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Research Paper

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Abstract

The COVID-19 pandemic caused most companies and organizations to start utilizing remote work. Naturally, this gave rise to many issues regarding employee performance, communication, and collaboration, especially in the early stages of the pandemic. Since the beginning of the pandemic, organizations and employees have learned to cope with the situation. In this paper, we wanted to study how the COVID-induced remote work period has impacted organizational knowledge creation processes. By conducting a case study in a higher education organization, we conclude that the SECI mode of socialization was affected the most by the remote work period. In addition, we found no differences between genders. Younger employees were better at combination, and employees from the ICT department coped better with socializing during the remote work period. Based on the results of the study, we conclude that if remote work remains dominant, organizations might stand to lose more tacit knowledge due to lowered socialization over time.

Keywords: Knowledge, knowledge creation, SECI, remote work.

1 Introduction

Before the COVID-19 pandemic, remote work was not widely used in most industries (Kossek & Lautsch, 2018). For example, in Europe, only 2 percent of people worked from home in 2015 (Eurofound, 2017). In the United States, this percentage was 2.9 (American Community Survey, 2017). Thus, during the early days of the pandemic, most employees and companies did not have enough experience in remote working (Wang et al., 2021). This posed many challenges when governments ordered lockdowns, and companies started to utilize remote work.

Wang et al. (2021) have identified four key challenges of remote work: work-home interference, ineffective communication, procrastination, and loneliness. Additionally, Wang et al. (2021) found that social support, job autonomy, monitoring, and workload affect the experience of these challenges. Workers' self-discipline is also a key factor in how individuals cope with remote work. As more and more people have been vaccinated, companies have slowly started requiring employees to work in the

office as well. For instance, Apple requires employees to work three days a week in the office, and the same is true for Google (Haring, 2022).

One aspect where remote work can cause extra challenges is knowledge creation. In the IT literature, knowledge is usually defined by distinguishing between knowledge, information, and data. 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 between knowledge and information. Knowledge should be something more than information; otherwise, there is nothing new or interesting in knowledge management (Fahey & Prusak, 1996). Yet often, the knowledge management that academics and business-oriented people talk about just means information management (Nonaka et al., 2000).

Tuomi (1999) argues that the traditional hierarchy of data-information-knowledge is actually reversed: data emerges only after we have information, and 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 actual temperature data.

Following Tuomi's (1999) view, Alavi and Leidner (2001, p. 109) state that "information is converted to knowledge once it is processed in the mind of individuals." In this view, knowledge is information plus something more. This 'something more' is the associations, memories, and past experiences - previous knowledge that the individual possesses - that are related to the information. Knowledge is therefore "information possessed in the mind of individuals: it is personalized information" (Alavi & Leidner, 2001, p. 109). 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" (Alavi & Leidner, 2001, p. 109).

Jennex et al. (2022) suggest that effective management strategies should be employed to control and mitigate risks to knowledge, such as identifying and evaluating employee communication channels. Jennex et al. (2022) note that virtual social interactions are not a substitute for physical interactions and that employees miss socializing with their co-workers. To reduce the risk of knowledge spill-overs and promote job satisfaction, proper channels for work-related socializing should be utilized. Additionally, the authors emphasize the importance of implementing controls to identify and block misinformation or disinformation, as they pose a significant threat to the quality of knowledge.

This paper seeks to examine the impact of remote work on organizational knowledge creation, using the SECI model proposed by Nonaka (1994) as a framework for understanding the processes involved. While other models for knowledge creation are available (such as the 7C-model developed by Oinas-Kukkonen, 2004), the SECI model is perhaps the most widely recognized and utilized. The following section will delve into the relevant literature on knowledge creation processes and remote work. This will be followed by a case study, which will provide further insights into the topic at hand. Finally, the paper will conclude with a discussion of the implications of our findings and avenues for future research.

2 Knowledge creation and remote work

The dynamic theory of organizational knowledge creation – also known as SECI-model - has four modes of knowledge conversions that take place when tacit and explicit knowledge interact. The modes are: 1) socialization, 2) externalization, 3) combination, and 4) internalization. (Nonaka 1994).

Socialization is a process of sharing experiences (Nonaka 1994). 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 the form of shared mental models or technical skills.

