Meta-Analysis Of Nonaka & Takeuchi's Knowledge Management Model In The Context Of Lifelong Learning

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ABSTRACT:

Recently the application of Nonaka & Takeuchi's organizational knowledge management SECI model for learning has been studied a lot in different settings in learning contexts. A survey-type of study about SECI model is needed for getting better insight about practical aspects of application of the model, also in teacher training context. Study analyzes with qualitative meta-analysis the state of art of using SECI model from 20 research papers. For data analysis an open-ended coding matrix was developed to delineate each study's purpose, method, learning settings, outcome and technological aspect. Meta-study revealed that SECI is mainly studied in organizational level in the industries' settings and individual learning has not been in the focus. As a result the paper discusses the main findings of SECI meta-study in teacher training context and proposes a concept of cross-organizational SECI activities that may support teachers' lifelong learning and professional development.

Keywords: *SECI model, Teacher training, Organizational learning, Lifelong learning*

Introduction

In today's knowledge society, a firm understanding of the interplay between the management of knowledge and learning is strategically important for creating and maintaining effective learning processes in a large variety of non-traditional learning situations (Lytras et al., 2005). According to Grace and Butler (2005), Zuboff (1988) argues that learning, integration and communication are becoming key to leveraging employees' knowledge. Learning in workplace and informal learning settings could be supported with knowledge management models. Systemic approach to learning, knowledge construction and knowledge management in organizations should be useful for achieving the learning organizations. Such systematic approaches are for example double-loop learning (Argyris, 1977) and the knowledge management model in organizations (SECI model) (Nonaka & Takeuchi, 1995). Argyris (1977) proposes the double loop learning theory, which supports the idea that individuals need to adapt themselves to the changing environmental conditions and thus increase organizational responsiveness.

Another relevant system model, that could actually integrate reflective double-loop learning, is the model of a knowledge spiral developed by Nonaka and associates (e.g. Nonaka and Takeuchi 1995; Nonaka et al. 2000). The SECI model has been broadly accepted, especially among management practitioners, due to its intuitive logic and clear delineation of knowledge types between tacit and explicit knowledge, although due to the heavy employment of philosophical elements in the SECI framework makes empirical research in the area difficult (Rice & Rice 2005). This study analyzes SECI not because of its broad use, but because it has been used in several empirical studies and model describes the cognitive organizational processes and associates them with activities that are potentially observable. Lastly SECI model handles the knowledge as something that changes cyclically and is influenced by organization and individuals, not as knowledge that is transferred from one to other.

