Open Research Online

The Open University's repository of research publications
and other research outputs

Changing the way we learn: towards agile learning and co-operation

Conference or Workshop Item

oro.open.ac.uk

Changing the Way We Learn: Towards Agile Learning and Cooperation

Poul Kyvsgaard Hansen[1], **Manuel Fradinho**[2], **Bjørn Andersen**[3], **Paul Lefrere**[4]
[1]Aalborg University; [2]Cyntelix, [3]Sintef; [4]Global Leadership Team
[1]kyvs@production.aau.dk; [2]mfradinho@cyntelix.com, [3]Bjorn.Andersen@sintef.no;
[4]lefrere@mac.com

ABSTRACT
 This paper addresses the need for learning and competence development in industrial organizations. The people that enter professional organizations today are part of a gamer generation that have some or much experience with on-line games. Therefore they are more open to e-learning and in general more open to access anything on-line. At the same time industrial organizations experience a pressure on their ability to train employees faster due to the increase in complexity. We argue that games are not yet mature enough to support this training challenge as stand alone efforts. But games can support the training and competence development in a synchronized setup with other means.

Introduction

 The aim of this paper is to discuss the learning and competence building challenges of the many industrial and professional organizations that need ever-faster and more powerful ways to handle current or prospective threats in the external environment. Our proposed solution is ways of learning that foster greater agility and cooperation. In particular we are aiming at positioning serious games in a context of learning and competence building, and furthermore, aligning games with other learning and competence building means.

 To characterise industrial and professional learning today: in specialist areas with an established or slow-changing body of knowledge (e.g., computerized analysis techniques, ERP systems, Facility Layout, Inventory Planning, etc), people learn in two main ways: (a) through Systematic Formal Instruction, **SFI** (via training, e-learning and materials-based self-study curricula), and (b) through flexible but often inefficient Ad Hoc Informal Learning, **AHIL** (including self-regulated learning and peer-to-peer learning). In other more integrated (meaning cross-functional or multiple-specialist) areas (e.g., lean approaches to manufacturing/innovation/ services), the body of knowledge is poorly defined or is evolving faster than formal courses can handle. In such cases, learning method (a), SFI, is much more difficult for employers to provide and method (b), AHIL, cannot readily be scaled up to meet the demand for learning, because AHIL is too expensive in terms of the opportunity cost of diverting experienced staff from their professional tasks to providing as-needed help to colleagues.

 There is, however, an urgent need for better support to learn to handle external challenges than either SFI or AHIL can provide. This is explained by the fact that people most often are recruited to a relative specialist area. Here, the training takes place as AHIL (peer-to-peer training) and whenever support is needed this is immediately at hand from colleagues. The integrated areas most often play the role as coordinating department or functions. Each company has a unique setup, and therefore, the challenges are not well defined, making SFI inappropriate.

 However, in the integrated areas decisions are taken that have a crucial influence on the competitiveness and profitability of a company. These decisions relate to

questions like various strategic management tasks, product portfolio, product program, competitor strength, competition parameters, market segmentation, project planning, innovation management, process management, etc.

These integrated areas all require competences that go beyond the narrow technical competences that can be acquired easily and affordably through SFI. As complexity and dynamics in the internal and external specialization and collaborations increase the need for training and competence development increases as well. In terms of competence development, organizations therefore have concrete needs that are not met well by AHIL and SFI, namely:

- Reduce the time it takes a employee to acquire the necessary competences to do their job in the most efficient and effective manner;
- Change the learning context rapidly and in response to the real world;
- Facilitate knowledge sharing within an organization;
- Support a soft failure environment where mistakes have no impact on the real world, thus promoting a willingness to engage in measured risk taking, focused on achieving a high level of polished performance in the real world

The above are a response to market pressures, but society itself has also gone through changes as a result of the advances of technology. For example, the way people scan reading material has changed significantly due to the World Wide Web, thus having a significant impact on marketing strategies. With e-learning it is no different and already there are signs that e-learning needs to take account of the enhanced abilities of the so-called gamer generation such as differences in cognitive processes when compared to non-gamers, which can give gamers a competitive edge in fast-changing market situations such as arise in economic downturns. This has implications for organizations that need to change work environments and business practices to face new challenges. In this light games can be seen as the most recent element in e-learning offering new and different approaches to organizations in their effort to upgrade and enhance competences.

