The Use of Integrative Framework to Support the Development of Competences

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Abstract. In corporate environments, there is a growing interest in deploying more effective solutions in supporting competence development, namely to address the identified need of developing soft-skills (eg: negotiation, leadership) and complex competences (eg: sense-making and cross-cultural communication). The "learning by doing" has gained prominence, in particular when considering the use of serious games as the delivery platform for the educational content. However, the adoption of serious games alone is not a guarantee for effective learning and consequently, the aim of this paper is to present the integrative framework that combines together five key developments in education research, namely Knowledge Ecology, Social Learning Communities, Threshold Concepts, Experience Management and Cognitive Management. Based on the integrative framework, the paper proceeds to present the TARGET componentized platform.

Keywords: Serious Games, Competence Development, Threshold Concepts, Cognitive Load, Social Learning, Knowledge Ecology.

1 Introduction

This was recently illustrated in an article by Richard Barker:

> *No, management is not a profession. Some business skills can't be taught in a classroom. They have to be learned through experience.*
>
> Barker 2010 [4]

The above comment does not refer only to the challenges faced by business schools and the those institutions teaching management, but may be applied to other learning domains that are relevant to different industrial sectors, as demonstrated by the study by Nair et al [24], where employers indicated there to be a shortfall in some competences deemed essential for a graduate engineer to have in their repertoire, such

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as ‘capacity to analyze and solve problems’ and ‘ability to develop new and innovative ideas, directions, opportunities or improvements’. However, it has been argued that the solution relies on the industry, research institutes and universities need to cooperate with one another [36].

With the fast pace of technology and the shrinking of geographical distances due to globalization, the “war for talent” is fiercer than ever before. This has led to increasing acceptance by organizations, as a key business strategy, of the need to retain and re-train their existing staff through some kind of tailored competence development that reduces the lead-time for a learner to achieve target productivity: the “time-to-competence" (TTC). The need for rapid competence development is compounded by shorter cycles concerning the knowledge to be acquired and mastered. Aldrich in [1] draws an interesting parallel of e-learning industry with the fast-food industry, where the focus is in reducing costs, increase efficiency and minimizing the time spent by a customer in eating. Unfortunately, in maximizing the process efficiency of fast-food, the nutritious and health value of a meal has been neglected and similar claims are made concerning e-learning, where the focus is on maximizing the efficiency of delivery of content, but not necessarily achieving the TTC. Finally, the fabric of society has been shaped by technology, resulting in the emergence of the “digital natives” [30] who due to their familiarity with multiple technological stimuli and social interactivity, have become more demanding on how the facilitation of learning should be carried out. This paper presents the Integrative Framework used in the Transformative, Adaptive, Responsive and enGaging EnvironmenT (TARGET) project [31], which shapes the associated componentized platform.

2 Integrative Framework

Today, the main route to short TTC is a bespoke (hand-crafted) face-to-face or blended course, which tends to be resource-intensive (expensive to create and deliver). There is a need of methods and tools to effectively and economically address dynamic competence development rapidly, with flexible learning contexts of varying complexity and longevity. One challenge is that each learner is a unique individual, with different cognitive abilities, emotional intelligence, personality, knowledge, and experience. Thus, it is not feasible to develop a single solution tailored to all learners, but rather it is necessary to support mass-individualization. The problems are exacerbated by the need to retain the capacity to handle unpredicted events, meaning that at least some of the learners/managers in an organization need to attain novel ways of understanding and the ability to think with different perspectives.

In order to address these problems, the TARGET project [31] has taken the approach of building an integrative framework (Figure 1) that brings together five key development areas of education research, namely Knowledge Ecology, Threshold Concepts, Experience Management, Cognitive Management, Social Learning Communities, each of which will be described in the subsequent subsections.

2.1 Knowledge Ecology

As we are living in a knowledge society, knowledge-management is increasingly important, especially from an organizational point of view. Traditionally, the term

Fig. 1. Integrative Framework

knowledge management is applied to any method of gathering, organizing, refining and disseminating the knowledge present in an organization. However, the scope of knowledge management has changed, extending the traditional content perspective to a broader vision that also includes the individual's knowledge. As an outcome of this trend, successful knowledge management nowadays tries to make knowledge potentials of organizations and the individuals as transparent and holistic as possible. Besides, the explication and detection of knowledge potentials has also the possible impact as a remedy against brain-drain in organizations and in knowledge societies.