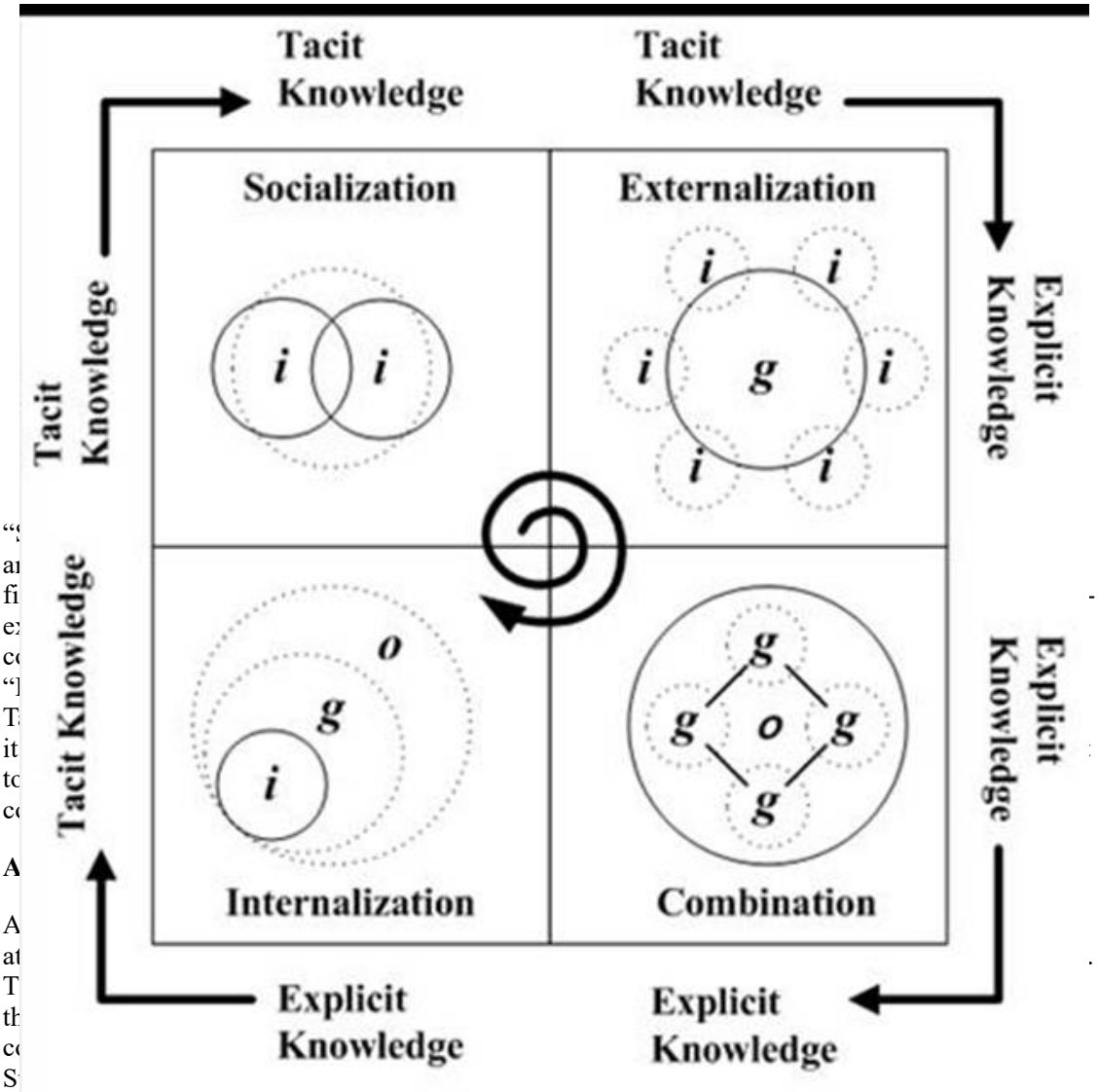
Yeh, et al. (2011) have said that knowledge management has not been applied in teacher training programs on numerous occasions. Same time they suggest that knowledge management could be implemented in teacher training context because it supports focusing on helping teachers to identify, create, represent, distribute, and enable the adoption of good teaching practices in collaborative settings. They believe that SECI model could be useful for teachers' professional development. But as there has been limited research to validate the SECI model and empirical research involving SECI is even rarer (Haag, 2010), especially in educational settings and within the context of multi-organizational settings, then the usefulness of SECI model in teacher training context grounds more on assumptions. Therefore the aim of this study is to investigate:

- What kind of different aspects (for example individual and organizational learning aspects, technological aspects) have been analyzed in different SECI-related contexts?
- How the application of SECI model has been methodologically studied?
- What aspects of the SECI meta-study could be transferred to teacher training context?

With the result of conducted meta-analysis we propose the underlying mechanisms that could contribute to the successful knowledge management based teacher training for supporting teachers' lifelong learning and therefore influencing the knowledge of teacher education being cyclically updated.

SECI Model

For describing processes in creative organizations, Nonaka and Takeuchi (1995) have developed the cyclical knowledge management model, which contains four phases of knowledge conversion within an organization: socialization, externalization, combination and internalization (SECI phases). They propose that in organizational knowledge-creation, personal subjective tacit knowledge has to be externalized into objective explicit knowledge in order to be shared, combined and synthesized within and beyond organizations. Model describes how explicit and tacit knowledge is generated, transferred, and recreated in organizations (see Figure 1).



knowledge theorists, who believe that knowledge can be treated like a 'thing' that can be possessed and understand knowledge creation as a system. Stacey, argues that knowledge is not a 'thing' or a system but an active process of relating. He also claims that knowledge cannot be managed, and there is no need to manage it, because knowledge is participative self-organizing processes patterning themselves in coherent ways. Haarmakorpi & Melkas (2005) responded to that comment that in newer writings, Nonaka and his colleagues underline the importance of understanding the dynamic process of knowledge creation that contains an interplay between explicit knowledge and tacit knowledge (Nonaka et al., 2001). Despite of the criticism related with SECI model, it has potentials to be useful knowledge conversion model in different contexts and therefore it should be studied in what circumstances the model could be used in educational settings and for example supporting teachers' lifelong learning.

