

Knowledge management in an ICT classroom: an agile group dynamics for innovative teaching and learning

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Abstract

This paper was an attempt to investigate agile group dynamics and knowledge sharing in an ICT project classroom. The paper furthermore explains how agile group dynamics influence logical reasoning and information processing capabilities of project team members.

This research was based on a qualitative, action-research approach. Twenty students at an institution of higher education expressed their experiences of agile project dynamics. The sample was selected using a purposeful convenient sampling method. The data in the ICT classroom were collected by means of semi-structured interviews, the hybrids of formal interviews and observations.

Findings highlighted some agile methods and techniques (adaptive innovation agile strategies, conceptual mapping, telling and predicting, communication skills, entrepreneurial initiatives, show time, agile planning, discipline of dialogues,) that were successfully applied in the ICT classroom. Findings indicated the positive influence of agile group dynamics on learners' information processing, reasoning skills and knowledge sharing.

In the promotion of students' concurrent thinking and knowledge sharing appropriate attention should be given to a multidisciplinary agile group dynamics within the ICT classroom.

Keywords: knowledge management, agile methods, agile group dynamics, ICT classroom, entrepreneurial initiative

1.1 Introduction

Lindvall, Basili, Boehm, Costa, Dangle, Shull, Tesoriero, Williams & Zelkowitz (2002) define agile methodologies as a group of software development processes that are iterative, incremental, self-organizing, and emergent. The word iterative is derived from iteration which carries with it connotations of repetition. Incremental means each subsystem is developed new release. As the development progresses, the usable functionalities increase until a full system is realized. The term self-organizing introduces a notion to the management. The emergent nature of agile methodologies means that agile software development is in fact a learning experience for each project (Bodje & Balaji, 2012:23).

Agile methodology as a new paradigm has been researched and now recognized as a successful strategy for growth in the ICT/Software engineering field (Nagel & Dove, 1991; Dove, 1994; Sharifi & Zhang, 1999). Methodology is the collection of philosophies, phases, procedures, rules, techniques, tools, documentation, management and training for developers of software products (British Computer Society).

It is assumed that teachers in an ICT classroom as project managers have no in-depth conceptual and procedural knowledge (McCormick, 1997). In the content of technology McCormick notes that “it is the possession of conceptual knowledge that makes possible the effective use of procedural knowledge of problem solving”. This requires an effective knowledge management and knowledge sharing in the ICT context.

Leontyev (1981) defines three different levels of learning actions throughout the completion of a learning task such as skill based action, rule based action and knowledge based action. However, at the knowledge based level there is a need for a feedback control. It is possible that a feedback control is not efficient in ICT classrooms. With a feedback practice learners’ could recognize their mistakes and this improves their performance for future tasks.

Knowledge sharing and transfer in the ICT project environment need to be assessed as agile methodology could offer innovative inputs into the project group dynamics. Practice show that ICT project teams use poor knowledge sharing techniques (Granath & Hinnerson, 2002; Wennström & Eriksson, 2006). Teachers are unsure how to approach project planning using agile planning strategies and how to guide the cognitive, emotional and creative aspects of the learners. In addition, in terms of learning, experiential inquiry and guided participatory learning is seldom observed in ICT classrooms. Highsmith (2004) states the importance of informal communication through agile group dynamics.

The question is how do agile project environment empower logical reasoning and information processing capabilities of ICT project team members? “How can we improve the transfer of competence (skills, knowledge) between learners in ICT classrooms?”

The focus of inquiries in this research paper will be the facilitation of agile group dynamics in an ICT classroom which serves as a vehicle to cater for human limited information processing capabilities (Miller, 1956; Sheridan & Ferrell,1974; Neerincx, 1995) and a lack of logical reasoning in the ICT area (Mende, 2005, 2006). Furthermore, the paper examines the way in which tacit knowledge is shared in the ICT project-based environment. The guiding research questions therefore are:

1. *How can agile project planning engage individuals in innovative knowledge sharing?*
2. *How do agile methods and techniques influence the extent of knowledge sharing within the project group?*
3. *How do agile group dynamics influence logical reasoning and information processing capabilities of project team members?*

This paper strives toward giving some evidence how knowledge sharing within an agile and innovative ICT classroom has generated advances in our understanding of learning and teaching processes that can dramatically improve and change the processes and outcomes of learning and teaching.

