Evaluation of a Technology for Reflective Practice: A Case Study of Learning about Cybersecurity

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Abstract. Organizational learning can require more advanced types of learning that go beyond remembering information. Reflective learning, in which different possibilities to apply knowledge in different situations, is often necessary in organizational learning settings. In this study, we have evaluated the use of a mobile application to support reflective learning practices using situational trilemma learning. The application was used in an asynchronous mode, giving users the opportunity to participate when and where it suited them best. We focused on two research questions: Do the users consider the system to be user friendly? Do the users consider the system to be useful? We studied a learning situation in which personnel in a financial organization learned about cybersecurity. We conducted interviews with two facilitators, that were responsible for the execution of the learning process. In addition, we sent out a questionnaire to the participants in the learning process. In both the interviews and the questionnaire, questions related to user friendliness and usefulness of the technology were addressed. The application was considered user friendly, although there is room for improvement. With respect to usefulness, three important conclusions could be drawn. The concept of situational trilemma learning takes time to understand properly but was perceived as very useful for reflective learning. Using situational trilemma learning makes the learning more relevant. Using the application in an asynchronous mode enabled many users to participate, but it required follow-up by physical meetings to enable the dialogue required for reflective learning.

Keywords: Organizational Learning, Reflective Practice, Usefulness, Usability, Learning Technology.

1. Introduction

Cyber security is the protection of data from theft and damage. It is a significant challenge in today's digital world with increasing vulnerabilities and threats. National cybersecurity month is an annual campaign arranged every year in Norway to increase the competence and awareness about cybersecurity in the industry, public sector, and media for a safer digital everyday life. Several e-learning courses are offered to organizations to increase the employee's knowledge and competences, such as nano learning programs (learning activity takes at most 10 minutes) that divide micro-content to address single objectives or by using applications such as Kahoot! [1]. There is a need for efficient and innovative learning systems applied to

cybersecurity education due to an escalation of threats that employees must face in their daily work, however, it is important to evaluate the impact of such educational activities for cybersecurity and to which extent these kinds of initiatives succeed [2]. Applications for nano learning support what is known as single loop learning where the focus is on doing things right and according to known procedures [3] However, cyber security learning is not about learning the right or wrong thing to do, but about reflecting on the balance between risk decreasing measures and the impact the have on work practices. Too many security measures can hamper efficiency. So, this type of learning requires what is known as double-loop learning. Double-loop learning can promote a reflective learning practice which involves thinking about both how to do things at work and to understand why you do what you do as well as how to improve your work performance [4].

VOXT is an interactive digital technology developed to stimulate reflective learning to facilitate deliberate decisions and a reflective practice in employees' everyday work. We have previously explored how interactive technology for collaboration and learning can be used to improve organizational culture [5] and how the use of in-house crowdsourcing can enhance collaboration and learning in organizations [6]. This paper builds upon our previous work by evaluating the use of the application VOXT during the national cybersecurity month in an organization in the finance industry. In this study, we address the research question: What are the user experiences with the interactive technology VOXT to foster reflections and support double-loop learning? This main question is broken down into two sub-questions related to the concepts *perceived user friendliness* and *perceived usefulness*, that are highlighted in TAM models as important factors for determining technology acceptance [7]

- Do the users consider the system to be user friendly?
- Do the users consider the system to be useful?

The rest of this paper is organized as follows: Section 2; theoretical background, Section 3 describes the method and context of the study, Section 4 presents and discusses the results, and finally we draw some conclusions in Section 5.

2. Theoretical Background

In an organizational context, learning initiatives often have a focus on behavioural changes, e.g., single-loop learning and double-loop learning. While single loop learning focuses on achieving established goals and adjusting how an organization functions by doing things right, [3 p. 754], double- loop learning often involves changing the objective itself to do the right things by reflecting upon assumptions and beliefs [8] . Double loop learning is defined as *"organizational behaviours directed at changing existing valued states or goals. This is concerned with radically transforming an organization's structure, culture, and operating procedures." [3, p. 748]*

Reflective learning practice requires employees to both think what they are doing while doing it (reflection-in- action) as well as reviewing their actions afterwards to explore their own understanding of their actions (reflection – on- action) [9]. In addition, reflection before action and as part of preparations for experience is important. Double-loop reflective learning can be seen as an approach to understand experiences and generate new knowledge [4]. Even though there is an emphasis on the importance of double loop learning in organizations, such as creation of new knowledge [10], there has been less attention on digital tools and systems that can support this kind of learning in organizations [11].