Methods

Qualitative meta-analysis was conducted for synthesizing the theories, methods, and findings of both qualitative and quantitative inquiries of application of SECI model. Glass (1976) have described the meta-analysis as the analysis of analyses - the statistical analysis of a large collection of analysis results from individual studies for the purpose of integrating the findings. Qualitative meta-analysis basically follows the same, replicable procedure of a quantitative meta-analysis, but

is more interpretative than aggregative. Instead of a statistical data analysis, texts are analyzed for developing new interpretations in the analysis process. Reis et al. (2003) have said that although meta-analysis of quantitative research is a well-established technique, the synthesis or aggregation of qualitative studies remains rare and controversial. Therefore, they claim, that questions of feasibility, validity, study selection, mechanism, and interpretation are usual.

Data Collection

A set of criteria was specified to select appropriate research for this study (Slavin, 1986). Preliminary criteria included:

- Content relevance - research focused on the application SECI model in the context of learning
- Year of publication was 2003-2011
- English-language publications

The data search was systematic within the data pool consisting of electronic databases (i.e., EHIS, ISI Web of Knowledge, ScienceDirect, SpringerLink, Taylor & Francis databases) that were accessible by the author. A total of 58 studies were reviewed for this analysis and 38 out of them were excluded:

- 23 studies were either development articles that described the proposed design of application of SECI model or discussion articles that described opinions of implementing SECI model without empirical or systematically presented evidence;
- 15 of reviewed studies focused on analysis and comparing several knowledge management models, including SECI, and the evaluation framework of learning did not focus on only SECI phases.

Meta-analysis included analysis of purposes, learning settings, technological aspect, methods, and findings. These aspects were analyzed by one researcher for getting insight why and how the SECI was implemented and studied, how was the learning process organized and if it was technologically supported (individual and/or organizational) and what were the SECI related results of implementation process. Such aspects allow to analyze how the individual and learning aspects could be studied in teacher training context, but also what other aspects should be considered in the implementation phase. An initial open-ended coding matrix was developed for studied aspects. In the next phase the synthesis of implications and results was performed.

Lincoln and Guba (1985) have suggested that in qualitative studies it is important to assure the credibility, transferability and dependability in order to reach the “emphatic neutrality” of the research. It means that it is not important to have large sampling, but rather the richness of information and researcher’s ability to interpret the different types of collected data. In this study the different type of data was collected among existing studies and the results have been interpreted to the teacher-training context. Transferability means that in the qualitative studies the generalizations should be able to transferred to different contexts as well. Therefore the general findings of this meta-study can be used for understanding how the SECI model have been used in different organizational settings, how the individual and organizational learning aspects have been analyzed and what general aspects should be considered when implementing SECI in organizations.

Results

This section presents answers to the research questions of this study.

What kind of different aspects have been analyzed in different SECI-related contexts?

Meta-analysis analyzed the contexts of SECI model, used methodologies in SECI studies, role of technology in the implementation process and the focus of learning settings (individual, organizational or cross-organizational). Figure 2 illustrates the results of the meta-analysis in the form of concept map. Numbers behind the concepts were used to identify the studies that were carried out.