Emergence of Complexity

Traditionally, problems have been seen as complicated challenges that should be solved through breaking them down into smaller and smaller chunks. Seen from the solution perspective the solutions then emerge by solving the problems related to the smaller chunks.

Largely, this reflects an analytical way of thinking. In such regimes learning and training are also related to the smaller chunks. By training the competences behind the smaller chunks the person gradually becomes able to meet the challenges.

We experience that most modern problems are more frequently complex rather than complicated. Complex problems are messier and more ambiguous in nature; they are more connected to other and often very different problems; more likely to react in unpredictable non-linear ways; and more likely to produce unintended consequences.

Most organizations have been designed to deal with a complicated rather than a complex world. Hierarchical and silo structures are perfectly designed to break problems down into more manageable fragments. They are not, however, so effective in handling high levels of complexity. For this reason many institutions and companies are now struggling to adapt to a more complex world.

There is a need for leaders to both understand and accept that the world is often irrational and unpredictable. In most cases this requires radical changes in organizations and mindset. But most approaches to organizational change have limitations which make them unsuitable for tackling the predominant issues.

The Cynefin (the word has a Welsh origin and is pronounced *kun-ev'rin*) framework proposes an association between the nature of context of problems and appropriate responses (Snowdon & Boone, 2007).

The Cynefin framework consists of five domains (see figure 1):

- Simple, in which the relationship between cause and effect is obvious and the appropriate approach is to Sense – Categorize – Respond
- Complicated, in which the relationship between cause and effect requires analysis or some other form of investigation and/or the application of expert knowledge, and the appropriate approach is Sense – Analyze – Respond
- Complex, in which the relationship between cause and effect can only be perceived in retrospect, but not in advance, and the appropriate approach is Probe – Sense – Respond
- Chaotic, in which there is no relationship between cause and effect at systems level, and the appropriate approach is to Act – Sense – Respond
- Disorder – in which it is unclear what type of causality exists. Disorder is in the centre of the graphical model. Here people will revert to their own comfort zone and choose the approach related hereto.

Figure 1. The Cynefin Framework (Snowdon & Boone, 2007).

Each domain of the Cynefin framework represents different levels of expected achieved practice. In the simple domain, we can expect "Best Practice". In the complicated domain, we can expect "Good Practice". In the complex domain, we can expect "Emergent Practice", and in the chaotic domain, we can expect "Novel Practice".

These expectations relate to the nature of the problems. Heavily process-oriented situations, such as loan payment processing, are often simple contexts. Directives are straightforward, decisions can be easily delegated, and functions can be automated. As problems become complicated, they tend to require assistance from specialists: A car owner may know that something is wrong with his car because the engine is knocking, but he has to take it to a mechanic to diagnose the problem.

When problems become complex, the clear pattern between cause and effect disappears. We can understand why things happen only in retrospect. Instructive patterns, however, can emerge if the leader conducts experiments that are safe to fail. That is why, instead of attempting to impose a course of action, we must patiently

allow the path forward to reveal itself. We need to probe first, then sense, and then respond.

There is a scene in the film Apollo 13 where the astronauts encounter a crisis that moves the situation into a complex domain. A group of experts is put in a room with a mishmash of materials – bits of plastic and odds and ends that mirror the resources available to the astronauts in the flight. The team is told: This is what you have; find a solution or the astronauts will die. None of those experts knew a priori what would work. Instead, they had to let a solution emerge from the materials at hand.

In the chaotic context, searching for right answers would be pointless: The relationships between cause and effect are impossible to determine because they shift constantly, and no manageable patterns exist – only turbulence. Here we must first act to establish order, then sense where stability is present and from where it is absent, and then respond by working to transform the situation from chaos to complexity, where the identification of emerging patterns can both help prevent future crises and discern new opportunities.

The analytical learning and competence building approach that have proven efficient when dealing with simple and complicated problems proves inefficient when confronted with complex problems. In short the "probe" element is missing in traditional approaches, and the "sense" element appears to be very different when dealing with complex problems compared to complicated and simple problems.

Dealing with the probe and sense elements

The probe and sense elements seem to be crucial when dealing with complex problems. This is supported be a number of research results published in the past 30 years.

