Knowledge Creation in Oulu Game LAB

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Abstract: In this paper we study how knowledge creation is used in game education. We examine the model and learning from the perspective of knowledge and knowledge creation. Based on literature review different aspects related to knowledge creation are identified and the Oulu Game LAB is then evaluated in relation to these aspects. Overall, the model seems to offer great support for knowledge creation. In addition to supporting learning the model offers the students good understanding of entrepreneurial thinking. The main challenges for the model are to find suitable place and quality coaches. As a future research more studies are needed to study the LAB-model in other industries besides games.

Keywords: Knowledge, Knowledge Creation, Higher education, Games, LAB-model, Design Studio Model

1 Introduction

Educational institutions across Europe are facing challenges related to the financing and delivery of quality education. With respect to finances, government funding for higher education has been decreasing throughout Europe [4]. In Finland, these issues are no different. Additionally, the most recent results from the OECD Programme for International Student Assessment (PISA) have raised concerns within the public sphere related to the maintenance of high quality teaching while the system is under pressure to perform with less. Ultimately, his means that new forms of teaching and learning are required to accommodate this new reality.

Recent research points to learning as both a constructive process (i.e. built from previously gained knowledge, [22]) and a cognitive process (i.e. learning as a mental process influenced by intrinsic and extrinsic factors, [7]). One way to understand learning is to look at it through the concepts of knowledge – as we learn we gain new knowledge. In the Information Technology literature, knowledge is defined by distinguishing between knowledge, information and data [1]. Data is seen as raw numbers and facts, information as processed data and knowledge as personalized information. What is important in this classification is the distinction of knowledge and information. Knowledge should be something more than information – otherwise there is nothing new or interesting in knowledge management [5]. Yet, many times the knowledge management that academics and business people talk about means just information management [15]. Tuomi [21] argues that the traditional hierarchy of data-information-knowledge is actually reverse: data emerge only after we have information and that information emerges only after we already have knowledge. We must have knowledge about how to measure temperatures before we can build a thermometer to get the actual temperature-data.

Following Tuomi's [21] view, Alavi and Leidner [1] state, that "information is converted to knowledge once it is processed in the mind of individuals". In this way, knowledge is information plus something more. This "something more" represents the associations, memories, past experience – previous knowledge that the individual possesses – that are related to the information. In this view knowledge is "information possessed in the mind of individuals: it is personalized information" [1]. An interesting part of this definition is that "knowledge becomes information once it is articulated and presented in the form of text, graphics, words, or other symbolic forms" [1]. So knowledge doesn't exist without individuals. When somebody articulates part of his knowledge to written form, it becomes information until somebody reads it: the reader gives (his or hers own) meaning to this information and it becomes knowledge again. It should be noted that the knowledge in the mind of the reader is different (it is his personalized information) than the one in the mind of the writer. In addition, even if knowledge resides in the mind it often has its origins and significance in the culture in which it is created [2].

The paper is organized into four additional sections after the introduction as follows. In section two, definitions of knowledge and knowledge creation are discussed. In section three, the authors present the Oulu Game LAB model. Section four, offers a discussion with respect to a connection between the LAB-model and the related concept of knowledge creation. Finally, section 5 provides a discussion and conclusion.

2 Knowledge and Knowledge Creation

Nonaka [13] (following the work of Polanyi [17]) explicated two dimensions of knowledge in organizations: explicit and tacit. Explicit or codified knowledge refers to knowledge that is transmittable in formal, systematic language. Explicit knowledge can be "articulated, codified, and communicated in symbolic form and/or natural language" [1] and indeed, many times it is captured in the "records of the past such as libraries, archives, and databases" [13]. Procedure manuals, product literature, and even computer software can be seen as explicit knowledge [23].

Tacit knowledge, in contrast, has a personal quality, which makes it hard to formalize and communicate. Tacit knowledge is held in people's bodies and heads and it is rooted in action, experience and involvement in specific context [13][17]. Tacit knowledge is comprised of both cognitive and technical elements [13]. The cognitive element refers to individual's mental models, which include schemata, paradigms, beliefs, and viewpoints that provide "perspectives" that help individuals to perceive and define their world. Technical element of tacit knowledge covers concrete know-how, craft and skills that apply to specific contexts [8]. An example of tacit knowledge could be how to deal with a specific customer.