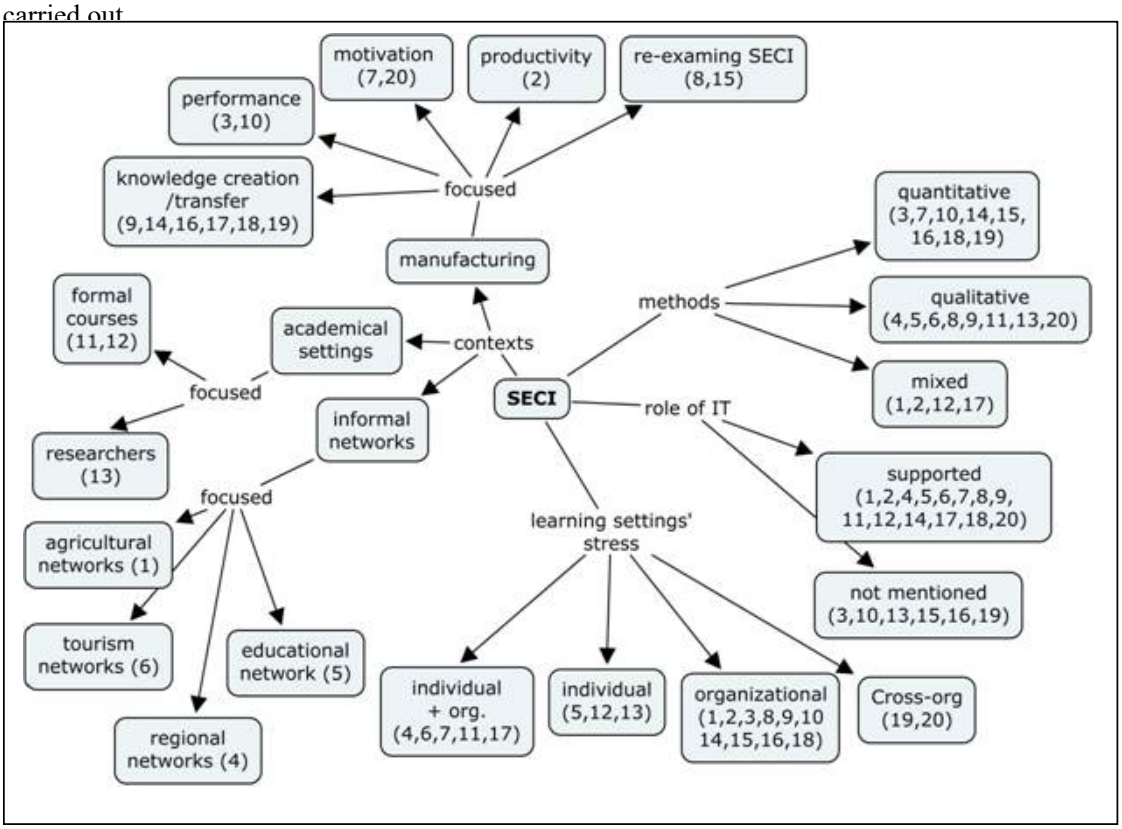


Figure 2: Concept Map Of The Results Of SECI Meta-Study

Meta-analysis of SECI model indicated that model has been mainly implemented in the context of the industries and enterprises with the aim to analyze how the implementation of SECI in organization may influence the organization's a) productivity; b) performance; c) motivation of employees. Less have been focused on studying the SECI model in academic settings or in the context of informal networks.

Also the analysis of SECI model studies may hint that cross-organizational learning is not studied yet, especially from the simultaneous individual and organizational learning aspects. It would be interesting to study how the learning goals and activities could be harmonized with the purpose of dynamic development of organizational and employees' knowledge. Individual learning of employee was stressed seldom in the studies, less than half of the studies mentioned that individual learning and organizational learning influence and support each other. It is presumed that development of organization is tightly connected with the individual development. For increasing and supporting the organizational learning, employees have to develop professionally. The results of the meta-study indicate that so far the organizational performance is more important than individual growth and the development of employees' goals and organization's ones do not seem to be harmonized.

For filling in the gap in current research, it is important to study how the SECI model could be implemented in school-university partnership for supporting teachers' lifelong learning, development of the professional knowledge of teacher education and harmonization of the learning goals of teachers, communities and organizations.

How the application of SECI model has been methodologically studied?

Table 1 illustrates the research methods used by different SECI studies. Method was defined by the author of this study accordingly what instruments were used and how the data was analyzed. It seemed that quantitative studies (mainly questionnaires) were used for analyzing the organizational knowledge conversion processes. Individual learning was studied with qualitative methods (interviews and observations). Mixed methods were used for analyzing the organizational and individual learning aspects. It hints that mixed method might be the more systematic method as it enables studying the simultaneous organizational and individual aspects of learning. Most of the studies did not use triangulation methods for studying different learning aspect (for example questionnaire for studying organization level knowledge and social network analysis for studying individuals in the community). Both aspects are still important to study for understanding how the individuals share and construct the professional knowledge and how the knowledge of organization changes through the actions of individuals.