Externalization is a process of articulating tacit knowledge into explicit concepts (Nonaka 1994). 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 (Emig 1983). The use of metaphors and analogies seems 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 (Nonaka 1994). 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. The use of large-scale databases could also be seen as an example of combination.

Internalization is a process of embodying explicit knowledge into tacit knowledge (Nonaka 1994). Reading documentations or watching videos is an example of the kind of "re-experiencing" that internalization requires. "Learning by doing" can also 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 along the ontological dimension (*i.e.* from individual to group, from group to organizational, and from organizational to inter-organizational level).

The generation of knowledge in the context of the ongoing pandemic is a critical factor for achieving organizational prosperity and competitiveness. Al-Omoush et al. (2020) have demonstrated the vital role of knowledge creation in facilitating proactive responses to the COVID-19 crisis, particularly in the domain of e-business. Several factors have been identified in the extant literature that can potentially affect the process of knowledge creation, either positively or negatively. For instance, Al Shaifi (2015) has established the positive influence of information systems and organizational culture on knowledge creation, while Tu (2020) has highlighted the significance of social capital. Against this backdrop, this paper aims to examine the impact of remote work on the creation of knowledge in organizations.

By looking at the possible remote work challenges (by Wang et al., 2021) and knowledge creation modes we can see (Table 1) that there are some possible problem areas for knowledge creation during remote work.

	Socialization	**Externalization**	**Combination**	**Internalization**
home-work interference	possible effect	possible effect	possible effect	possible effect
Ineffective communication	Ineffective communication is a direct challenge for socialization	Ineffective communication is a direct challenge for externalization	possible effect	
Procrastination	possible effect, missing meetings	possible effect, slows communication down	possible effect, slows progress	possible effect, delaying work
Loneliness	direct challenge for socialization	possible effect, more hesitant to express ideas		
Workers' self-discipline	possible effect	possible effect	possible effect	possible effect

Table 1. Mapping remote work challenges and SECI-modes (by authors).

Home-work interference can happen at any time. Thus, it can affect any crucial stage of the knowledge creation process as well. Working at home has a higher likelihood to cause interference compared to working at the office. The primary obstacle with respect to knowledge creation will pertain to those modalities that encompass social aspects such as communication, collaboration, and teamwork. Nonetheless, any process of innovation can be impeded by various kinds of interference.

Ineffective communication can also happen in any knowledge creation process that has social aspects. This has a direct effect on socialization and externalization because socialization requires communication and externalization includes aspects of communication as well. Remote work means that meetings have to be conducted via ICT (*e.g.*, Teams, Zoom), which can mean challenges for tacit knowledge transfer.

Challenges related to procrastination affect any mode of SECI. If the worker delays or postpones work related to knowledge creation it can slow down innovation processes, time-to-market etc. For example, if a worker does not check emails on time, this can cause delays for co-workers as well.

Loneliness has a direct effect on socialization. By reducing opportunities for socialization workers will have less opportunities for shared experiences. Loneliness can also reduce communication and knowledge transfer. Over time loneliness can also make workers more hesitant to express ideas and give and receive critique. Workers' self-discipline can affect any mode of SECI similarly to procrastination. Knowledge creation requires time and brain power and if a worker needs someone to push them forward, remote work will at the minimum slow down knowledge creation.

In addition, Wang et al. (2020) contend that in the aftermath of the COVID-19 pandemic, knowledge work has transformed into digital and location-independent work. Consequently, workers must utilize various ICT-tools to communicate, collaborate, and share and apply knowledge to address complex problems remotely. DeFilippis et al. (2020) report that because of remote work the number of meetings attended by individuals has increased, as has the number of attendees per meeting, while the average length of meetings has decreased compared to pre-pandemic levels. This has resulted in a reduction in the duration of meetings attended by individuals on a daily basis during the post-lockdown period. Additionally, DeFilippis et al. (2020) note that there has been a significant and enduring increase in the length of the average workday, and a short-term increase in email activity. This could pose challenges to *e.g.* work-life balance and also to knowledge creation processes over time due to increased fatigue and stress.

Next, we will present a study where we investigate more closely how remote work affects knowledge creation processes.