1.2 Theoretical Background in Building Agile Project Dynamics, and Innovative Teaching and Learning Within an ICT Classroom

1.2.1 Agile philosophy in teaching and learning

There is the fundamental distinction between traditional practices and agile software development approaches. The focus of agile approach is on concurrent thinking (Ambler, 2002; Highsmith, 2004).

Concurrent thinking focuses on what is to be made/created and what works in small increments so that feedback along with learning can improve the results as rapidly as possible. Traditional approach favours sequential thinking (Ambler, 2002; Highsmith, 2004). This approach focuses on the activities presumed to be necessary to produce a result and assumes that one has nothing to learn so that each activity can be completed in sequence.

Agile methods relate to managing the development of software, which is based upon obtaining early client feedback and frequent software releases (Beck, 1999). Due to the complexity of agile methodologies the focus on human aspects in terms of knowledge transfer is not clearly understood and it is usually very vague. Project managers' are not adequately trained with regard to the human aspects side (Rauterberg & Felix, 1996a; Rauterberg, 1996b) as well as how to manage knowledge transfer (Highsmith, 2004).

Teachers as project managers are unsure how to approach agile project planning. Consequently, they neglect the cognitive, emotional and creative aspects of the workforce (Highsmith, 2004) which could lead to project failure (Keil & Robey, 1999).

Agile philosophy requires people to be well versed in various integrated themes of system development life cycle (SDLC) through creative knowledge sharing. Teachers and project teams must be equipped with the necessary agile skills and knowledge to make the paradigm shift and focus on human aspects. Principles of learning (Jakovljevic, 2002; Mende, 2006) can be applied in the ICT project environment as it is necessary to pay attention to agile 'ecologies of practice development'.

1.2.2 Knowledge management and learning

The key concerns of knowledge management are, effective and efficient knowledge processes, as well as supporting learners' creativity and innovation. Knowledge management enable individuals and teams to systematically capture, store, create, share and apply knowledge, to better achieve their ICT project objectives.

There are four different types of knowledge: factual, conceptual, procedural, and meta-cognitive. Real-world problems that necessitate a project based environment may require procedural knowledge; but it should also require factual, theoretical and meta-cognitive knowledge. Many teachers do not provide enough opportunities for students to employ their meta-cognitive skills knowledge about the innovation processes; they don't encourage the students to reflect on their own learning and thinking processes.

There is no systematic approach to sharing of knowledge in an agile project environment Liebowitz (2004). Apostolou and Mentzas (2003) developed the Know-Net knowledge management (KM) approach, which includes the interplay among strategy, assets, process, systems, structure, individual and teams. This interplay is not clear in an ICT project-based environment.

1.2.3 Tacit knowledge sharing in an agile project environment: Learning approaches in an ICT project environment – from 'cascading' to focused human practice

There are two types of knowledge namely explicit (that exists typically in documents, databases and as part of processes) and tacit (embedded in people and their experience) (Evans, 2003: 17).

Tacit knowledge is a source of competitive advantage because it is hard to replicate by its competitors. Knowledge creation is a process of communications between explicit and tacit knowledge.

The strength of students' knowledge activities lies in the transfer and integration of tacit knowledge through activities such as project estimation, quality assurance, identifying sources of ideas and innovation. Especially interesting is learning in professional contexts because it is predominantly informal and may represent a metacognitive process about teaching practice and teaching activities in the classroom (Gola, 2008).

There is no knowledge sharing in an ICT classroom independent of metacognitive processes, social and cultural context. Through social networks the individuals receive, evaluate, and return knowledge. People are unaware of the tacit dimensions of their knowledge or are unable to articulate them. It is difficult to share tacit knowledge (actions, procedures and routines) as it requires a kind of 'simultaneous processing'. Knowledge can be shared and integrated through a network of social interactions, for example communities of practice and electronic documents. Codified knowledge can be protected to some extent by patents, copyright and trade secrets.