The term knowledge Ecology (or Ecosystem of knowledge) has been used within the field of knowledge management to highlight parallels between ecological ideas and the dynamics and properties of the knowledge environment within organizations. The metaphor also highlights the fact that knowledge within organizations is dynamic, which implies a lifecycle beginning with the creation of new knowledge and its recognition (in the sense of altering prior knowledge to incorporate new, hence re-conceptualizing, re-thinking), which evolves and matures over time. Elements of these ecologies have life cycles that mimic natural life cycles [7][16]. According to [29], the concepts of knowledge ecologies and ecosystems help to bridge the gap between the static data repositories of traditional knowledge management and future, more useful repositories that embody the dynamic, adaptive behaviour of natural systems. Recently the distinction between tacit and explicit knowledge has also become popular within organizational knowledge management approaches. Tacit knowledge is regarded as not yet explicated knowledge and is seen as individual knowledge. The major difference of tacit to explicit knowledge is the lack of conscious awareness of the individual about the tacit knowledge he or she has. Implicit knowledge also mostly results from the accumulated experience of several episodes rather than that of a single event. Thereby it is hard for yourself to explicate

the tacit knowledge you own. However, to address these problems, the Knowledge Ecology is concerned primarily with the transmission and acquisition of dynamically changing knowledge connected to and embedded in shareable processes.

2.2 Experience Management

Management disciplines involve a combination of skills. Hard skills are often described as science and require technical training. Whereas soft skills relate to working with and managing people. Soft skills, often described as an art, are critical for project management success. These skills are typically acquired through experience [4] and consequently experiences are key to human understanding. It is not primarily a matter of remembering general concepts or applying abstract rules. Rather, humans think and understand best when they can imagine (simulate) an experience. The simulation is preparation for performing necessary and preferred actions in order to accomplish goals.

Serious games are strong contenders to support competence development and have potential advantages over more traditional learning methods and on-the-job training because they offer tailored experiences, in which participants learn through a grammar of doing and being [32]. These include tolerance to and encouragement of risk within a safe environment, thus promoting and encouraging experimentation and better understanding instead of passive learning [18]. In addition serious games increase motivation, provide ego gratification, encourage creativity, socialization and above all are fun. Serious games also support a situated context for learning in a virtual world as when you learn by playing a game, you apply that learning immediately in the game and move on to learning new skills [15]. Game scenarios and characters in the game that reflect the real world will enable a near-transfer of knowledge. Evidence is growing for the increased efficiency of serious games over more traditional learning methods [9]. Serious games have already been adopted in numerous sectors like Manufacturing, Sales, Human Resource, Finance, Energy, and also Project Management. Some example like IBM's INNOV8 2.0, Sharkworld Game and SimuLearn's Virtual Leader already give a glimpse of how serious games can leverage the power of computer game by engaging the learners in tasks and experience situations which would otherwise be impossible and/or undesirable for cost, time, logistical and safety reasons.

In TARGET, serious games offer learners an opportunity to experience realistic project situations, which are highly motivating and engaging learning experiences that contribute to long-term knowledge retention. Using serious games, a learner is able to go through a multitude of experiences, each one introducing different situations generated dynamically to suit the learning purposes. This is one way serious games can offer the advantages of both experiential learning and situated learning, which is learning by doing and acting in real life situations [19].

2.3 Cognitive Management

According to Cognitive Load Theory (CLT), learners have a working memory with very limited capacity. Learning is dependent on three kinds of cognitive load: the intellectual demands of the learning content (intrinsic cognitive load), cognitive

demands that interfere with learning (extraneous cognitive load) and, finally, deep processing that leads to the development and/or integration of schemas in long-term memory (germane cognitive load) [3].

Early CLT research focused on design techniques to reduce extraneous cognitive load so that available cognitive resources could be fully devoted to learning. Recently CLT research has focused on the identification of techniques to optimize cognitive load by decreasing intrinsic load and bolstering germane load [3]. In part, this switch of focus is an attempt to make CLT more relevant to complex learning. In complex learning, students must learn to deal with materials incorporating an enormous number of interacting elements. Even after all sources of extraneous cognitive load have been removed, element interactivity of learning material can still be too high to allow effective learning. Therefore, new instructional methods are needed to reduce intrinsic cognitive load and/or bolster germane load.