3 Case study in Finnish Institution of higher education

Oulu University of Applied Sciences, located in Oulu, Finland, employs approximately 460 staff and serves a student population of around 9,000. In response to the severe COVID-19 situation, the Finnish government mandated a lockdown of public places, including schools and restaurants, as well as the transition to remote work for companies. In week 11 of the Spring 2020, Oulu University of Applied Sciences shifted to providing online lectures, which continued throughout the 2020-2021 academic year. Although COVID-19 cases were low during the Spring of 2021, workers were still recommended to work remotely until the end of June 2021.

To investigate the effects of remote work on knowledge creation, a survey was conducted in June 2021, which was distributed to all employees of Oulu University of Applied Sciences, with a total of 461 staff members receiving the survey. Of those, approximately 70% (n=325) were teachers, while the remainder consisted of administrative staff and researchers. The response rate for the survey was 31.5% (n=145), and the data was analysed using IBM SPSS Statistics 26.

The survey questionnaire was designed to focus on the SECI-model, and to assess employees' perceptions of the effects of remote work on knowledge creation. The questionnaire was modelled after Sharifi et al. (2012) and employed a 5-point Likert scale. Socialization was assessed through five questions, while externalization, combination, and internalization were each measured through four questions. Table 2 summarizes the survey questions.

SECI-mode	Topics	References
Socialization	1. Informal meetings like coffees, luncheons, and other social activities	Nonaka, Toyama & Konno (2000);
	2. Informal activities focused on free-time, and social activities outside the workplace	Nonaka, Toyama & Konno (2000);
	3. Activities related to and master-apprentice relationships	Payne & Hoffman (2003)
	4. sharing experiences with co-workers	
	5. Unit cohesion is stronger	Nonaka & Takeuchi (1995)
Externalization	1. Organizational members share beliefs, values, and ways of thinking.	Nonaka, Toyama & Konno (2000);
	2. Expression of the corporate mission, vision, and values, as well as the organizational history through documents, policy declarations, etc.	Nonaka, Toyama & Konno (2000); Schulz (2001);
	3. Organizational routines are documented in schemes, organizational charts, flow charts, etc.	Smith et al. (2005)
	4. Utilization of metaphors, analogies and models	Nonaka & Takeuchi (1995)
Combination	1. The information contained in files, databases, intranets, corporate networks, company software and other tools for information management is classified and accessed	Nonaka, Toyama, and Konno (2001)
	2. We short, add, combine, and classify already available information to develop written reports	Payne & Huffman (2003)
	3. Collaboration between team members	
	4. Combination of data and information from various sources in remote work	Nonaka (1994)
Internalization	1. The perspectives and insights are shaped by the data and information already available	Smith et al. (2005)
	2. internal processes are shaped by the data and information already available	Nonaka, Toyama, and Konno (2001)
	3. points of views and mental models of the organization are shaped from data and information already available	Sharifi et al. (2012)
	4. Internalization is hampered by remote work	

Table 2. Questionnaire used in the case study, modified from Sharifi et al. (2012)

3.1 Hypotheses of the study

Overall, Finland is a country with a high level of education. The staff of universities of applied sciences in Finland are well-educated. To obtain an academic position, applicants must have a master-level or higher degree in a relevant field of study. In general, close to 50% of the staff at Oulu University of Applied Sciences are women, and 50% are men. The age distribution is slightly skewed towards more experienced (*i.e.*, older) individuals, with the average age being 49.9. Additionally, 18.2% (n=84) of the staff are over 60 years old.

According to Tondeur et al. (2016), while "women have a less positive attitude towards computers in general [...] their attitude towards computers for educational purposes does not differ from men's." Thus, Tondeur et al. (2016) argued that computer attitudes are context-dependent constructs. Therefore, in terms of any possible gender differences, it is crucial to understand context-specific issues. Although

research has shown that there are gender biases towards access, use, and ICT skills, meta-analysis performed by Qazi et al. (2022) "did not reveal gender differences in ICT use and skills." Moreover, numerous studies have explored the topic of gender differences in the use of ICT, but their findings are often inconsistent and even contradictory. Some studies have reported varying results, with certain studies suggesting that females may experience certain advantages while others show that males have the advantage (Siddiq & Scherer, 2019; Qazi et al., 2022).