Team members 'cascade' the knowledge and understanding to other team members. The cascade model has been widely scrutinized as an inadequate model for delivering effective information (Anderson & Holt, 1996). Cascading of information is watering down and/or misinterpretation of crucial information between different ICT teams.

Leontjev (1981) explained the crucial difference between an individual action and a collective activity. It is interesting to see that the activity theory provides some insight into tacit knowledge and information systems development (Korpela, et al 2000). The activity is socially mediated: consciousness and meaning are always formed in joint, collective activity (Leontjev, 1978; Hacker, 1994) through knowledge sharing.

In terms of learning, experiential inquiry and guided participatory learning is seldom observed in practical ICT settings (Frese & Sabini, 1985; Salomon & Globerson, 1987; Frese & Zapf, 1994; de Vries & van der Meij, 2003). Mind shift is necessary as the team-based approach is not always successful.

1.2.4 Knowledge management for innovation in the ICT classroom

Few teachers and learners in institutions of higher education have experienced teaching, learning and managing knowledge with regard to innovation skills that refer to creating new ventures, markets or products with new technologies. The innovative process is a set of steps and activities focusing on the transformation of an innovative ability into innovative performance (Drucker, 1993).

The human inclination towards fragmented knowledge, caused by information-processing incapability, is an obstacle to innovative practice (Jakovljevic, 2002). This can be solved through cognitive and practical apprenticeship that indicates knowledge-sharing between experts and novice learners through observation of practice (Collins, Hawkins & Carver, 1991; Brown, Collins & Duguid, 1989).

Educating learners about homological transfer can widen their interest for knowledge transfer and learning. Mende (2006) pointed that an innovative practice in one discipline could be transferred to

another discipline through homological transfer. Managing the creative process of learners is critically important for teachers as they have a role to play of both sensing and signalling where creative attention should be focused. The teacher possessing four dimensions of creative intelligence (Jakovljevic, 2012) has the opportunity to empower learners with a desire for inventions and innovation.

1.2.5 How to create an innovative climate within the ICT classroom?

Learners have to recognise the particular times of day that are especially conducive to focus on creative work. The appropriate time, familiar objects, surroundings and other stimuli are associative triggers for innovative states of mind, but these differ among learners (Jakovljevic, 2012:in press). It is necessary to pay attention to key elements to unlock creative inspiration, such as: discipline, routine for creative work, one's own efficiency/construction system and spontaneity (McGuinness, 2011; Allam, 2008).

An innovative ICT classroom is a secure environment with an innovative teacher where the biggest enemies to creativity (fear of critics, ridicule and retrenchment) have been removed. In an innovative ICT classroom learners should develop a 'personal innovation plan' aimed at achieving a better understanding of their own creativity through self-awareness of future project challenges (Jakovljevic, 2012).

In an innovative classroom teachers can plan many activities, for example, developing an invention idea, brainstorming for creative solutions, practising the critical parts of creative thinking, completing and naming the invention and generating marketing activities (Bis, 2009; Jakovljevic, 2012). In an innovative ICT classroom learners could chart the lifecycle of the typical innovative start-up project and explore innovation at each stage of development from product design, development through to manufacturing, financing, marketing and sales. Good communication, risk-taking and a free learning atmosphere that includes trial-and-error brainstorming can stimulate the development of knowledge sharing and an agile project environment (Jakovljevic, 2012).

1.2.6 Knowledge sharing: An agile group dynamics and entrepreneurial initiatives

It is impossible to carry out all project activities if there is a lack of interdisciplinary teams, enthusiastic teachers and experts from industry. Multidisciplinary teams have been on the rise, who can solve problems from different perspectives (Svoboda, 2006). Students, the teacher and external professionals are aiming to share and transfer knowledge on creativity and innovation from multidisciplinary viewpoints.