Knowledge creation is the process that is probably researched the most. Many different models and theories try to explain how knowledge is created. Knowledge creation is dynamic [9]. It is also most often displayed as a spiral, be it the SECI model [13] or the 7C model [16]. Or as Nonaka et al. [15] put it "knowledge is created in the spiral that goes through two seemingly antithetical concepts such as order and chaos, micro and macro, part and whole, mind and body, tacit and explicit, self and other, deduction and induction, and creativity and control."

Next the dynamic theory of organizational knowledge creation is explained in more detail.

2.1 Organizational Knowledge Creation

This section summarizes the key aspects and concepts of organizational knowledge creation as detailed by e.g. Nonaka [13], Nonaka and Takeuchi [14], and Alawi and Leidner [1]. This summary is offered to outline the key concepts from the existing literature that can be used to conceptual ground the LAB-model. The dynamic theory of organizational knowledge creation [8] explains how new knowledge emerges within organizations. Knowledge creation is a "spiral" that takes place in two dimensions. These dimensions are the epistemological and ontological dimensions.

The epistemological dimension is the distinction between tacit and explicit knowledge. In the ontological dimension are the levels of knowledge creation entities. These are individual, group, organization and inter-organization. Strictly speaking all knowledge is created by individuals. Thus, "organizational knowledge creation […] should be understood as a process that 'organizationally' amplifies the knowledge created by individuals" [14]. In essence "human knowledge is created and expanded through social interaction between tacit knowledge and explicit knowledge" [14].

The dynamic theory of organizational knowledge creation has four modes of knowledge conversions that are created when tacit and explicit knowledge interacts. The modes are [13]: 1) socialization, 2) externalization, 3) combination, and 4) internalization.

Socialization is a process of sharing experiences [13]. It creates new tacit knowledge from existing tacit knowledge. For example by observing a colleague the observer can learn through imitation or practice. Typically the new tacit knowledge is in a form of shared mental models or technical skills.

Externalization is a process of articulating tacit knowledge into explicit concepts [13]. Externalization is the key process in the theory as it is the process that creates new explicit concepts from the tacit knowledge. One example of this is writing. It can be seen as an act of converting tacit knowledge into articulable knowledge. The use of metaphors and analogies seem to be a key in externalization as it is typically triggered by dialogue or collective reflection.

Combination is a process of systemizing concepts into a knowledge system [13]. It creates new explicit knowledge from existing explicit knowledge. It is the kind of knowledge creation that happens in formal education or training at schools. Also the use of large-scale databases could be seen as an example of combination.

Internalization is a process of embodying explicit knowledge into tacit knowledge [13]. Reading documentations or watching videos is an example of the kind of “re-experiencing” that internalization requires. Also “learning by doing” can be seen as an example of internalization.

On their own these knowledge conversion modes produce only a limited amount of knowledge creation. They must form a dynamic and continuous knowledge spiral for knowledge creation to truly happen. Typically this spiral starts at the individual level and moves up on the ontological dimension (i.e. from individual to group, from group to organizational, and from organizational to inter-organizational level).

An organization usually provides the context that facilitates the knowledge creation, especially from the group-level onwards. An organization can also promote knowledge creation and requires the following five conditions [14]: 1) intention, 2) autonomy, 3) fluctuation and creative chaos, 4) redundancy, and 5) requisite variety.

The organizational intention provides “the most important criterion for judging the truthfulness of a given piece of information” [9]. Without intention it would be difficult to say anything about the value of knowledge being created. While organizations usually have strategies and visions that form the intention, Web-based communities of practice are more driven by common interests. The users themselves judge whether or not the newly created knowledge is important or not. The intention takes the form of a shared interest or even a passion on the certain topic.

This also means that the intention is also found in communities of practice. However as users all have their intrinsic intentions (e.g. somebody needs to install a driver for his PC) it also means that justifying knowledge can be difficult. Each participant can and probably will justify the knowledge by themselves.

Each member of the organization should also be allowed to act autonomously [14]. Autonomy not only increases motivation but it also increases the chances of unexpected opportunities. Wisdom of crowds also highlights the importance of autonomy [20].