One approach has aimed at the reducing intrinsic cognitive load. For example [28] studied the effects of sequencing in the context of CLT and found that understanding of complex material was greater when isolated elements were processed prior to the presentation of the full information with all the interacting elements. Another key development in CLT research is based on the idea that instructional design effectiveness depends, in part, on the learner's experience in the domain being taught. According to the expertise reversal effect, instructional techniques that are effective for novices (e.g. instructional guidance) can lose their effectiveness and even have negative consequences for learning when used with more experienced learners [3]. The implication for instructional design is that materials should be tailored to the learner's level of expertise. Within computer-based environments, this requires a dynamic assessment of individual learners' expertise and adaptation of the instruction, in real-time, to changes in the student's performance and/or cognitive load [3].

Some researchers within the CLT framework interested in e-learning have focused on effective expertise measurement. Expertise assessment usually includes some or all of the following: performance, mental load and mental effort. The latter refers to the cognitive capacity that is allocated to accommodate the task demands. To date, most studies have used self-report rating scales to measure mental effort [26] although there has been some research into other methods e.g. psychophysiological measures [33]. One strand of research has addressed the challenge of measuring performance in complex tasks, for example [17] "rapid assessment test". Finally, some work has addressed the challenge of how to combine mental effort and performance measures.

2.4 Threshold Concepts

The Threshold Concept (TC) Framework focuses on identifying those aspects of a discipline that are essential to a grasp of the discipline, that are likely to be difficult and once overcome will transform the learner's view of that discipline. This means the learner will now begin to think as does a practitioner of their discipline, e.g., thinks as a manager, thinks as an innovator. It arose from a study of the teaching of economics but has now been taken up by educational researchers and teachers across a wide range of disciplines [12]. "Difficulty in understanding TC may leave the learner in a state of liminality (Latin limen "threshold"), a suspended state in which understanding approximates to a kind of mimicry or lack of authenticity" [23]. The originators of the framework, Meyer and Land, characterize the TC as:

- **Transformative**: once a TC is understood, a significant shift appears in the student's perception of the subject;
- **Integrative**: once learned, TCs are likely to bring together and relate different aspects of the subject that previously did not appear to the learner;
- **Irreversible**: given their transformative potential, a TC is also likely to be irreversible, difficult to unlearn;
- **Bounded**: a TC will probably delineate a particular conceptual space, serving a specific and limited purpose;
- **Discursive**: Meyer and Land suggest that the crossing of a threshold will incorporate an enhanced and extended use of language;
- **Troublesome**: TCs are likely to be troublesome for the learner.

The framework draws on Perkins' discussions of how knowledge may be troublesome e.g. alien, incoherent or counter-intuitive [27]. In grasping a TC a student moves from an apparent 'common sense' understanding to an understanding which may conflict with perceptions that have previously seemed self-evidently true. [10] suggests some influences that TCs can have in the design of a university course curriculum: first, they enable teachers to focus on what is fundamental to grasp of the taught subject, a 'less is more' approach to curriculum design; once identified, the tutor becomes aware of the areas where students might encounter problems; then, they might need recursiveness in order to be mastered; they also require listening from tutor's side in order to hear what the students' misunderstandings and un-certainties are in order to engage with them [10]. Cousin characterized in 2009 the TC framework as a transactional curriculum enquiry [11]. This would require a partner-ship between the discipline's experts, educational re-searchers and learners in which curriculum inquiry and curriculum design are seen as feeding into each other rather than as sequential activities.

Recentlty it has been suggested that a two contemporary and powerful conceptual frameworks, TCs and variation theory share a key pedagogic principal and share a central common focus [22] warranting further examination. Variation theory of learning is associated with a much more formalized approach rooted in phenomenography [20]. It states that a key feature of learning involves experiencing that phenomenon in a new light [21]. Marton argues that "there is no learning without discernment and there is no discernment without variation". Therefore, in order for students to discern the object of learning, they must experience how they vary. The key elements that are relevant here may be summarized as its four pat-terns of variation:

- contrast - experience something else to compare it with;
- generalization - experience varying appearance of an object;
- separation - experience a certain aspect of something by means of varying it while other aspects remain invariant
- fusion - experience several critical aspects simultaneously.

The work of Bernhard's group [8] on applying variation theory to a circuit analysis problems in which a TC is embedded and the study by [13] on how a TC in engineering comes into view when approached from two very different engineering contexts suggests Meyer and colleagues suggested further examination is justified. Problem-based learning has also been suggested for facilitating a learner's traverse across the liminal space. Other recent studies of Meyer and colleagues [23] show how

meta-learning can help at overcoming TCs and its importance in identifying transformation. To sum up, all these studies show positive results over the improvement of the learning process by integrating TCs. In this context, we consider that TCs are indispensable for an efficient, beyond the current state-of-the-art, learning environment.