Table1: Used Methods In SECI Studies

	Authors	Purpose and Context	Technological aspect	Learning settings	Method and Sampling	Main finding, new to SECI
1	Lwoga, Ngulube & Stilwell (2010)	Assessment of SECI model in managing agricultural indigenous knowledge for agricultural practice	ICT support suggested	Individual learning not emphasized, knowledge sharing stressed. Network learning.	Mixed methods. Interviews and observations. Sampling – 181 farmers from two villages.	Farmers' knowledge is tacit and created through conversion. E,C,I phases are less presented.
2	Chaikrongrag & Angkasith (2010)	Analyzes a missing link between team and production operators in manufacturing	ICT support suggested	Individual learning not emphasized. Collaboration in workplace settings stressed.	Mixed methods. Questionnaire and observations. Sampling – organization's two units	Socialization and combination phase dod not work. A "Knowledge Agent" was hired as missing link between units and to bridge the knowledge.
3	Ramirez & Garcia Morales (2011)	Analyzes how the knowledge creation of the firm (reuse of materials and products) influence the performance of it.	n/a	Learning is not emphasized, knowledge creation is imporant at workplace.	Quantitative method. The LISREL 8.70 program was used to test the theoretical model. Sampling – 284 Spanish firms	SECI affects the importance of firm - the greater presence of the processes of knowledge creation in the organization, more important are the processes of firm, enhancing its performance.
4	Haarmakorpi & Melkas (2005)	Investigates knowledge creation and management in regional innovation networks	ICT-support suggested	Collective learning within the innovation network emphasized.	Mixed method, Delphi method. Sampling – one network from Lahti.	Self-transcending knowledge was added to SECI.
5	Kantola & Hautala (2008)	Network of people working with internationalisation in Finnish universities of applied sciences	ICT-support suggested	Individual learning shapes the learning network	Qualitative – questionnaire combined with the SNA. Sampling - 29 members	Suggest using SNA for analyzing process in network, like sharing tacit knowledge and co-operation
6	Chalikiti & Sigala (2008)	Studies the social networking and knowledge creation capabilities and affordances of online forums to support tourism professionals.	ICT-support suggested	Individual learning should be fostered in order to create knowledge through the exchange information amongst members of the community.	Qualitative – Participants' observation, questionnaire, SNA. Sampling – 28 members questionnaire; 149 observed	Internalization was hard to examine by studying and observing the online interactions, interview should be done for studying how did they use forum discussions for own learning.
7	Tan, Lye, Ng & Lim (2010)	Investigates and examines the motivational factors that encourages the widespread sharing of knowledge among bank employees	ICT-support suggested	Employee's learning is intrinsic motivational factor that may influence the knowledge	Quantitative method – questionnaire. Sampling 114 respondents from 7 banks	Motivational factors and knowledge sharing process by applying SECI had a influence in determining the success of the sharing of warranted knowledge among bank employees in