Because performing knowledge work is highly context-specific, and since the data in this study was collected more than a year after the COVID-induced remote work period started, we argue that even if there were some differences in ICT skills among males and females at the start of the remote work period, by the time of data collection, any differences that may have existed were insignificant. Thus, in this paper, we argue the following:

> *Hypothesis 1, there are no differences between the genders when it comes to their knowledge creation during remote work period.*

Numerous research studies have demonstrated that educators who actively integrate information and communication technology into their pedagogical approaches place importance on leveraging technology to facilitate collaborative learning, foster learners' active participation in the process of knowledge creation, and enhance the efficacy of intelligence acquisition. These findings have been confirmed in various educational contexts, including primary and secondary schools, online courses, and teacher training programs (e.g. Hakkarainen et al. (2001), Donnelly et al. (2011), Uluyol, Ç., & Şahin, S. (2016), Costley, K. C. (2014). By leveraging ICT-tools such as videos, simulations, and digital collaboration platforms, teachers can create more interactive and student-centered learning environments that enable learners to take ownership of their learning process, exchange ideas with peers, and develop critical thinking skills as well. These findings suggest that the same principles may apply to knowledge work in other settings. The more familiar workers are with ICT, the less likely it is that remote work will negatively affect their ability to perform knowledge work and engage in knowledge creation.

A recent study by Kerzic et al. (2021) investigated the relationship between university teachers' age and their self-reported use of ICT for educational and personal purposes. The study found that while there were no significant differences in instructional ICT use (*e.g.*, using online video lectures, online resources, and communication tools) between younger and older teachers, younger teachers reported using ICT for entertainment purposes *(e.g.*, games, music, and movies) and social networking significantly more than older teachers. This suggests that age may play a role in how individuals use ICT-tools but may not have a significant impact on their ability to use ICT for instructional purposes.

In a study of upper secondary school teachers, Krumsvik et al. (2016) found that teachers who are 50 years or older have less digital competence compared to younger teachers. This may suggest that age-related differences in ICT use are more pronounced in certain contexts and populations. However, it is important to note that this finding does not necessarily mean that older teachers are less capable of using ICT for instructional purposes.

In general, it would seem that ICT-teachers and younger teachers are more tech savvy so we argue the following:

> *Hypothesis 2, younger workers are more accustomed to working with computers and thus their knowledge creation processes are hampered less than older workers.*
>
> *Hypothesis 3, staff members working in the ICT department are more accustomed to working with computers and thus their knowledge creation processes are hampered less than workers from other departments.*

3.2 Results

Table 3 summarizes all answers related to the SECI-model. By looking at the table we can see that socialization is the mode that got by far the lowest answers. This might seem natural as COVID-19 pandemic forced people into working remotely. Computer-mediated work should pose less challenges

for other SECI-modes but if staff members are less accustomed to socializing using virtual environments it is logical that socialization suffers. The first line in Table 3 is calculated by summing all knowledge creation modes of the SECI-model.

Knowledge Creation	**n**	**Min**	**Max**	**Mean**	**Std. Deviation**
SECI	145	1,18	4,64	2,6652	0,72099
Socialisation	145	1,00	5,00	1,9747	0,90615
Externalisation	145	1,00	4,67	2,6391	0,90225
Combination	145	1,00	5,00	3,0897	0,93066
Internalisation	145	1,00	5,00	3,1034	1,01019

Table 3. Descriptive statistics of all answers showing mean and standard deviation.

In the next sections we will look at the hypotheses more closely. To save space, descriptive stats are removed from now on.

3.2.1 Men vs women

In Table 4 (it should be noted that in order to save space and for clarity we omitted from Table 4 the 95% Confidence Interval of the Difference) you can see the analysis of independent samples T-test between the genders. It should be noted that few respondents did not want to specify their gender, so they were omitted in the analysis regarding this hypothesis. It should also be noted that there were 49 men and 91 women in the data set. Based on the analysis we conclude that there were no statistical differences between male and female in how the remote work affected their knowledge creation processes. Thus, Hypothesis 1 is supported.