Fluctuation and creative chaos stimulate the interaction between the organization and the external environment. For example employees could benefit from a “breakdown” of routines, habits, or cognitive frameworks. In the Web the danger is that this goes too far. If users participate infrequently in different discussion forums or Web sites there might be no routines, habits or cognitive frameworks to breakdown. There might even be a danger for information overload [11].

Redundancy as an enabling condition for knowledge creation is defined as “the existence of information that goes beyond the immediate operational requirements of organizational members” [14]. This helps in knowledge creation by making it easier to sense what others are trying to articulate. The Web is full of redundant information. Discussion forums usually have discussion threads with similar topics. These threads are packed with redundant information. The more the users participate in similar forums the more redundant information they are likely to possess.

The last enabling condition is requisite variety. Requisite variety can be enhanced by “combining information differently, flexibly, and quickly, and by providing equal access to information” [14].

Besides the above-mentioned enabling conditions the authors acknowledge Nonaka and Takeuchi‘s [14] five-phase model of the organizational knowledge-creation process. The model consists of the following phases: 1) sharing tacit knowledge, 2) creating concepts, 3) justifying concepts, 4) building an archetype, and 5) cross-leveling knowledge.

Since organizations cannot create knowledge by themselves, knowledge creation, according to Nonaka and Takeuchi, starts by harnessing the tacit knowledge residing in the individuals. This phase matches with the socialization mode of the spiral. It is also suggested that this is also the phase where the five conditions work best.

The second phase uses collective reflection to verbalize the shared mental models into words and phrases, and finally into explicit concepts. The externalization mode of the knowledge creation spiral is similar to the creation of concepts –phase.

As these concepts are created the organization must screen them in order to justify the “true beliefs” among the rest. This phase does not have equivalent in the knowledge conversion modes. The organization needs some sort of criteria for the justification. For example, some concepts may be too expensive or otherwise not feasible. The justified ones can be taken to the fourth phase.

The fourth phase consists of building an archetype of the concept. This can be a prototype of the product under development, for example. As the prototypes are usually built by combining existing knowledge with the newly built concept this phase is close to the knowledge conversion mode of combination.

The fifth and phase of the model is the cross-leveling of knowledge. In this phase the newly created, justified and modelled concept moves on to another ontological level where new knowledge creation process can begin.

Nonaka et al. [15] have also talked about the role of Ba in enabling knowledge creation. Ba refers to a shared context. This is crucial as knowledge needs a context to be created [15]. Ba is defined as a shared context in which knowledge is shared, created and utilised. The knowledge creation process is a spiral, and the key to leading it is dialectical thinking. In short "using existing knowledge assets, an organisation creates new knowledge through the SECI process that takes place in Ba, where new knowledge, once created, becomes in turn the basis for a new spiral of knowledge creation" [15]. They also state that in knowledge creation, generation and regeneration of Ba is the key, as Ba provides the energy, quality and place to perform the individual conversions and to move along the knowledge spiral.

Ba is a difficult concept as it unifies physical space such as an office space, virtual space such as e-mail, and mental space such as shared ideals [15]. There are four types of Ba. In virtual environments there is exercising Ba and systemising Ba. Systemising Ba is defined by collective and virtual interactions. It mainly offers a context for the combination of existing explicit knowledge, as explicit knowledge can be relatively easily transmitted to a large number of people in written form. Exercising Ba is defined by individual and virtual interactions. It mainly offers a context for internalisation. Here, individuals embody explicit knowledge that is communicated through virtual media, such as written manuals or simulation programs. Exercising Ba synthesises the transcendence and reflection through action, while dialoguing Ba achieves this through thought [15].

In the Table 1 the aspects identified in literature review are displayed. Sharing of tacit knowledge is omitted because it is equal to the SECI-mode of socialization, and creating concepts because it was identical to externalization. In the next section we will use the table below to evaluate how the LAB-model supports knowledge creation.

Table 1. Identified aspects of knowledge creation.