Project teams are not always solutions, as there may be personal disagreements, weak engagement and poor management of the innovation process. According to Cavan (2007) at Sheffield Hallam University, projects in schools are guided by a network of advisers, subject associations and mentors (Jakovljevic, 2012).

Allowing individuals to self-select projects they see as opportunities either to accumulate or to create knowledge is vital for the knowledge enrichment (Felin, Zenger & Tomsik, 2009). Teacher should motivate learners to pursue entrepreneurship within their profession and to harness "functional" creativity within an entrepreneurial initiative (Jakovljevic, 2012). Thus, an innovative ICT classroom depends on a wider knowledge-sharing environment with project teams that are transforming themselves into entrepreneurial ventures.

Within agile group dynamics learners develop curiosity such as investigation, exploration, and learning to find out new entrepreneurial hidden ideas. There are planned and a well-established learning strategies within agile project teams. Learning strategies are divided into cognitive strategy (acquisition, structuration and using of knowledge), cognitive and metacognitive strategy, motivation and emotion strategy, cooperation strategy (Baumeister & Leary, 1995).

1.2.7 Agile planning: communication in an agile environment

There is a need for agile planning, execution and controlling in a systematic manner. Teachers are not acquainted with adoption of agile methodologies in learning and teaching practices in the ICT context.

Agile methods are a departure from plan-driven traditional approaches, where the focus is on generating early releases of working software using collaborative techniques, code refactoring, and on-site customer involvement (Mahanti, 2006). However, there is no agile methodology that can be universally applied and have to be tailored to integrate into existing processes (Mahanti, 2006).

Communication is an essential skill in the project management and it is often listed as one of the most needed areas for improvement. Much information needs to be communicated on a regular basis to all major stakeholders, including project expectations, goals, needs, resources, status reports, budgets and purchase requests.

Informal communication is particularly important during casual meetings in an agile project environment that refrain from a clear and concise communication plan to address project responsibilities. To ensure timely and appropriate generation, collection, distribution, storage and retrieval of project information there need to be frequent and short informal communication sessions.

1.3 Methodological Framework

1.3.1 Research approach

The qualitative, action research approach was adopted for this study seeing that the learning experience of students' is being investigated in relation to a specific event in a bounded context (Creswell, 1994, Yin, 1994; Walsham, 1995; Merriam, 1998; Leedy, 2005). The action research was applied to concurrently create and examine changes during the design and development of an ICT system with innovative agile methods and techniques.

The necessity of improving knowledge transfer, reasoning and information processing skills of learners in the ICT context requires an action research paradigm. Action research is an iterative process with five phases: diagnosing, action planning, action taking, evaluating, and specifying learning (Baskerville & Wood-Harper, 1996, p. 238; Baskerville & Pries-Heje, 1999). The researcher was thus in a position to diagnose, plan and implement different agile methods and techniques as the process of a system design progressed.

The teacher recognised the problems of teaching software design skills. Through the action research process of diagnosing, action planning, and action taking a variety of agile methods and techniques were implemented in the ICT classroom.

1.3.2 Profile of the students

In this study twenty students from mixed cultural groups were identified, at a tertiary institution. The students' were grouped into five teams, with four students in a group. Thus, respondents presented a purposive convenient sample as they were readily available and inexpensive to this study (Merriam, 1998; Patton, 1990; Saunders, Lewis & Thornhill, 2003, Creswell, 1994). According to Merriam (1998) the most appropriate sampling strategy in qualitative research is non-probabilistic. The most common form of non-probability sample is called the purposive sampling that includes convenience sampling. It usually consists of available subjects or volunteer subjects (Merriam, 1998).

The researcher of this study coordinated design of ICT projects. Students had to submit four deliverables at a defined time frame: project proposal, high-level analysis, detailed analysis and design and prototype.

1.3.3 Data Collection Methods

The primary data was collected by means of semi-structured interviews and the hybrids of formal interviews (dyadic interviews; group discussions). Informal discussion-type interviews yield data that are easy to align with observation data (Kumar, 1999). The interviews were conducted to explore, identify categories and the core aspects relevant to KM, innovation and agile methods in the ICT educational setting. Furthermore, recall discussions were performed in which a team-project manager was shown a recorded session extract and then he was asked questions about instances in action. In this form of data gathering, some cultural and contextual details emerged.

