }
 access_show_hidden_entities($access_status);
 gamification_userpoints_su(true);
}

/**
* Hooks on the register action and checks to see if the inviting
* user has a pending userpoints record for the invited user. If
* the uservalidationbyemail plugin is enabled then points will
* not be awarded until the invited user verifies their email
* address. The same is true for the siteaccess module with
* auto activation disabled.
*/
function gamification_userpoints_register() {
 $friend_guid = (int) get_input('friend_guid');
 $email = get_input('email');

 // register.php has to be overridden to pass m has a hidden input
 if (get_input('m')) {
  gamification_userpoints_contact_importer($friend_guid, $email);
  return(true);
 }

if (elgg_is_active_plugin('uservalidationbyemail') ||
elgg_is_active_plugin('siteaccess')) {
   return(true);
}
if (elgg_is_active_plugin('siteaccess') &&
elgg_get_plugin_setting('autoactivate', 'siteaccess') != 'yes') {
   return(true);
}
// No email validation configured so award the points
gamification_userpoints_registration_award($email);
return(true);
}

/**
* Award points to unvalidated users on register. This
* is to support users that were invited using openinviter. Requires
* a modification to contact_importer plugin to pass friend_guid,
* invite code, and a parameter that specifies an openinvite.
*/
function gamification_userpoints_contact_importer($friend_guid, $email) {
   if (!$points = elgg_get_plugin_setting('invite')) {
      return true;
```

```
    }

    $access_status = access_get_show_hidden_status();

    access_show_hidden_entities(true);
    elgg_set_context('userpoints_access');
    gamification_userpoints_su();

    userpoints_add($friend_guid, $points, $email, 'openinviter');

    gamification_userpoints_su(true);
    access_show_hidden_entities($access_status);
}

/**
* Hooks on the invitefriends/invite action and either awards
* points for the invite or sets up a pending userpoint record
* where points can be awarded when the invited user registers.
*/
function gamification_userpoints_invite() {
    if (!$points = elgg_get_plugin_setting('invite')) {
        return;
    }
    $emails = get_input('emails');
    $emails = explode("\n",$emails);

    if (sizeof($emails)) {
        foreach($emails as $email) {
            $email = trim($email);

            if (elgg_get_plugin_setting('verify_email') &&
            !gamification_userpoints_validEmail($email)) {
            continue;
            }

            if ((int)elgg_get_plugin_setting('require_registration')) {
                if (!gamification_userpoints_invite_status($_SESSION['user']-
                >guid, $email)) {
                    $user = get_user($_SESSION['user']->guid);
                    $userpoint = userpoints_add_pending($_SESSION['user']->guid,
                    $points, $email, 'invite');
                    if (elgg_is_active_plugin('expirationdate') && $expire =
                    (int)elgg_get_plugin_setting('expire_invite')) {
                        $ts = time() + $expire;
                        expirationdate_set($userpoint->guid, date('Y-m-d H:i:s',
                        $ts), false);
                    }
                }
```

```
        } else {
        userpoints_add($_SESSION['user']->guid, $points, $email, 'invite');
        }
      }
   }
}

/**
* Check for an existing pending invite for the given email address.
*
* @param integer $guid The inviting users guid
* @param string $email The amail address of the invited user
* @return Bool Return true/false on pending record found or not
*/
function gamification_userpoints_registration_award($email) {
   $context = elgg_get_context();
   elgg_set_context('userpoints_access');
   gamification_userpoints_su();

   $guids = gamification_userpoints_invite_status($email);

   if (!empty($guids)) {
      foreach ($guids as $guid) {
         userpoints_moderate($guid, 'approved');
      }
   }
   gamification_userpoints_su(true);
   elgg_set_context($context);
   return;
}

/**
* Check for an existing pending invite for the given email address.
*
* @param integer $guid The inviting users guid
* @param string $email The amail address of the invited user
* @return mixed Return userpoint guid on pending otherwise return
moderation status or false if no record
*/
function gamification_userpoints_invite_status($email) {
   $status = false;
   $meta_array = array(
      array(
         'name' => 'meta_type',
         'operand' => '=',
```

```
            'value' => 'invite'
        ),
        array(
            'name' => 'meta_moderate',
            'operand' => '=',
            'value' => 'pending'
    )
    );
    $entities = userpoints_get_entities_from_metadata_by_value($meta_array,
    'object', 'userpoint', false, 0, 0, 10000, 0);

    foreach ($entities as $entity) {
        if ($entity->description == $email) {
            $status[] = $entity->guid;
        }
    }

    return($status);
}

function gamification_userpoints_validEmail($email) {  }
```

A2.3 lib/userpoint.php