In 1984 David Kolb published his book title "Experimental Learning" (Kolb, 1984). His claim is that we are learning by cyclic patterns of four types of activities: Concrete experience, reflective observation, abstract conceptualization, active experimentation (see figure 2). According to Kolb it does not matter where we start - the important requirement for real learning is that one goes through the full cycle.
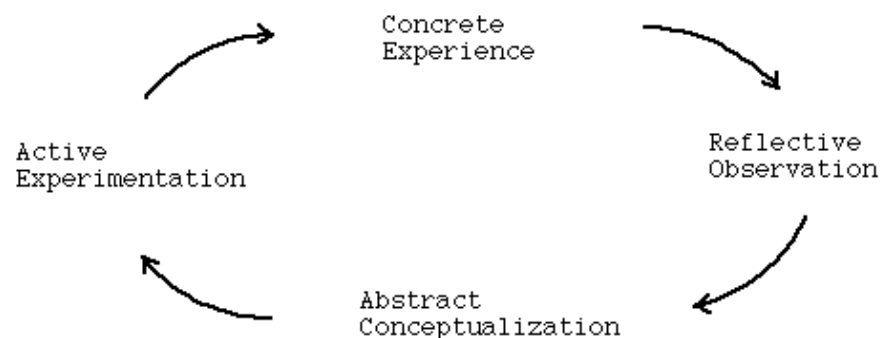

Figure 2: David Kolb's learning circle.

Though Kolb's work is aiming at the individual level there are several contributions supporting that a similar pattern is valid at the organizational level. Dorothy Leonard argues that: "The primary activities spawning organizational learning are experimentation and prototyping" (Leonard, 1995) and Argyris and Schön (1978) has introduced the notion of single-loop and double-loop learning which includes active experimentation.

Donald Schön has been studying how professionals are working very differently from novices. His point is that when people have reached a certain level of

professionalism it will change their working style and become "reflecting practitioners" (Schön, 1983). The reflective practitioner is in a constant process of thinking, reflecting, acting, and building experience – very much in line with the learning process as described by Kolb. This process is efficient for the professional person but due to the amount of tacit knowledge it is often difficult to articulate and share the results with others (Polanyi, 1967). Physical models or other model representations seem to be the most efficient means to facilitate this sharing (and learning) process (Schrage, 2000).

In his book, Serious Play, Michael Schrage (2000) praises many aspects of prototyping for speeding up processes etc. and mentions examples of great breakthroughs made by new prototyping tools. The following extracts provide exemplary viewpoints form the book:

- When talented musicians improvise, you don't look inside their minds; you listen to what they play. When talented innovators innovate, you don't listen to the specs they quote. You look at the models they've created.
- The challenge of converting uncertainty into manageable risks or opportunities explains why serious play is often the most rational behavior for innovators.
- Serious play is about improvising with the unanticipated in ways that create new value.
- Prototypes engage the organization's thinking in the explicit. They externalize thought and spark conversation.
- Prototypes force confrontation with the tyranny of trade-offs.
- The conventional wisdom that "innovation processes" drive prototype development is misleading. Empirical observations of organizations with effective innovation cultures confirm just the opposite: changes in prototypes and simulations drive the innovation process.
- Prototypes are machine tools for producing choice.
- Most companies have formal prototyping processes and informal prototyping cultures.

Schrage agues against the common assumption that "great teams make prototypes" and suggests that instead one should realize that "prototypes make great teams". The making of great teams goes beyond the individual team, but helps create teams out of people with different backgrounds by creating "shared space". Shared space is the common ground where people can meet on even terms and objectively discuss matters.

Obviously, physical and mental prototypes provide opportunities to probe and sense. They invite for questioning and challenging of conventional wisdom (March, 2006) and thereby learning and competence development can be supported. Increasingly games provide a strong alternative or supplementing opportunity.

Games in a learning context

In "Got Game", a book published in 2004 by Harvard Business School Press, John Beck and Mitchell Wade argue that gaming provides excellent training for professionals in business (Beck & Wade, 2004). Gamers, they write, are skilled at multi-tasking, good at making decisions and evaluating risks, flexible in face of change and inclined to treat setbacks as chances to try again.

The changing role of gaming was also an issue in a special report in The Economist (The Economist, 2005). Under the provoking title "Breeding Evil?" gaming is discussed from the perspective of the age of players and habits of a new generation.