The systems analysis and design processes were *observed* in formal and informal observation sessions. The researcher was present in different meetings (releases, quick wins) and other forms of interaction, so as to observe, record discussions and events. Next, all available artefacts produced were utilized for analysis. These include templates, agendas for macro releases, work plans, control reports, design documents and so forth.

1.3.4 Intervention and setting

The purpose of the study was to provide an exploratory analysis of students' and the teacher experience within an agile project environment. An exploratory study looks for patterns, ideas or themes.

An agile dynamic environment was created for an ICT module entitled "Software Engineering". An objective of the project-based course was for students to gain experience in software design, agile methodologies, and problem-solving methodologies. The class met weekly for two hours over 10 weeks. The students formed project teams of 4 members in each team.

Team groups were given a project brief of 'Assume you work within a company with a focus on producing innovative mobile devices for old age homes. The manager has asked your team to design a software product to improve nursing care in old age homes'. The students created a prototype of their new software product and presented that prototype as a final product. The students were taught all major topics of software product design process.

Students had 15 minutes task to present their project idea to an expert board of ICT professionals and educators. The expert board evaluated project ideas that resulted in the selection of a winning concept to move forward with by testing the ideas with clients in a real-world business environment. The project was evaluated against the following requirements:

1. The use of agile methods/techniques to underlie tasks undertaken, and a demonstration that methods were used
2. The completion of each project deliverable in an innovative way
3. The degree of novelty originality and technical application of the project deliverable.

The following learning aspects in the ICT classroom were diagnosed as problematic: understanding of programming techniques, understanding of a traditional system design and standard data flow diagrams. Changes in the application of agile methods were subsequently planned, and the following agile methods and techniques were implemented through action research approach and evaluated by the learners and the teacher: innovation agile strategies, conceptual mind-maps, telling and predicting, communication skills, entrepreneurial initiatives, show time, agile planning, discipline of dialogues and activity reports.

Agile methods and techniques were applied in an organized manner with the support of learning theories. These methods are better utilized if they are integrated within appropriate instructional strategies such as experiential inquiry and guided participatory learning in the ICT classroom.

Within the agile project environment students developed conceptual mind maps that assisted in product design. The researcher instructed students how to draw/construct a map (usually on paper in a form of conceptual map or using software) that shows the route of the 'heart' of the issue. Conceptual mind maps assisted learners in developing strategic thinking necessary for requirement engineering (Jakovljevic, 2002; Mishra, 2010). The concept mapping helps in representing the logical structure of the intended information system with input, processing and output elements placed in the visual field of learners. The purpose of the concept mapping is to visually depict procedural knowledge pathways.

Students were trained how to write project activity reports and agendas for short project sessions. Students were taught how to engage in entrepreneurial initiatives. Teacher instructed team members how to apply *telling and predicting methods and dialogues*. A reporting method/device elects details of 'yesterday, today and tomorrow' arising from the need to 'look into the future'. People are notoriously bad in predicting the future.

1.3.5 Data Analysis Methods

Analysis of data consisted of examining, finding patterns, themes and constructing categories (Yin, 1994; Merriam, 1998). According to Merriam (1998) qualitative research focuses on processes, meaning, and understanding, the product of a qualitative study is richly descriptive. Words and pictures rather than

numbers are used to convey what the researcher has learned about a phenomenon (Merriam, 1998). 'Survey research may or may not be the best research method to analyze the impacts of agile methods, in lieu of qualitative methods, which yielded richer experiences' (Bodje & Balaji, 2012: 23).