```
<?php

class UserPoint extends ElggObject {
    private $subtype = "userpoint";

    protected function initializeAttributes() {
        parent::initializeAttributes();
        $this->attributes['subtype'] = $this->subtype;
    }

    public function __construct($guid=null, $user_guid=null,
    $description=null) {
        parent::__construct($guid);
        if ($guid) {
            return true;
        }
        if (!$user = get_entity($user_guid)) {
            return false;
        }
        $this->attributes['owner_guid'] = $user_guid;
        $this->attributes['container_guid'] = $user_guid;
        $this->attributes['description'] = $description;
```

```
    }
}
```

A2.4 actions/add.php

```
<?php
global $CONFIG;
admin_gatekeeper();
action_gatekeeper();
$params = get_input('params');
$user = get_user_by_username($params['username']);
userpoints_add($user->guid, $params['points'], $params['description'],
'admin');
system_message(sprintf(elgg_echo("gamification_userpoints:add:success"),
$params['points'], elgg_get_plugin_setting('lowerplural',
'elgg_gamification'), $params['username']));
forward($_SERVER['HTTP_REFERER']);
```

A2.5 pages/leaderboard.php

```
<?php

$offset = get_input('offset') ? (int)get_input('offset') : 0;
$limit = 50;

$users=array();
if($page[0]=='overall'){
    $meta_array = array(array('name' => 'userpoints_points', 'operand' =>
'>', 'value' => 0));
    $count = userpoints_get_entities_from_metadata_by_value($meta_array,
'user', '', true, 0, 0, 0, 0);
    $users = userpoints_get_entities_from_metadata_by_value($meta_array,
'user', '', false, 0, 0, $limit, $offset, 'v1.string + 0 DESC');
    }
else{
    $point_entities=elgg_get_entities(array(
        'types' => "object",
        'subtypes'=>"userpoint",
        'created_time_lower'=>strtotime('-1 month'),
        'limit'=>0
        ));
```

```
    foreach($point_entities as $p){
        if(!isset($users[$p->owner_guid])) $users[$p->owner_guid]=$p->meta_points;
        else $users[$p->owner_guid]+=$p->meta_points;
        }
    arsort($users);
    }

$title = elgg_echo('leaderboard');
$leaderboard="<div class='elgg-body elgg-main' style='margin-top:25px'>";
$leaderboard.="
<ul class='elgg-menu elgg-menu-filter elgg-menu-hz elgg-menu-filter-default'>
    <li class='".($page[0]=='overall'?"":"elgg-menu-item-all elgg-state-selected")."'><a href='".elgg_get_site_url()."leaderboard/'>This Month</a></li>
    <li class='".($page[0]=='overall'?"elgg-menu-item-all elgg-state-selected":"")."'><a href='".elgg_get_site_url()."leaderboard/overall'>Overall</a></li>
</ul>";

$leaderboard.="<ol id='leaderboard' style='width:100%;'>";
$i=0;
foreach($users as $k=>$u){
    if($i>24 || $k==35 || $u->guid==35) continue;
    if($page[0]=='overall'){
        $lvl=gamification_calculate_level($u->userpoints_points);
        //$xp=gamification_calculate_non_leveled_xp($u->userpoints_points);
        $xp=$u->userpoints_points;
        }
    else{
        $xp="+".$u;
        $u=new ElggUser($k);
        $lvl=gamification_calculate_level($u->userpoints_points);
        }
    $leaderboard.="<li><ul class='leaderboard-entry'>";
        //$leaderboard.="<li class='user'>".elgg_view_list_item($u)."</li>";
        $leaderboard.="<li class='user'>".elgg_view_entity_icon($u, 'tiny')."<h3><a href='".$u->getUrl()."'>".$u->name."</a></h3></li>";
        $leaderboard.="<li>Lvl. <strong>".$lvl."</strong></li>";
        $leaderboard.="<li><strong ".($page[0]!='overall'?"style='color:#0093dd'":'').">".$xp."</strong> XP</li>";
    $leaderboard.="</ul></li>";
    $i++;
    }
$leaderboard.="</ol>";
```

```php
$content = elgg_view_layout('one_sidebar', array(
    'title' => $title,
    'content' => $leaderboard
));

echo elgg_view_page($title, $content);
```