Cluster		**F**	**Sig.**	**t**	**df**	**Sig. (2-tailed)**	**Mean Difference**	**Std. Error Difference**
Socialisation	equal var assumed	,005	,943	,540	138	,590	,08739	,16174
	equal var not assumed			,529	92,430	,598	,08739	,16532
Externalisation	equal var assumed	,238	,626	,196	138	,845	,03087	,15729
	equal var not assumed			,195	95,907	,846	,03087	,15870
Combination	equal var assumed	,005	,942	-,712	138	,478	-,11460	,16089
	equal var not assumed			-,705	95,684	,482	-,11460	,16247
Internalisation	equal var assumed	,880	,350	,946	138	,346	,16797	,17753
	equal var not assumed			,918	90,385	,361	,16797	,18289
SECI	equal var assumed	,006	,940	,251	138	,802	,03154	,12545
	equal var not assumed			,246	92,206	,806	,03154	,12834

Table 4. Detailed analysis of hypothesis 1 (male vs females) using independent samples T-test.

3.2.2 Young vs old

The Hypothesis 2 stated that younger workers should be more accustomed to working with computers and virtual environments. Thus their knowledge creation processes should be less affected by remote work period. Please see Table 5. Again descriptive statistics were omitted to save space.

Table below summarizes the comparison between young (under 50) and old (50 or more) workers in the university.

Cluster		**F**	**Sig.**	**t**	**df**	**Sig. (2-tailed)**	**Mean Difference**	**Std. Error Difference**
Socialisation	equal var assumed	,599	,440	,543	143	,597	,08000	,15097
	equal var not assumed			,531	142,962	,596	,08000	,15460
Externalisation	equal var assumed	,447	,505	-1,031	143	,304	-,15460	,14991
	equal var not assumed			-1,033	142,980	,303	-15460	,14961
Combination	equal var assumed	,002	,969	-1,995	143	,048*	-,30540	,15309
	equal var not assumed			-1,998	142,928	,048	-,30540	,15284
Internalisation	equal var assumed	,852	,357	-,288	143	,773	-,04857	,16842
	equal var not assumed			-,289	142,943	,773	-,04857	,16790
SECI	equal var assumed	,116	,734	-,938	143	,350	-,11247	,11987
	equal var not assumed			-,914	142,937	,348	-,11247	,11950

Table 5. Hypothesis 2 (under 50 vs over 50-year-olds) using independent samples T-test.

In Tables 5 above you can see a comparison of under 50 years old workers and over 50 years old workers. Only statistically significant difference is with combination (sig. 0.048). This could mean that the younger generation is more accustomed to using ICT to combine information from various sources. For example, this could be working in Google documents and writing reports jointly. Maybe the older generation is more accustomed to the traditional way of working alone with electronic documents. Or to put it in other words maybe the older generation is not so accustomed to working remotely using cloud-based tools for collaboration and knowledge work.

Based on the results we can conclude that Hypothesis 2 is only partially supported.

3.2.3 ICT-department compared to other departments

The last hypothesis stated that employees of the ICT-department are more accustomed to working with computers. Thus, their knowledge creation processes should be affected less than employees of other departments. It should be noted that there were 20 employees from the ICT-department and 125 employees from other departments. Please see the Table 6 below (to save space, descriptive statistics are omitted again).

Based on the results presented in Table 6, a significant difference (sig. 0.037) was observed between departments with regards to the SECI-mode of socialization. The mean response for the ICT department was 2.3667 with a standard deviation of 1.11816, while in other departments the mean was significantly lower, measuring 1.9120 with a standard deviation of 0.85629. Although employees in the ICT department tended to rank their knowledge creation processes higher than other departments in all SECI-modes, except for internalization, these differences were not statistically significant. Therefore, it can be concluded that Hypothesis 3 is only partially supported.

Cluster		**F**	**Sig.**	**t**	**df**	**Sig. (2-tailed)**	**Mean Difference**	**Std. Error Difference**
Socialisation	equal var assumed	2,600	,109	2,108	143	,037*	-,45467	,21567
	equal var not assumed			1,739	22,702	,096	,45467	,26150
Externalisation	equal var assumed	,713	,400	1,127	143	,262	,24467	,21709
	equal var not assumed			1,127	25,466	,270	,24467	,21709
Combination	equal var assumed	,046	,831	,311	143	,756	,07000	,22484
	equal var not assumed			,305	25,071	,763	,07000	,22980
Internalisation	equal var assumed	,000	,985	-,016	143	,987	-,00400	,24413
	equal var not assumed			-,016	24,985	,987	-,00400	,25075
SECI	equal var assumed	1,147	,286	1,206	143	,230	,20909	,17336
	equal var not assumed			1,030	23,095	,314	,20909	,20306

Table 6. Hypothesis 3 (ICT-department vs others) using independent samples T-test.