A constant comparative method was applied which includes comparison of data within interviews and between interviews. The constant comparative method involves comparing one segment of data (interview and observational data) with another to determine similarities and differences. Data were grouped together on similar dimension. This dimension was tentatively given a name. The patterns in data were arranged in relationships to each other in the building categories (Creswell, 2008). In addition, the qualitative data analysis was conducted largely by the way of content analysis in grounded theory mode (Kerlinger, 1992; Merriam, 1998). In this way data was systematically grouped into units of meaning and ultimately summarized in thematic patterns.

This study is characterized by the use of two different data sources, the teacher and the students, and multiple data gathering methods. In addition, according to the peer/colleague examination and the researcher's awareness of biases, these aspects of data collection and analysis contribute to the reliability of this research (Creswell, 1994; Yin, 1994). A rich and extensive description of the phenomena that is studied, contributes to the external validity of this research (Merriam, 1998). The qualitative work with its narrative and ethnographic character does not veer from the criteria for data-integrity and researchers intellectual honesty.

Necessary preparations were performed to improve essential competence in the field, which included the clarification of biases and assumptions (LeCompte, Preissle & Renata, 1993; Creswell, 1994).

Interview transcripts and observational protocols contain raw data that were analysed using qualitative analysis methods (Merriam, 1998). Presentation of raw data from interview transcripts and observational protocols are beyond the scope of this paper.

The next sections endeavour to present the findings based on students' and the teacher's feelings and thoughts regarding the application of agile methods and agile group dynamics in the ICT classroom gathered through the discussion-type interviews, group discussions, observations and documents analysis. Thus analysed data in a form of categories and corresponding evidence for devised categories is presented in the following section.

1.4 Findings

1.4.1 Findings regarding students' and the teacher experience of agile project environment in the ICT classroom

At the end of the project the researcher evaluated students' views on the usefulness of the agile methodology. The four categories emerged:

- A. *The use of conceptual mind maps simplified the overall assessment of the intended system empowering students' knowledge transferring in the ICT classroom*
- B. *Entrepreneurial initiatives initiated enthusiasm and innovative climate in the ICT classroom*

- C. *Planning frequent short time meetings with dialogues positively influenced students' detection and correction of reasoning errors in a system design*
- D. *Frequent project reporting in a form of 'yesterday, today and tomorrow' telling and predicting feedbacks encouraged information processing capacity of learners and project outputs.*

The following paragraphs present evidence related to the students' and the teacher's experiences with regard to agile methods and the agile dynamic environment.

The students felt working through the agile project environment gave them a good experience of the design process. One student said *"The project provided me with a practical experience that otherwise I would not have gained just by traditional design environment"*.

The students felt that the way the project tasks were organized and how design process was aligned with the agile project management helped them to get a better understanding about how to apply knowledge sharing, problem solving and thinking in an innovative way.

The comments regarding concept mapping were recorded during the interviews with students'. *"...I cannot follow flowcharts...I prefer maps...it gives me an overview of the whole system and its components ..."*

The teacher made the following comments observing students: *"...Through recurrent short meetings students exchanged their comments that influenced their detection and correction of logical errors in system design...they enjoyed planning 'short time' meetings..."*

Observations notes indicated that a wide communication network in a real-world environment enhanced students' knowledge sharing and system design skills, *"... Students were thinking reflectively, clearly applying their cognitive skills at an appropriate level of complexity"*.

Observational notes also revealed: *"During frequent communication sessions with experts from industry students were inspired with regard to entrepreneurial initiatives in the agile project environment. This was visible during the project presentations. Each team formed a company with company colours, business cards and posters."*

One student commented during the interview *"... marketing, it is a good idea...I am getting valuable experience... Another student reported during the interview "it went well during quick project deliverable releases ...we need a networking with businesses ...we like this kind of knowledge sharing"*.

The teacher commented in the observational protocol: *"...the students' expressed their dedication and excitement in finding a solution to a real-world business problem... During the technical assessment of the*

systems, team members clearly shared their client-based business experience and knowledge they learnt in the real-world business environment”.