Aspect	Description
Socialization	Sharing experiences, creating new tacit knowledge from tacit knowledge
Externalization	Process of articulating tacit knowledge into explicit concepts
Combination	Creating new explicit knowledge from existing explicit knowledge, combining existing knowledge into new knowledge
Internalization	Process of embodying explicit knowledge into tacit knowledge
Intention	Provides criterion for judging the truthfulness of a given piece of information
Autonomy	Allowing members of the organization to act autonomously
Fluctuation and creative chaos	Stimulate the interaction between the organization and the external environment
Redundancy	The existence of information that goes beyond the immediate operational requirements of organizational members
Requisite variety	Combining information differently, flexibly, and quickly, and by providing equal access to information
Justifying concepts	Process of justifying that the created concepts are true
Building an archetype	Build a prototype of the product under development
Cross-leveling knowledge	Move the justified concepts on to another ontological level where new knowledge creation process can begin
Ba	Shared context, including physical, virtual and mental spaces

3 General LAB-model

The following section provides an overview of a training process introduced here as the LAB-model. The LAB-model is a modification from the existing design studio models and it was developed as part of development work establishing a unique training process at the Oulu University of Applied Sciences in Finland. The LAB-model represents a promising example for innovation and entrepreneurship in the training of professionals in the fields of creative industries. Main motivator to modify the traditionally used studio model was the sudden decline of Oulu area ICT-industry. The university education was supposed to fit to the needs of the experienced and talented professionals as well as to serve as a platform for creating new employment for them and to encourage establishing new start-ups.

The design studio is the traditional mode of learning in design education. It is essentially a shared environment in which studio participants, i.e. students, are assigned problems and projects to solve through a process which is often acknowledged as a "reflective practice" or "a dialogue of thinking and doing through which (students) become more skilled" [19]. The design studio is widely accepted as the core of curriculum because it aims to include many curricular topics within a project-based approach. The teaching system of Ecole des Beaux Arts has often been recognized as one of the foundations of current design studios [9]. In the Beaux Arts model, the students are given a design problem and guided by their instructors via critiques throughout the process. Typically, the process for each project culminates with an evaluation in the form of a final jury. Although it has been over two and a half centuries since the adoption of this system, the delivery modes in studio teaching have not much evolved as a response to changing generations and developing technology.

The LAB-model development was started in 2012 by establishing Oulu Game LAB (OGL) to support the needs of the local and Finnish game industry. The major factor for this decision was the game industry statistic that showed the game industry to be one of the fastest grown industry areas globally and Finland [12]. In addition the game industry start-ups and especially the development teams are multidisciplinary combining different professions together to solve complex problems. Oulu Game LAB is introduced more closely in the section 4.

Specifically, the LAB-model is an eight-month multidisciplinary education aimed at producing skilled professionals and self-directive teams. At the practical level, teams are established to develop working demos and products from industry-specific ideas or problems. The multidisciplinary aspect of the model is derived from the inclusion of team members from different fields and with different skills associated with the industry focus of the LAB. The ultimate goal of the teams working within this training model are to produce working product prototypes and the establishment of new start-up businesses within which work on the prototypes can continue after completion of the program.

The LAB-model is divided into two four-month pathways: the Demo Path and the Product Path. See Figure 1 for further explanation.

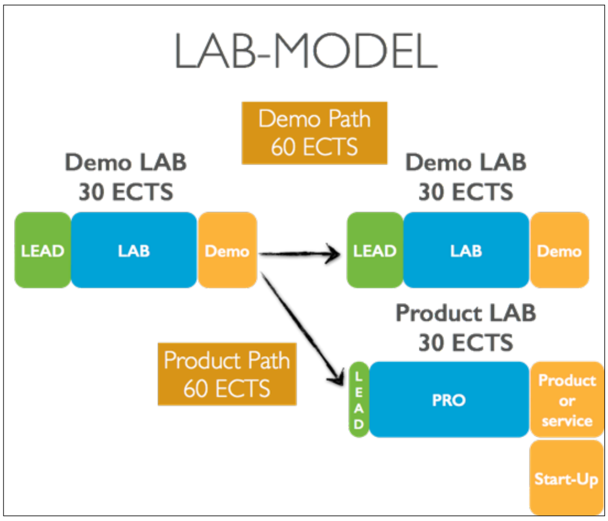

Figure 1. Demo and Product Paths

The Demo LAB provides specific training to individuals through the production of product demos. This pathway consists of two parts: a concept development part and demo development part. The concept development part is called LEAD and the demo development part is called LAB. The LEAD-part produces project proposals from the ideas provided by existing companies or organisations or from the participants themselves. Individuals self-organize into groups associated with a particular idea and then engage in a process of concept design. The process of concept design in the LEAD part places considerable effort into finding the ideas that hold potential market value. This is done through the use of an internal competition process through which ideas are presented in specific event named Gate 1 and Gate 2 under the principle of "Fail Fast, Fail Often". In the LAB-component, teams set after the last stage of LEAD-part develop demos. In the LAB-part, roles within the development team are defined and effort is put into both demo development and individual's professional skill development. The Figure 2 describes the LEAD-part principles.