We acknowledge these results which point to the fact that younger gamers seems to be able to cope with higher complexity due to their gaming experiences.

However, we have found it difficult to convert this insight fully to professional settings. We anticipate that this is a sign of the difficulties in adapting games to a context that is considered relevant to every company.

We have recently tested the efficiency of learning and competence development in the ICT project PRIME (2006). The PRIME project aimed demonstrating that serious games could be a potential effective delivery mechanism for competence development in industrial organizations. Although successful in achieving its aim, the push of the hardcore serious games was not sufficient for competence development.

This has led us to propose a framework that incorporates play and gaming into a company specific context and that incorporates significant elements of flexibility. The framework is illustrated in figure 3.
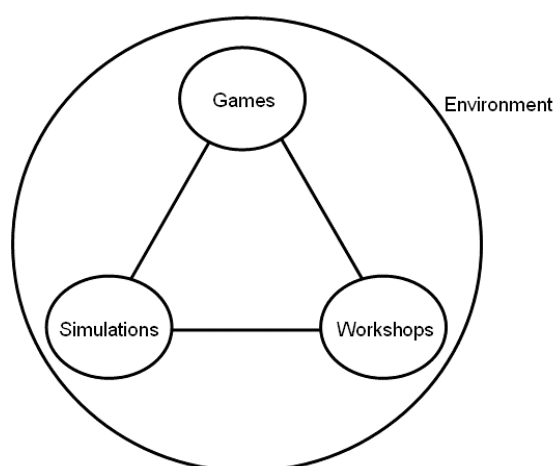

Figure 3: The SWING framework.

Our framework includes four different types of mechanisms: Workshops, Simulations, Interactive Environments, and Games. These four mechanisms have different characteristics, and when applied in various combinations, can stimulate the various elements of the process. In figure 3, the conceptual model of the SWING framework illustrates the relationship between the four mechanisms (Simulation, Workshops, Interactive eNvironments and Gaming).

The act of **simulating** a phenomenon generally entails representing certain key characteristics or behaviors of a selected physical or abstract system. Simulation is used in many contexts, including the modeling of natural systems or human systems in order to gain insight into their functioning. Other contexts include simulation of technology for performance optimization, safety engineering, testing, training and education. Simulation can be used to show the eventual real effects of alternative conditions and courses of action. Key issues in simulation include acquisition of valid source information about the referent, selection of key characteristics and behaviors, the use of simplifying approximations and assumptions within the simulation, and fidelity and validity of the simulation outcomes.

A **workshop** is defined as: "An educational seminar or series of meetings emphasizing interaction and exchange of information among a usually small number of participants".

The workshop mechanism is the social engagement element of our model, which necessitates workshops as a part of an exploration process. Relatively simple

problems can normally be handled by a workshop alone; for example, when a small group of people gather to solve or to communicate a problem they currently face. As problems become more complex the effectiveness of workshops as a stand-alone learning mechanism decreases.

By **interactive environments**, we refer to the social, physical, and informational environments in which we live and work. To survive, an organization must continuously monitor its environment and respond to it. Socially, the environment consists of various relationships an organization has developed with suppliers, lead-users, and retailers as well as within its business units. Physically, the infrastructure of an organization has a strong influence on habitual behavior of its members. Informationally, new information and communication technologies are constantly changing the essence of an organization. In particular, hitherto ephemeral organizational experiences can now be externally and digitally stored for later reflection and improvement. By altering the physical and informational environment of an organization and changing the social rules, organizations now can experiment with alternative identities in the context of others.

The new insight into how **games** can be used in professional setting has triggered a range of activities to develop games for this particular purpose. In professional settings the notion of "serious gaming" has recently emerged. Serious Games will provide the means for learning by experience within a virtual environment that is safe and encourage risk taking without detrimental impact on the business. We expect electronic and on-line games to become available in the near future. However, for the moment this is still an emerging discipline.

In summary: games give us opportunities for emotional play; simulations provide opportunities for conceptual play especially to examine the evolutionary properties of systems; workshops provide opportunities for social play and being discursive they allow us to clarify needs, to frame problems, and to build consensus. Finally, interactive environments allow us to experience our selves in new situations.