Many digital technologies for collaboration and learning are offered to organizations in today´s digital world, and they can play an important role in facilitating interaction and collaboration among employees. An important success factor for these technologies is that they offer support for both individual reflection and collaborative reflection at the right time in the learning process [12]. Factors, such as the role of a facilitator, the way a learning technology is used, the nature of the group of learners and learners' preferences for "off-line reflection" has been identified as key factors for successful use of learning technologies for reflection [13]. The use of in-house crowdsourcing can promote organizational learning by supporting employees to share their experiences and reflect on issues at stake from different perspectives, either asynchronously or in real time in time-and space bound group events [6]).

The interactive learning technology that is central to our study, VOXT, is presented briefly in the next section. In order to evaluate this technology, we decided to use the well-known Technology Acceptance Model (TAM). TAM is also use by Mugo et al [14] to study the adoption of mobile technologies for educational activities and to identify what might hinder user acceptance. The framework is built on the premise that *perceived usefulness* (PU), *perceived ease of use* (PEOU), and users' *attitude towards usage* (ATU) are three factors that influence the user's decision on how and when they will use it. While PU entails to what degree users believe that the technology will enhance their work performance, PEOU addresses to what degree the users think that the technology is better than its substitutes, and these two factors affect the ATU. The ATU influences the user's behavioural intention to use, which again affects the actual use of the technology [16].

3. Study Context

This study is a part of a Norwegian research project, SAMSPILL (which means social interaction or teamwork), financed by the Norwegian Research Council and includes an SME, VOXT AS (voxt.no), and a partner from the finance industry. As part of the project, the application VOXT is further developed and combined with new principles for management and governance to create change readiness in the financial industry.

The aim of the interactive technology is to support sharing of experiences and reflective thinking among the users, which in this case are employees in the financial industry. The interactive learning technology has been used in processes where employees' experiences and concerns are shared in a facilitated and timebound group sessions. These are considered as dilemmas that employees may face, which may have several alternative ways to resolve and each individual or group may choose to resolve them in different ways. These are then discussed in the group to stimulate reflection among the participants through sharing different situations and views.

The Interactive Technology VOXT

VOXT consists of two platforms: (1) an application where users share and reflect upon experiences via their mobile phones, and (2) a platform for the administrators, e.g., the facilitators of an activity or a workshop to prepare the material for the group activity and to document and summarize the outcomes of the process as a report.

The mobile platform where the users share their experiences is based on the concept of crowdsourcing, where several users can contribute with content anonymously, respecting the privacy of the contributors. The co-created and crowdsourced content can be made accessible to the other users, for example employees who participated in a workshop. Users can contribute with their own situations and alternative responses by using their smartphone. The experiences are structured as a situation or a problem, that can have three alternative reactions or solutions. This is named a trilemma. The application therefore supports what can be called *situational trilemma learning*. An example of a trilemma could be:

- **How do I prioritize privacy policy under time constraints?** Three alternative ways of dealing with this, are:
    - delaying deliveries in the project to address privacy concerns;
    - minimize the areas where privacy concerns are addressed, or;
    - continue as usual and hope for the best.

Through the platform for the administrators, the facilitator can create a module for a specific session by creating pre-defined trilemmas. When users respond by selecting an alternative for each trilemma, the responses from all participants are visualized as a pie chart. An overview of the anonymized responses by all the participants is available as a report of the collective responses which could be used to support group discussions. In addition to the pre-made trilemmas, based on the ideas of crowdsourcing and to facilitate employees to share their experiences, individual users can create their own trilemmas, which could be shared among others to obtain their responses.