3.3 Discussion and Conclusion

The shift to remote work during the COVID-19 pandemic has disrupted traditional modes of socialization and has affected the SECI model of knowledge creation and management. The reduced socialization may have negative implications for organizational learning, knowledge creation, collaboration, and innovation, and over time it may lead to loss of tacit knowledge within organisations. To address these challenges, organizations must find innovative ways to foster socialization and build social capital and trust in remote work environments.

Based on the analysis of the study Hypothesis 1 (*i.e.*, there are no gender differences) was supported. As such there seems to be no differences between men and women when it comes to knowledge creation processes during remote work. This is exactly as the hypothesis stated. As previously indicated in this paper, knowledge work is characterized by a high degree of specificity to the context in which it takes place, such that any variations observed between individuals are more likely to be attributable to their distinct responses to challenges posed by remote work, rather than to their gender. Nevertheless, as

research has also indicated that in some cases there might be some gender differences in ICT use (see *e.g.*, Siddiq & Scherer, 2019; Qazi *et al.*, 2022), this should be studied more.

In Hypothesis 2 it was stated that younger workers (*i.e.*, under 50-year-old) are more accustomed with working with computer technology, *e.g.* through playing games and interacting through avatars and other virtual tools. Based on the analysis it was concluded that socialization was the only SECI-mode where the difference between the groups was statistically significant. Younger employees are more accustomed with ICT-mediated socialization than older employees. Most likely, the younger generation uses tools such as games, VR/AR, Tinder, and other mobile apps more for socialization purposes. It could also be that when it comes to the mode of socialization, the younger employees have not experienced as many shared experiences as the older employees and thus they *feel* that socialization is not affected as much by remote work. In comparison, older employees may have seen retirements and other possible events where workers have left the organization or maybe they have experienced challenges that could only be solved through face-to-face collaboration and thus they know more about situations where remote work is a challenge. It can be also argued that the amount of information channels used for ICT-mediated socialization has expanded. In any case hypothesis 2 was partially supported.

In Hypothesis 3 it was stated that employees of ICT-department are more accustomed with working with remote tools. Thus, their knowledge creation processes should be less affected by the remote work period. Based on the analysis it was concluded that this was only partially supported. The only statistically significant difference was again with socialization. Reasons for this are probably at least a little bit like that with Hypothesis 2. Maybe the members of the ICT-department are more accustomed with socialization through ICT.

Combining the results of hypotheses 2 and 3 we can conclude that especially in knowledge-intensive industries where innovation and the ability to create new knowledge is essential for success, young and ICT-savvy workers are well-positioned to overcome challenges posed by remote work. They have grown up with digital technologies and are therefore more comfortable with using them to connect and collaborate with others. Additionally, they may be more likely to have recently acquired the latest knowledge and skills in their field, making them better suited to knowledge-intensive remote work. As the difference between age groups is not that big, older workers are still needed for their experience and domain expertise.

Based on all the analysis in this paper we can conclude that from the SECI-model socialization is the one that is affected the most by the COVID-19 induced remote work period. Our conclusion is well-aligned with Jennex et al. (2022) findings; employees miss socializing with their co-workers. This is somewhat logical, as humans are social beings, and we require each other's company in order to collaborate not only in higher education settings but in other professional settings as well as in our personal life. Based on the results, the younger generation could be more accustomed to socializing using ICT. Thus, their socialization processes are affected less by remote work. Similarly, employees of the ICT-department work daily with computers and other ICT-related technologies. Their socialization processes are also affected less by remote work.