In particular the game dimension is developing fast for the moment, and in the long run it is expected that games will be configurable to be adaptable to the challenges of a given organization. However, as an important part of this development we anticipate that we have to go through several processes where the four elements are applied.

A limited empirical test

In order to test the SWING framework we have focused on a type of problem that most organizations consider as being complex. We have focused on the Product Lifecycle Management (PLM) area. PLM can be understood as a range of activities that relates to the lifecycle of products from idea to the discontinuation of a product on the market. PLM is often understood as a holistic concept aiming at directing, managing, controlling and evaluating all data and processes related to the product lifecycle.

In order to secure a sound empirical basis for our empirical testing we have chosen to work close with one company, LEGO Group, a Danish toy manufacturer.

LEGO launches new products every year. Approximately 60 % of the product portfolio is renewed each year. In early December the different proposals for new product launches are presented and during a one-day management seminar the products for the next year's portfolio are selected. Hereafter the development project teams are being formed and the projects are executed to be ready for launch January one year after.

We have chosen a few factors that when brought together characterizes the complexity of the product portfolio process:

- The renewal degree is high and it is financially lucrative to extent as many of last year's product lines to the next year. This is due to the marketing effort as well as utilizing the knowledge that have been built up in the team.
- Both the product line managers and the project teams posses a lot of knowledge that to a large extent can be classified as tacit knowledge.
- A new product launch will to a certain extent cannibalize on existing products. The degree of cannibalization is not only depending on internal factors but as well on the behaviour of the competitors.
- New product lines should in general build on re-use of as much of the present element platform as possible. This balance between existing geometrical shapes and a certain degree of newness is critical in order to attain perceived innovation value.
- There is a potential substantial learning effect in terms of cost reduction in the supply chain when relying on existing production platforms. This includes both internal and external production.
- Overloads in the supply chain are often caused by a few critical decisions. However, it is difficult to foresee these overloads because of the complex relationship between the product and the supply chain structure.

We have taken outset in these factors and have applied the different aspects of the SWING framework to the LEGO organization. Initially we have held workshops that have aimed at framing the situation. In these workshops we have had participation of people with as different organizational background as possible.

The workshops have identified areas of potential interest and risk. In a few of these areas we have found existing simulation tools. These have been applied, and the results have been feed back to the workshops. In cases where a simulation was highly wanted by the organization we have build simple spread sheet programs to support this.

Finally, we have built a simple card board game where participants could play the product portfolio setup. The card board game was build to simulate a computerized game and a few elements of the game was implemented in a computerized game.

The initial tests on the workshop, simulation, game setup lead us to summarize our initial observations:

1. The number of variables is too big to overviewed and handled by a workshop.
2. There is a high risk of the solution being either a compromise (that we really don't know the consequences of) or a solution based on what we have done before (that we really don't know the consequences of either).
3. The complexity is too high to be handled by simulations. The effort to build a comprehensive model that can cover the complexity is huge and the risk of not succeeding is high. However, critical elements can be simulated and detailed parts of the solution or refinements can be supported by simulations.
4. Games can only give superficial indications of a solution. However, they can support in testing the robustness of a chosen solution.
5. When games and workshops are combined they evoke an emotional dimension in the form of involvement (and competitive behavior) that seems to facilitate a deeper understanding of the problems. Furthermore, it creates a form of share neutral language across the organization.

6. The combination of all the SWING elements stimulates the progression of knowledge between the different involved organizational units. In many cases this can be characterized as a shift in the individual's past understanding.
7. The combination of games and workshops frequently generate metaphors that capture and support articulation of complex problems.

The conclusion is that each of the workshop, game, and simulation elements can support the effort if configured and synchronized properly.

Perspectives and Future Work

We have addressed a number of related problems in the paper. All of them revolve around the challenges of learning and building competence when dealing with complex problems in organizations. There are indications that such challenges can be supported by various forms of games.

However, since the existing games still lack capability in coping with the challenges of learning and competence building we have proposed a framework, which can support our efforts to explore and exploit both the needs and the means. The SWING framework simply combines and synchronizes a number of well-known means in a structured and facilitated way. This has and will in the future support us in both testing means (in particular game fragments and scenarios) and doing further research into the processes of acquiring competences.