				sharing in organization		achieving organizational competitiveness.
8	Roy & Gupta, (2007)	Attempts to re-examine the SECI model in the context of a small manufacturing organization in India	ICT-support suggested	Learning of individuals not emphasized. Exchange of the knowledge is important	Qualitative - observations, interviews. Case study of organization (300 employees)	Examination of observations and behavior of the firm reveals that the processes of tacit–explicit transformation vary in good measure from the description of the model.
9	Wickes, Leslie & Lettice (2003)	Presents a findings of the project that focused on developing the knowledge transfer tool for corporations	ICT-support suggested	Learning not focused, individual knowledge transferred to organization level and across organizations is focused	Qualitative method - Interviews, document analysis	Tool was developed that supports operationalization of SECI model
10	Li, Huang & Tsai (2008)	Study examines the relationships among entrepreneurial orientation, knowledge creation process, and firm performance	n/a	Focus only on organizational learning, all items of questionnaire focused on processes of firm not employees	Quantitative method – questionnaire. Respondents 165	Managers should choose and design appropriate methods according to the SECI process to facilitate knowledge creation. Firms need to enhance employees' involvement and participation in SECI activities.
11	Hosseini (2010)	Aims to define SECI model of knowledge creation as a framework of Virtual class management	ICT-supported	Focus on collaborative learning in virtual learning environment	Qualitative method - observations and interviews.	Proposing SECI model to educators a possibility for knowledge creation processes In formal courses.
12	Yeh, Huang & Yeh (2010)	Purpose was to develop a teacher-training program that integrates SECI and blended learning for supporting professional development	ICT-supported	Individual learning of pre-service teachers in collaborative settings	Mixed methods - Likert-scale and reflective questionnaire, observations. Sampling - 44 pre-service teachers	The SECI model and blended learning may be integrated to create a new paradigm for teacher training
13	Travaille & Hendriks (2010)	Examines how processes of knowledge creation contribute to success in academia	n/a	Focus is in individual development and therefor influencing community capacity	Qualitative method – interviews. Sampling – 17 academic staff	SE work, CI don't
14	Lopez-Nicolas & Soto-Acosta (2010)	Investigates the influence of the adoption and use of ICT on organizational learning (OL) of Spanish enterprises. The focus is on knowledge, creation, and the SECI.	ICT-supported	Focus on organizational knowledge creation – all questions of the survey begin with "my organization"	Quantitative method - questionnaire. Sampling - 297 employees of Spanish SMEs	ICT oriented to communication and workflow is found, to produce a significant positive impact on knowledge creation processes, except for, socialization process
15	Martın-de-Castro, Lopez-Saez & Navas-Lopez (2008)	The purpose of the research was to test empirically the SECI in two different settings. Asks: do the knowledge creation processes that can be found in real firms follow the scheme of the SECI model	n/a	Organizational knowledge creation process, individual learning not mentioned	Quantitative method - questionnaire. Sampling 52 American firms & 63 Spanish firms	There is no unique way of learning, but knowledge creation is conditioned by context-based considerations.
16	Samuel, Goury, Gunasekaran, Spalanzani (2011)	Analyzes how the knowledge creation process can be adapted to supply chains and which factors enable that process	n/a	Organizational knowledge creation process,	Quantitative method - questionnaire. Sampling 179 employees from France Supply chain management enterprises	SECI process not complete, especially C-phase occurs seldom. Learning can be realized across company borders.
17	Vaccaro, Veloso & Brusoni (2009)	Examines the organizational knowledge creation processes in two virtual teams involved in new product development	ICT-supported	Organizational knowledge creation process with a small emphasis on individual	Mixed methods - project documentation, observations, interviews. Sampling – two organizations	Externalization with ICT was not found

		projects in the automotive industry		development of employees		
18	Chou & He (2004)	Investigates the interrelations among four categories of knowledge assets and four knowledge creation processes (SECI) in variety of organizations in Taiwan	ICT-supported	Organizational processes related with knowledge assets	Quantitative method - questionnaire. Sampling - 204 employees.	There are correlations between SECI phases and different types of knowledge assets
19	Halley & Beaulieu (2005)	Studies the relationship between supply chain and knowledge management practices in Canadian manufacturing companies	n/a	Organizational learning emphasized, individual learning not studied yet	Quantitative method - questionnaire. Sampling 163 employees	Indicates that SECI model could be used in cross-organizational settings in order to support efficient knowledge management
20	Holocher et al (2011)	Studies the motivational aspects of SECI model in cross-organizational settings	ICT-supported	Organizational and individual learning emphasized	Qualitative method – scenarios and focus-group interview. Sampling – 10 employees	Technology can support individual's motivation to share knowledge and to become self-regulated learner

Likert-scale questions with the focus on organizational performance may not entirely reflect actual SECI phases in organization. Using mixed methods for studying SECI enables to study the organizational and individual level learning more thoroughly. Triangulation of data with the mixed methods supports focusing on two different viewpoints – what will the individuals receive from the organization and what does the organization learn from the individuals.

What results of the studied SECI aspects could be transferred to teacher training context?