Furthermore, students commented in the interview that *“...having links with the real-life environment, we could exchange ideas, ask questions, observe and use some business documentations... ”.*

Students also commented during the interview, *“communication of requirements across stages needs frequent short meetings ...there are too many details and errors ...I forget easily what happened earlier ... now I can think deeper”.*

Students named these sessions as ‘yesterday, today and tomorrow’. The activity report provided a full accounting for all software changes, additions, and comments made by each team member. Teacher’s comments indicated that *“...Discussions and brainstorming sessions were true reflections of students’ knowledge sharing processes... recurrent reporting in a form of ‘yesterday, today and tomorrow’ project state and activities positively influenced students’ information processing capacity”.*

The transfer of innovative ideas and knowledge skills during frequent face-to-face communication sessions was also evident in the analysis of project documentation.

1.5 Discussion

The above findings indicate some key aspects of the agile innovative project environment that may influence the motivation of learners to undertake knowledge exchange activities in the ICT classroom. Agile methodologies offer flexibility; students can meet often for a brief session in an informal way. In addition, agile methods and planning were particularly beneficial to improve communication and understanding of requirements. Thus, creating an agile project environment was an opportunity for students to share information in an innovative way and empower their logical reasoning and knowledge sharing. Perhaps their memory wasn’t overloaded within agile group project dynamics.

The findings indicated that agile group dynamics could be a promoting factor for productive concurrent thinking, information processing capability and problem-based learning. The frequent short sessions, and working closely with experts from industry were some efficient learning strategies. Students had the opportunity to create variety of activities in their internal agile environment which ultimately leads to the emergence of novelty and the creation of new knowledge and innovation.

While students were exposed to different modes of learning, they were able, through an informal learning environment, a face-to-face communication, in discussion groups to improve their desire for innovation. Thus, students fulfilled the knowledge management cycle such as knowledge identification, knowledge generation, knowledge codification, knowledge storing, and knowledge sharing and knowledge application. Students feel confused in the object-oriented software design with complex maps of use cases due to the nature of human limited information processing (Graham ,1994; Blaha M & Premerlani ,1998).

However, some cultural and contextual aspects emerged. Few students didn’t want to transfer their knowledge to other team members either because they didn’t see any benefit they would gain by doing

this, they didn't know how to include this process in their work, or simply because they would rather devote their time to their own tasks that bring them tangible benefits. Perhaps, there was a need for a sustained practice in an undetermined time frame.

By building on experiences from previous projects, project estimation and quality assurance can be perfected. To facilitate knowledge sharing it is necessary to highlight the importance of frequent personal interactions that include meetings with industry experts to discuss new project ideas. Teachers' ability to innovate is visible through their enthusiasm to create an entrepreneurial environment that is particularly evident through its well-established agile learning culture.

The results of this study and features are tacitly in line with the philosophy of agile methodologies and KM processes ensuring the integration of major aspects and their ordered flow within an agile project environment.

1.6 Conclusion and Recommendations

The following conclusions and implications for learning and teaching in an ICT classroom can be drawn from this inquiry:

- Some agile methods (innovation agile strategies, communication skills, entrepreneurial initiatives, show time, agile planning, discipline of dialogues, conceptual mind-maps, activity reports) sets out a foundation to assist in innovative knowledge transfer within the ICT classroom. These methods could assist in the formulation and design of a possible new integrated software development approach.
- Agile methods support a structured approach in systems analysis and design. Agile methods resemble human information processing thus minimizing memory overload and increasing the quality of logical thinking.
- Experiential inquiry and guided participatory learning in ICT classrooms are powerful instructional methods to improve group dynamics and knowledge sharing and transfer.
- In the promotion and enhancement of students' concurrent thinking and problem solving skills appropriate attention should be given to a multidisciplinary agile climate within the ICT classroom.
- Designing a systematic and innovative learning environment within an agile project dynamics can help students to develop their conceptual and procedural knowledge (McCormick, 1997).

Because variations in agile methods implementation were not assessed, implementing and re-evaluating the agile methods by the teacher and learners could contribute to a more accurate conclusion regarding specified learning in the ICT classroom. Future research could highlight innovative methods for building agile project dynamics as well as barriers for cognitive, emotional and creative aspects of learners in the ICT context.

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