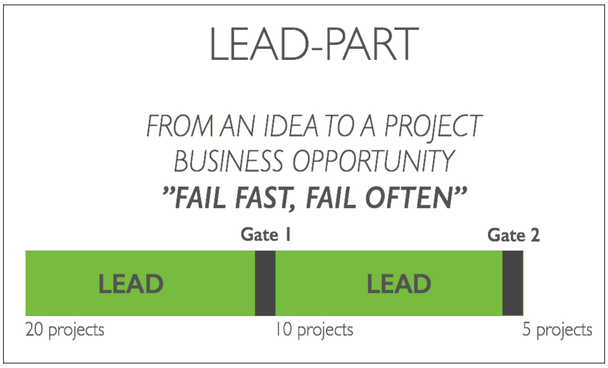

Figure 2. LEAD-part principles

As the studio education model pedagogically strongly relies on coaching, there are two kinds of coaches in LAB-model, Role Coach and Project Coach. The Role Coach is supporting the individuals' task in their project to succeed and also helping in their personal growth as professionals. The Project Coach task is to ensure each project results, and so act as an internal customer in the LAB. The Role Coach support in different parts of a LAB-model is described next.

The topics and skills taught during the LEAD-part focus on serving game concept development. Topics are taught through a combination of lectures, project work and coaching to prepare the individual teams' to work on their specific project development needs. The number of coaches working with a team ranges between 3 and 5 depending on the specific skill and training needs of the team and the nature of their product idea. In the case of game industry education, Oulu Game LAB, the training topics include Game Design, Concept Development, Game Business and Monetisation Models, Pitching and Presentations, Team Dynamics, Project Roles, Human Communications, Target Audience and Project Planning. Knowledge of all of these topics is needed for the game concept development and to successfully pass the Gate 2.

Teams are set at the beginning of the LAB-component of the programs in the DEMO path in order to focus on producing specific demos. In the LAB-part the roles of the production team are defined and the effort is put into the Demo production. The learning will happen by doing the actual demo, the role of coaches is to support both the learning and the project success. The amount of coaches will now rise to total of 11, covering the areas of Coding, Game Business and Funding, Game Sales and Marketing, Game Design, Graphical Design, Graphical Story, Game storytelling, Audio Design, Management & Leadership, Social Media, and Promotion. The coaches arrange weekly meetings with their students to be coached and handle the topics around the area of profession. Typically the coaching session starts by handling the common problems of the projects, continuing with wider topics that will effect to the projects outcome. The students are also encouraged to contact their coach if they have specific challenges relating any component within their project task.

The LAB-model, as the studio model uses a project-based learning (PBL) pedagogical method. Project-based learning is part of the instructional approach originating from Dewey [3], who stressed the importance of practical experience in learning. In real workplace settings, especially in game start-ups, skills such as decision-making, problem-solving, managing conflicts, team working and being innovative are important elements of job competence. Kloppenborg & Baucus [8] reiterate that many of skills learned through PBL are highly sought by todays' employers including the ability to work well with others and handle interpersonal conflicts, make thoughtful decisions, practice and solve complex problems. Kloppenborg & Baucus [8] also report on the learning outcome of students as manifested in their successful experiences gained in planning, managing, and accomplishing projects. Successful experiences include the ability to resolve conflicts through creative problem solving approaches and the accomplishment of a project that make them more aware of real life problems and issue. Therefore, PBL plays a significant role in exposing students to a meaningful learning process while they are engaged in completing their project.

An additional aspect of this pedagogical process is to allow learning-by-doing through project work. To ensure that each participant improves their skills, all students define a role in their team such that some students are project managers and producers, while other students work in a role more suited for their particular skill set (e.g. programming, graphic design). For example in the Oulu Game LAB the role of a student studying arts and music would be that of a graphical designer/composer. And the role of a business student would be that of sales and marketing. By having responsibilities in a certain role, students enhance their skills in that particular role. They also experience roles out of their primary discipline. In the Oulu Game LAB case, a coder can also be the musical artist for the team. This is done since the creative industries usually have relative small teams for the production and need to find all the usable potential from it.