This section synthesizes the most relevant results of the SECI model meta-study for the teacher-training context for supporting teachers' professional development and lifelong learning.

Table 2 illustrates the results of the studies that analyzed what SECI phases were less dominant. It can be assumed that socialization and externalization activities are more performed by the members of the organization, whereas internalization and combination activities have been less practiced.

Table 2: SECI Phases Studied And The Related Gaps

	Socialization	Externalization	Combination	Internalization
Chalkiti & Sigala (2008)				Internalization of individuals in the professional network is difficult to observe
Travaille & Hendriks (2010)			Played less dominant role	Played less dominant role
Samuel, Goury, Gunasekaran, Spalanzani (2011)			Less frequently mentioned	
Chaikrongrag & Angkasith (2010)	Inefficient		Inefficient	
Lwoga, Ngulube & Stilwell (2010)		Practiced at low rate	Practiced at low rate	Practiced at low rate

According to Nonaka & Takeuchi (1995), for successful knowledge conversion, all the SECI phases have to be performed. Without internalization or combination activities organizations' development could be inefficient, because employees' "know-how" and professional knowledge develops in internalize phase and collective knowledge in combination phase.

Technology Support For SECI Model

Kimmerle et al. (2010) claimed that although SECI model does not deal with knowledge transfer with the computer-based technologies, they suggest that some aspects of SECI model can be applied with the technology support. Cartelli (2007) proposed that integrating SECI with technology could improve students' learning, knowledge construction, and meaningful learning. Study by Lopez-Nicolas & Soto-Acosta (2010) identified that technology supports the performance of SECI phases and the organizational learning, but authors were less sure what is the influence of technology-supported SECI phases to individual learning. Yeh et al. (2010) studied SECI model in teacher training context with the blended learning approach and their study indicated that SECI model is suitable for teacher training and especially for improving teachers' professional knowledge. Also society presumes that teacher uses some technology for professional development and lifelong learning (European Commission, 2007). Therefore it might be suggested that implementing SECI model in teacher training context could be technologically supported. One possibility is using e-portfolio for the SECI activities. The portfolio recognizes individualized learning in a self-reflexive and self-regulated mode (Imhof & Picard, 2009) and allows personal growth in a cooperative and learning-oriented community (Tillema, 2001) by addressing the individual and community-based learning.

Organizational Culture For Supporting SECI Implementation

Study of Tan et al. (2010) focused on motivational aspects of using SECI model in professional activities and their results indicated that employees' motivation to share knowledge is influenced by the organizational culture, which was considered as external motivation factor. For example Riege (2005) have discussed as well that existing corporate culture does not provide sufficient support for sharing practices; lack of social network; knowledge retention of highly skilled and experienced staff is not a high priority; low awareness and realization of the value and benefit of possessed knowledge to others; dominance in sharing explicit over tacit knowledge such as know-how and experience that requires hands-on learning, observation, dialogue and interactive problem solving.

Technology-supported SECI activities seem applicable in teacher training context, because model encourages individual learning in the group and organizational level. On the other hand the implementation of SECI model to teacher training context should consider certain aspects that were identified in this meta-study. Firstly it is important to focus on individual learning aspects, not only on organizational performance. Secondly the technology-supported portfolio-based community should be selected for supporting individual professional development by reflecting and

construction of learning materials and same time community building aspects that allows collaboration between community members. Thirdly the culture of organization should encourage teachers and pre-service teachers to externalize their tacit knowledge, collaborate, co-construct learning materials, analyse themselves and feedback peers' reflections.

SECI In Teacher Training Context

For summarizing the discussion of SECI meta-analysis this section proposes the SECI model in teacher training context (see Figure 3).