2.6 Social Learning Communities

The concept of 'Social Learning Communities' is increasing considered to provide a valuable addition to how organizations utilize and develop their learning and knowledge assets. Learning social communities is the term applied in the TARGET context to describe a wide range of possible social constellations of collaboration within and among organizations. The modern workspace is characterized by increasing diversity and variety in the way learning communities are formed and operate, and this diversity is seen as a necessary repertoire to meet the speed of the new economy [25]. Learning social communities previously referred to groups that were co-located, homogeneous in background and education, and with relatively stable functions. As such, these groups are designed for the purpose of bringing new people into an existing environment of knowledge and practice. Here, the focus for the participants is on belonging. Increasingly, these stable and predictable organizational forms are augmented with different possible collaborative possibilities. The traditional team, such as found in communities of practice, with their guild resemblance, now is at one end of a gamut. This is complemented with networks of varying density and regularity towards the other end of the gamut. These learning communities are looser, more unstable, yet able to move quickly and adapt to changing situations. Their lack of formality is precisely their strength and attraction. At this end of the gamut, the focus is on connecting. Increasingly, these groups migrate to the web, creating collaborative forms beyond the scope of a group or a hierarchy. Different types of 'digital habitats' emerge [34][35]. Both varieties, the traditionally oriented and the future oriented share the common purpose of providing the means and environment for participation and the environment for transferring participation into reification. By this is meant the translation of an experience into a "collective anchor", that may be a certain method, a way of doing things, a way of thinking, a prototype, a perspective or a way of seeing the world. A common trait to be observed in these collaborative constellations is that the learning taking place is of a definite constructive and social nature.

At the same time as organizations have become more complex in their structure and functionality, the role of learning as a part of the added valued and competitive advantage has become increasingly important. The various ad hoc collaborative constructions may all contribute to this end. However, understanding and charting the changed landscape of the organization is a necessary complementation of understanding and charting the learning process. Such an approach to organizations may be found in the increasing body of literature that perceives organizations as 'complex evolving systems'. In this perspective, organizations are co-evolving within a social ecosystem, thereby changing the focus from the organization as the centre of attention to the social ecosystem. A major characteristic of these collaborative constellations is that they tend to emerge upon the initiative of individuals, and on the side of the ways of the organization they are a part of. Lack of control and predictability of development are salient features [34]. Consequently, an important

characteristic of these collaborate constellations is that they are difficult to govern or to rule, if applying a traditional organizational approach. Instead, the focus regarding learning communities should be turned from controlling to facilitating the activities of the individuals and the community they take part in [34][35].

3 TARGET Platform Overview

The TARGET project aims to develop an innovative TEL platform that provides learners with a responsive environment that addresses personalized rapid competence development and sharing of experiences.

3.1 The Duality of Individual and Social Learning

The approach taken in TARGET reflects upon James Baldwin's paradox [5] "in order to be social you have to be individual and in order to be individual you have to be social", thereby treating learning as a non-linear process moving away from a dichotomy of individual and social aspects of learning, whilst emphasizing dialogue and transformation (e.g. Threshold Concepts Framework [13]. This duality is captured in the block diagram of Figure 2. In TARGET, the learning process draws heavily from Problem Based Learning (PBL) [6] and Action Learning (AL) [14], resulting in the use of digital interactive Stories that provide situated rich contexts where a learner is required to apply and develop competences to achieve successful outcomes.

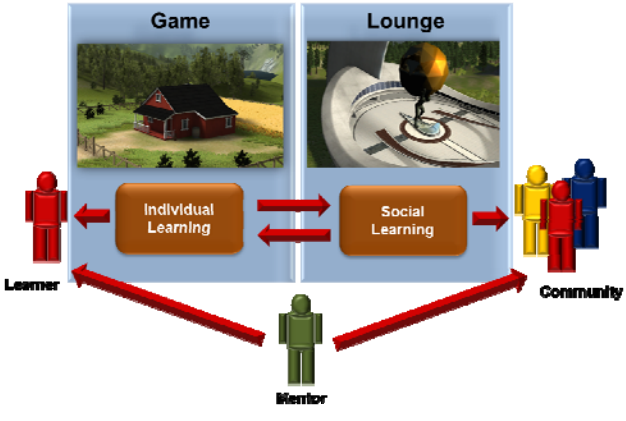

Fig. 2. Individual and social learning supported by TARGET componentized platform