In addition to affecting knowledge creation modes, remote work can also have an impact on the quality of knowledge being produced (Jennex et al, 2022). For example, remote work can pose knowledge risks and threats related to increased 1) frequency of misinformation and/or disinformation, 2) reliance and use of social media, 3) social isolation of remote working employees, 4) social justice movement, 5) transience of knowledge workers due to the great resignation, and 6) frequency of large-scale natural disaster events (Jennex et al, 2022). If socialisation mode is challenged by remote work this can indeed mean increased risks related to misinformation as workers might lack tacit knowledge relevant to identifying information as being misinformation. Also lack of socialisation among co-workers might mean that users rely more on social media for connecting with other people. Management should take this into consideration when implementing processes that aim to improve the quality of knowledge that is being created.

Besides knowledge creation remote work can also affect other aspects of knowledge management. For example, knowledge transfer (*e.g.* Alavi & Leidner, 2001) can be hindered by lowered socialization. According to Gupta and Govindarajan (2000), for knowledge transfer to occur, it is necessary to have rich transmission channels. Remote work means that there are less channels available for knowledge transfer. Richness of existing transmission channels can also be hampered due to *e.g.* low ICT-skills and missing of face-to-face channels. Knowledge application is another part of knowledge management that may or may not be affected by remote work. For example, during remote work period workers may not have full access to resources, such as libraries or specialized equipment, which can limit their ability to apply their knowledge effectively. Similarly remote work can also hamper collaboration and thus pose challenges for knowledge application.

While this study focused on the SECI-modes of knowledge creation, it is important to note that there are potential limitations to the findings. Specifically, the authors did not examine possible threats and risks related to the quality of knowledge created. For instance, while factors such as loneliness, lack of communication, and collaboration may not directly impede knowledge creation, they could increase the likelihood of misinformation being incorporated into or produced by the knowledge creation process. Therefore, further research may be necessary to fully understand the impact of these factors on knowledge creation during remote work. In addition, since the dataset was skewed towards females (49 male, 91 females) hypothesis 1 should be studied more with a larger and more balanced dataset. Also ICT department was not very well represented in the dataset (20 vs 125 employees) so more research is need for hypothesis 3 as well.

To expand on this topic in future research, it would be valuable to measure the quality of knowledge generated during remote work. A possible approach to measure this is by observing the organizational performance before, during, and after COVID, and comparing it to previous years. By analyzing the impact of remote work on organizational performance, researchers can gain insights into the quality of knowledge produced during this period. In addition, more research is needed to study the role of organizational culture and leadership in knowledge creation during remote work. For example, during our study there was no organizational communication control or proper KM to mitigate possible risks to knowledge so the organization is recommended to address more attention to KM in the future, perhaps starting by, as suggested by Jennex et al. (2022), adding controls to assist in identifying and blocking misinformation/disinformation. The impact of remote work on knowledge transfer and knowledge application should also be investigated.

In the context of remote work, it is imperative for managers to actively facilitate the transfer of tacit knowledge between employees. This is particularly critical in situations where certain employees are approaching retirement age. By taking proactive measures to enable tacit knowledge transfer, managers can ensure that valuable knowledge and expertise is not lost when employees leave the organization. Similarly, the findings suggest that managers ought to allocate significant consideration towards the orientation process of new employees, in order to ensure effective assimilation into the organizational culture and optimize job performance outcomes. This will have a direct impact on how organizations perform during the years following the retirements.

In this paper we wanted to study how COVID-induced remote work period affected knowledge creation processes in a Finnish higher education organization. In general, the study results indicate that the knowledge creation processes have not been hampered too much. Socialization is the one process that remote work affects the most. This can have some practical implications on tacit knowledge transfer in organizations. Most likely the new employees are the ones who are affected the most and they might struggle to get familiar with the organizational routines and culture due to lack of exposure. Due to challenges posed for socialization, organizations are in danger of losing valuable tacit knowledge, *e.g.* in case of increased retirement rate. This should be considered while arranging or managing the remote work practices in workplaces. Organizations should plan for this if they expect to face a lot of retirements in the near future.

It will be interesting to see all the long-term impacts that the last couple of years have had on organizations' procedures and cultures in regard to knowledge creation. Most likely this will have an

impact on long-term competitive advantage of those companies and organizations who fail to take challenges of remote work into account. For future research we would be keen to organize a longitudinal study on remote work's effect on knowledge creation processes.

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