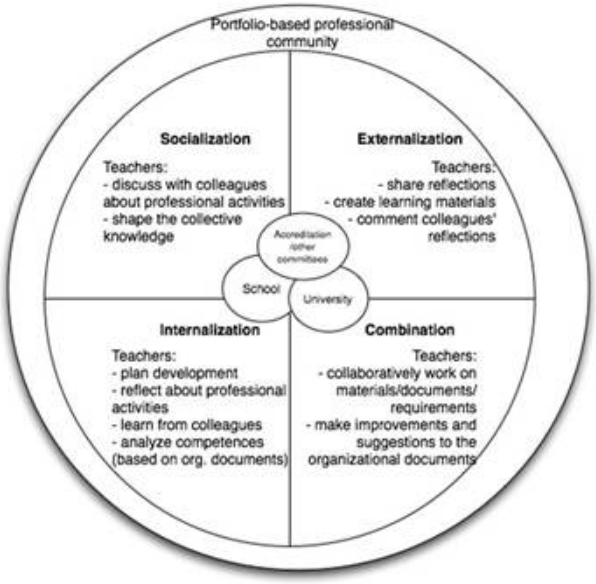


Figure 3: SECI Activities In The Teacher-Training Context

SECI activities as proposed in the Figure 3, may support teacher's professional development. Teacher plans individual development, externalizes professional knowledge in the portfolio, shares it with the community and together with colleagues works on the documents guided by organizational normative. As discussed above, meta-study identified that combination phase plays less dominant role in organizations. It might be presumed that combination phase may be insufficient in teacher training context as well. OECD Talis (2009) report indicated that teachers' collaboration involves exchanging the learning materials and discussing about them, talking about students' development and participating in the conferences. Less has been focused on collaborative knowledge building, co-teaching, observing and analyzing each other. Although teachers tend to discuss with other teachers (Talis, 2009), they do not have habit of sharing their professional knowledge in the form of reflection with colleagues (Helleve, 2009). Baran & Cagiltay (2010) suggest in their study that online communities support teachers to turn their implicit knowledge to explicit and share it with the colleagues online.

Currently in Estonia there have not been many studies about teachers' technology-supported professional development activities. Luik et al. (2011) studied pre-service teachers' blogging during the school practice. Timoštšuk & Ugaste (2010) have analyzed pre-service community-based learning. It can be presumed that implementing SECI model supports combining the documenting the professional activities and emphasizing the learning in the community as well in the pre-service but also in-service context. Tammets et al. (2012) have discussed the potentials and barriers of

implementing technology-supported SECI model in cross-organizational teacher training context. They propose that implementing SECI model in teachers' professional activities supports their lifelong learning through formal and informal studies, accreditation process and other types of evaluations and certifications. The professional knowledge of teachers' flows and influences the dynamically changing organizational knowledge. The teacher trainers at the university have an access schools' practical knowledge and in-service teachers may learn from the theoretical knowledge of university. Järvelä (2001) have indicated that currently the construction of professional knowledge between school-university partnership is rare and mainly unidirectional: from university towards schools. Bringing together teachers and university-based educators could create new forms of discourse about teaching and learning (Putnam & Borko, 2000).

Conclusion

This paper conducted meta-analysis of Nonaka & Takeuchi SECI model for studying different practices of SECI model, how the SECI phases have been studied and how the SECI model could be used in cross-organizational teacher education settings. Qualitative meta-analysis was conducted among 20 empirical studies about SECI model. Results indicated that mainly SECI model is used in the companies for increasing the performance and achievements of organization but employees' individual learning and professional development have been emphasized less. Additionally cross-organizational studies about SECI implementation are rare. Based on the analysis, this study proposes that analyze of the SECI model's effectiveness in teacher training context could focus on combining the questionnaires with the interviews by enabling teachers to describe how do they learn from colleagues, make their knowledge explicit, take into account the organizational regulations in their professional development process and so on. Additionally observations of teachers in portfolio-based community or social network analysis are good additional instruments for studying SECI model as they illustrate the real actions performed in the organization.

Article also proposes that implementing SECI in cross-organizational school-university partnership may influence the development of teacher professionalism in individual and organizational level. Teachers' professional activities inspired from SECI phases like documenting professional activities, learning from peers', sharing the resources, collaborative activities, giving feedback to colleagues makes the teacher education knowledge to flow and therefore keeps it cyclically updated and supports the balance between theory and practice. Same time SECI activities shape the teacher's habit to plan the development and competence, analyze the activities and therefore support the lifelong learning. Still, the meta-analysis of SECI model indicates that fostering the individual learning, using technology support and focus on organizational culture should be addressed for more efficient lifelong learning of teachers.

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