The situated contexts captured by Stories represent a scoped business environment where multiple characters are defined with specific roles and responsibilities. Since the paradigm of emergent storytelling is adopted, some of the characters are strategically controlled by Non-Player Characters (NPC) to ensure the Story unfolds with the aim of developing the associated competences, so for example with conflict management, the NPC will control the anti-protagonist to oppose the learner's goals. However, taking aside these strategic characters assumed by NPCs, the learner may choose which one of the remainder characters to assume in the Story. In the cases

where there is more than a single character available for the learner to choose, then it is possible to have multiple learners engaged in the same Story. The fact that a few learners may simultaneously engage with the same Story does not change that learning continues to be individual irrespective of the possibility of learners exhibiting behaviours out-of-character, communicating with one another.

As evidenced in social constructivism, peer-to-peer learning is essential for facilitating the externalization of the tacit experience acquired by learners whilst engaged in the Stories.

3.2 The TARGET Learning Process

The instantiation of the TARGET Learning Process, which is supported by a componentized platform, is illustrated in the diagram of Figure 3.

Fig. 3. Overview of the TARGET Learning Process

Each of the stages can be characterized as follows:

- **Curricula Design.** The TARGET Learning Process begins with the learner deciding on what competences to develop. This is done in one of two ways, either goal-oriented or self-directed learning. In the case of goal-oriented learning, the learner defines their current competence profile and their desired learning outcome in the form of outlining their target competence profile. The result of profiling leads to the creation of a learning plan based on custom stories tailored to the particular needs of the learner. Each story captures a business context, which may also involve defined characters with particular roles. The process of creating the learning plan is governed and shaped by a learning strategy that is

chosen by the learner. In the case of self-directed learning, the learner builds their learning plan from the experiences of others within the community and these are stored in the knowledge ecosystem.

- **Briefing.** The learner is provided a background to a Story, which gives insight into the context, including the various characters available and their role in the Story. Some of the characters are available to the learner to be played by them, but in many cases the characters are only manipulated by NPCs.
- **Experience.** Whilst engaged with the Story, the system provides an environment where the learner engages with other characters (either controlled by another learner or a NPC) and the environment, enacting their decisions. These decisions will have an impact which will affect and change the situated context of the Story. By monitoring the actions of the learner and taking into account the desired learning outcomes, the TARGET platform makes changes to the Story if necessary. As examples, these changes may be modifying the personality of a NPC to be more confrontational or delaying tasks within a project.
- **Reflection.** The learner is presented with the assessment of their competence during the experience in the form of a timeline manner. The ability of looking back on their decisions by reviewing how the story unfolded whilst cross-referencing the assessment of their competence at each point in time, allows the learner to evaluate their performance leading to reflection.
- **Peer Learning.** The TARGET learning process supports the learner in externalizing the tacit knowledge acquired after their experience of a Story, thereby contributing to the creation of knowledge assets that are uploaded to the Knowledge Ecosystem. Once uploaded, the learning community plays an important role in the process with the support of recognized mentors as facilitators and in discussion with other learners. The social aspects address the need of an ability to deal with flux and instability, and to thrive in situations of flux.

Each of the five phases of the TARGET learning process is supported by a set of well-defined services embodied into components that are event driven, thus loosely decoupled from one another with some sharing functional dependencies. This means that the TARGET platform need not be entirely deployed as an integrated solution, but only subsets of the supported functionality. However, one needs to ensure that those components sharing functional dependencies are deployed together otherwise they may be operational at run-time but not work as required.

5 Conclusions

Actually, there is a need to effectively and economically address dynamic competence development rapidly, with flexible learning contexts of varying complexity and longevity. One challenge is that each learner is a unique individual, with different cognitive abilities, emotional intelligence, personality, knowledge, and experience.

In order to address these problems, we presented in this paper the integrative framework deployed in the TARGET project which brings together five key development areas of education research, namely Knowledge Ecology, Threshold Concepts, Experience Management, Cognitive Management, Social Learning Communities.

In fact, TARGET goes beyond current competence development platforms, by combining serious games with cognitive science, threshold concepts and learning communities, thereby offering users a platform where they may develop their competences through the fastest learning path and in condensed time. Much like flight simulator training offers pilots the opportunity to train for thousands of situations not even a lifelong career would ever present to them, a few months' use of TARGET can give project managers experience of thousands of situations marked by community recognized challenges. And since both allow the learner to experiment with different approaches and solutions without risking more than losing the simulation/game, this way of building experience normally leads to an even richer set of lessons learned.

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