Business and design decisions are made within each team based on their own needs necessary to achieve their specific team business and product goals. For example if there is a need for decision on some graphical elements graphical designers and producer do the decision. If on the other hand we need a decision on software architecture it is the job of the programmers and project manager. The added benefit of self-directive teams is that the student will learn entrepreneurial skills and attitude that they can later use e.g. when working in a start-up. This is further highlighted in the beginning of the LAB-education when the teams have to focus on the business opportunity of their case.

4 Oulu Game LAB

Oulu Game LAB (OGL) represents the first implementation of the LAB-model tailored for the game industry needs. Established in 2012 in Oulu, Finland, the mission for the OGL-education is to produce skilled individual professionals and self-directive teams targeting the game industry. As a practical evidence of outcomes, new game demos with verified business opportunity are produced, as well as new Game Start-ups. After the first two years of delivery, OGL has produced ten start-ups and 21 Game Demos, as well as produced 140 new skilled professionals for the need of game industry.

Oulu as an economical area has suffered for two years a significant structure change in the ICT-employment. As a result, Oulu Game LAB was originally established for a need of re-educate ex-Nokia ICT-professionals into new industry areas. According to statistics from the Oulu regional business association - Business Oulu, this change has translated into roughly 3500 unemployed ICT-professionals over the last five years. At the same time the game industry showed to be one of the promising industry areas within which these professionals could transition based on forecasted growth and new employment potential. According to the study made and initiated by the Business Oulu, there was also a clear need for the game professionals in local game companies.

In response, the OGL education was designed to meet the needs of the local game industry, as well as to take into account the skills set and knowledge profiles of the professionals in need of re-training. Since the training program was designed as multidisciplinary university students also entered the program and were included as supplementary team members. OGL offers 30 ECTS credits for participants and is considered as a special subject for the studies within the Oulu University of Applied Sciences.

The Oulu Game LAB curriculum consists of the previously described two paths, Demo Path and Product Path, or in the game industry case - Game Path. Enrolment to OGL is open to both regular university students and professionals outside of the university system. When new students apply to OGL they are invited to an interview, where the motivation and suitability for LAB-model studies are find out. All the selected students start in Demo LAB together with more experienced students who remain at the training location as alumni. The maximum number of students starting in Demo LAB is forty students per one four months study period. The number of the participants is defined by the students themselves and based on the needs to support well performing game production teams. To our experience all well performing game production teams are defined as a multidisciplinary and intergenerational, e.g. consisted from a producer, game designer, 1-2 SW-coders and 1-2 graphical artists. Part time tasks can be defined the roles of music and effect design, manuscript, promotion materials and marketing. The definitions of team roles are suggested by the coaches, but defined by the students, so that a student can choose the role most attempting for them.

4.1 Knowledge Creation in Oulu Game LAB

In order to explore how the Oulu Game LAB supports knowledge creation, we compared how the different aspects of knowledge creation identified in section 2 (presented in Table 1) relate to the studies in Oulu Game LAB. In the Table 2 the different aspects of knowledge creation are discussed in conjunction with the LAB-model.

Table 2. Knowledge creation in Oulu Game LAB.