Our experiences will be utilized in a recent accepted ICT project TARGET – Transformative, Adaptive, Responsive and engaging EnvironmenT (Target, 2008). TARGET addresses the ever increasing need to reduce the time-to-competence of human resources within organizations and to facilitate the transfer of knowledge within a community and organization.

Our experiences as described above have been synthesized into five significant developments that are to form the TARGET integrative framework. Furthermore, the developments have references to recent references that have a similar integrative approach as this paper build on. The developments are:

- **Threshold Concepts** is an essential conceptual building block in progressing in the knowledge of a particular domain (Meyer & Land, 2003).
- **Knowledge Ecology** implies that knowledge is seen as a dynamic, polycentric system (Qvortrup, 2006) corresponding to self-organizing knowledge ecosystems that provide the infrastructure in which information, ideas, and inspiration can travel freely to cross-fertilize and feed on each other (Scharmer, 2007).
- **Cognitive Load Theory** states that a learner's attention and working memory is limited. This limited amount of attention can be directed towards intrinsic, germane, or extraneous processing. Therefore, it is necessary to minimise the load on an individual's working memory to optimise the learning process (Sweller, 2005).
- **Learning Communities** based on the seminal work of Wenger (1999) on communities of practice as the underlying framework can be thought of as shared histories of learning.
- **Experience Management with serious Games.** Serious games can be deployed as test beds for experience management that are highly motivating and emotionally engaging, causing high and long knowledge retention (Baxter, 2008)

The five developments will together with the SWING framework inform the future development in TARGET. The empirical setup includes a series of complex situations

captured in the form of game scenarios that the users engage with by means of emotionally engaging serious play.

The project is 3 year project that has been kicked of in January 2009.

Conclusion

In this paper we have discussed the learning and competence building challenges of the many industrial and professional organizations that need ever-faster and more powerful ways to handle current or prospective threats in the external environment. In particular we have focused on positioning serious games in this context. Our research reveals that games have advantages but that they have to develop substantially to be mature for the learning and competence building. However, games can play a significant role as a supplement to existing means. To support this development we have proposed a framework and have engaged in an EU-project in order to further explore the challenges.

References

Argyris, C. & Schön, D. (1978), "*Organizational Learning*", Addison-Wesley

Baxter, A. (2008), "Students take a leap into the virtual world. From first step to flight – an avatar's journey, *Financial Times*, March

Beck, John & Wade, Mitchell (2004), "*Got Game - How the Gamer Generation is Reshaping Business Forever"*, Harvard Business School Press

Kolb, D. A. (1984), "*Experimental Learning – Experience as The Source of Learning and Development*", Prentice-Hall

Leonard, D. (1995), "*Wellsprings of Knowledge – Building and sustaining the sources of innovation*", Harvard Business School Press

March, J. (2006), "Ideas as Art", *Harvard Business Review*, October, pp. 83-89

Meyer, J.H.F. & Land, R. (2003), "Threshold concepts and troublesome knowledge: Linkages to ways of thinking and practising within the disciplines", in Rust, C. (ed*.), Improving Student Learning Theory and Practice – Ten Years On*, Oxford Centre for Staff and Learning Development

Polanyi, M. (1967), "*The Tacit Dimension*", Doubleday

PRIME – Providing Real Integration in Multi-disciplinary Environments (2006). EU-Project FP6-IST-016542

Qvortrup, L. (2006), "Knowledge, Education and Learning", *E-learning in the knowledge society*, Copenhagen, Samfundslitteratur

Scharmer, C.O. (2007), "*Theory U – Leading From the Future as it Emerge*", The Society for Organizational Learning Inc., Cambridge, MA, USA

Schrage, M. (2000), "*Serious Play – How the Worlds Best Companies Simulate to Innovate*" Harvard Business School Press

Schön, D. (1983), "*The Reflective Practitioner",* Basic Books

Snowden, D.J. Boone, M. (2007), "A Leader's Framework for Decision Making", *Harvard Business Review*, November, 69-76

Sweller, J. (2005), "implications of cognitive load theory for multimedia learning", in Mayer, R. (ed.), *Cambridge handbook of multimedia learning*, Cambridge (MA), Cambridge University Press, pp. 19-30

TARGET - Transformative, Adaptive, Responsive and engaging EnvironmenT (2008), EU-project FP7-ICT-231717

The Economist (2005), "Breeding Evil?", *The Economist*, August 6th-12th, p 9