Aspect	**Explanation how the LAB-model and the aspect relate to each other**
Socialization	Students work in joint office spaces together with more experienced industry experts and coaches. Sharing the common values of the LAB-model creates and maintains mental models. The practices and experiences of the game development and business are discussed and shared in formal and non-formal ways. Students visit game companies and they establish networks with and between the other professionals and disciplines in the weekly events, industry seminars and conferences.
Externalization	During the period of Concept Development (LEAD-part) the tacit knowledge of game development is transformed into explicit knowledge. The joint office space is organised into a relaxed office environment. In addition no NDA's are signed between companies and the students. All this, in addition to a trusted, open and relaxed atmosphere, is essential for having debate and creativity to produce new ideas for game concept development.
Combination	The LAB-model is looking for the student need of creating new knowledge. The teams and individuals are served with new information mostly on their need basis. After there's a need for explicit knowledge coaches are there to give guidance. The new knowledge is created to support progress of the game project. Also working closely together the students are reflecting their existing knowledge and experience against more experienced students or coaches.
Internalization	The combination of more experienced and younger professionals to work toward a common practical goal creates the Master-Apprentice team set-up and enables tacit knowledge transfer. Also the "Learning by doing" pedagogical method enhances the transfer of young professionals' explicit knowledge to tacit knowledge.
Intention	Project based learning and working method and focus on the game industry give a basis for truthful judging of new given piece of information. Students can justify and have criteria for knowledge based on the need for industry, also by the business need.
Autonomy	The LAB-model values are "Care and Trust". The trust is shown in practical level by giving students their own premises for their projects. The students define the rules for the premises and they are also encouraged to setup networking events there. The unexpected is enhanced by keeping the premises doors open to enable open development environment. Visitors are treated as resources, potential customers and source of new knowledge.
Fluctuation and creative chaos	The LAB-model simulates the establishment of a small company or start-up by its operation. The students define the premises rules and they modify the premises according the project needs. The routines and mandatory events are minimal, still there are different kinds of happenings just in the next door to the premises. The fluctuation is coming from the constant need of making better solutions and the supportive climate of change.
Redundancy	In each team there are people with specific roles (e.g. programmer, graphic designer, and producer). The LAB-model facilitates the utilization of redundancy by making students from different teams but with similar roles collaborate. For example, programmers have weekly meetings where they share the programming problems their teams have faced. These meetings are led by the coaches and the goal is to make the students solve the problems together. Since in these weekly meetings all participants have similar background and role redundancy helps them by making it easier to sense what others are trying to articulate.
Requisite variety	The presence of the professionals and the coaches, the usage of internet, practical game products, and the use of the university libraries are examples of the requisite varieties of knowledge creation. These offer flexible, quick and democratic ways to create knowledge. Also the multidisciplinary teams and their networks are a way to combine information quickly and creatively.
Justifying concepts	LAB-model includes the close co-operation with the industry. In practice giving ideas to be developed or problems to be solved, their participation to the coaching of the teams and judging student teams developed concepts do this. The concept justification is done in events, which are selecting the projects with most opportunity to be done to demos.
Building an archetype	LAB-model Concept Development part includes prototype development. The justification of the concepts requires a prototype to show the practical layout and user interface of the proposed solution.
Cross-leveling knowledge	After the Concept Development (LEAD) part the selected concepts and project teams move to Demo Development (LAB) part. This changes the scope of the knowledge to be needed. The more solution focused knowledge.

Ba	LAB's are established around a context, game industry. This selection of context has effect to the LAB-model and the spaces. The context is also the key motivation to perform, "love for the context".

5 Discussion and Conclusion

By looking at the Table 2 we can see that overall the LAB-model offers support to a number of key aspects related to knowledge creation as defined in the information systems literature. In fact learning-by-doing seems to fit really well both the SECI-model and others aspects related to knowledge creation. In fact this would indicate that from knowledge creation perspective utilizing the LAB model is promising. The more we can get the students to actually work on actual projects the better it is for knowledge creation.

If we critically look that the LAB-model, it will be a challenge to find suitable location for the LAB, and find coaches with relevant knowledge. Optimally the LAB is based in a physical place that stimulates a start-up mentality and allows the LAB participants s to interact with non-students from a particular industry. This way there will be a lot of informal learning since the formal university environment and the industry environment are closely connected in this model. Also the coaches have to be familiar with the model in order to be of use to the students. If there are many teams with many different problem domains this can be a challenge. It is difficult to find a teacher who can coach iOS, Android and Windows Phone development all at once.

In this paper we presented the LAB-model for higher education. We also investigated how the LAB-model supports the SECI-model of knowledge creation as well as other aspects related to knowledge as identified by literature. We provided a case study of Oulu Game LAB – an example implementation of the LAB-model. We evaluated the Oulu Game LAB both theoretically and by collecting data using a survey among the students of the Oulu Game LAB. A preliminary hypothesis is proposed suggesting that LAB-model and similar models provide effective support for knowledge creation in comparison to other higher education studio training models.

With potential implications for higher education programming, it is suggested that the LAB model can be established in additional industry contexts beyond the game development industry. In order to determine if the LAB model is significantly more effective than other studio models, future research should be conducted on the LAB-model to provide more understanding on both the LAB-model and its support for knowledge creation purposes.

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