The Case

An asynchronous version of the system was developed in beta for this study to explore how the application could be used during the cybersecurity month to engage the employees in situational trilemma learning. Asynchronous engagement using the

application had the envisaged advantage that participation could occur whenever it suited the employees which could increase the participation, be time-efficient, and facilitate for continuous learning in combination with synchronous activities [6].

Facilitators for the cybersecurity month together with VOXT designed the process by defining pre-made trilemmas that the employees had to use for reflection. They also designed how and when the application would be used in combination with other activities during this month.

The employees received information from their organization about the application VOXT and that it was mandatory to participate in selecting answers to the pre-made trilemmas. This was done both through e-mails and at a physical meeting with the top-management. Co-creation of new trilemmas was voluntary.

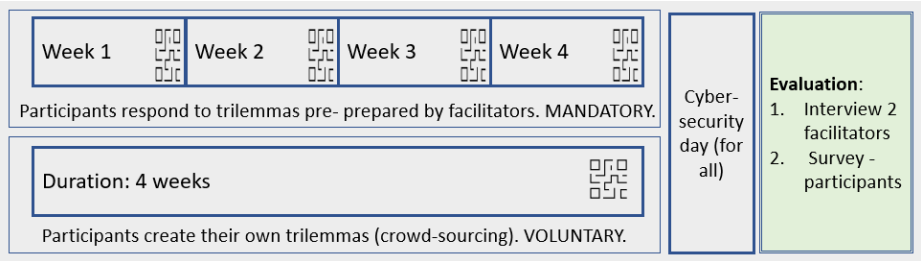

Fig 1: Cyber Security month Study Design

The employees accessed the application by scanning a QR-code. The QR-code was printed on several sheets of paper and posted at different locations at their work, and managers at the financial organization wore t-shirts with the QR-code printed on them to create awareness and curiosity among the employees. The process had a duration of four weeks. Each week new pre-made trilemmas were made accessible, and the employees needed to scan the QR-code again to access them. At the end of the cybersecurity month, the organization arranged a cyber security day where the two facilitators used some of the charts and analyses from VOXT, visualizing the responses from the participants, to discuss about the topic with the employees.

4. Method

Data was collected through semi-structured interviews with the two facilitators who are responsible for organizing the annual cybersecurity month. As a supplement to the interviews, an analysis of a presentation document about the study made by one of the facilitators was conducted. In addition, a survey was filled out by 19 respondents. 13 respondents completed the survey. The survey was sent out to all employees, which was around 200 persons. So, the response rate was quite low, around 10%.

In order to operationalise the three constructs from TAM that we decided to use in evaluating VOXT, we used the well-known instrument System Usability Scale (SUS). This instrument measures both *attitude towards usage* (ATU) (the first SUS question) and *perceived ease of use* (PEOU) (the other nine questions). The SUS questions are listed below:

1. I think that I would like to use this system frequently.
2. I found the system unnecessarily complex.
3. I thought the system was easy to use.
4. I think that I would need the support of a technical person to be able to use this system.
5. I found the various functions in this system were well integrated.
6. I thought there was too much inconsistency in this system.
7. I would imagine that most people would learn to use this system very quickly.
8. I found the system very cumbersome to use.
9. I felt very confident using the system.
10. I needed to learn a lot of things before I could get going with this system.

In addition, we included six extra statements that focus more on the *perceived usefulness* (PU) of the tool in the context of learning about cybersecurity. All the statements were formulated in Norwegian. The six additional statements were:

1. I think that the use of situations and three possible solutions is a good way to learn about cybersecurity
2. It is important to have the opportunity to create and share your own dilemmas in the application
3. I really liked using the application to learn about cybersecurity
4. I find it easier to participate in discussions using this application when it suits me rather than participate in a meeting to discuss
5. I think it was easy to understand when another session with a theme started
6. I discussed many dilemmas with colleagues during this process

We collected and analyzed the quantitative (survey) and qualitative (interviews) separately on the same phenomenon before we interpreted the data based on the quantitative results and qualitative results. Given the low response rate we decided to use the SUS results not as a firm indicator but more as suggestive. We compared its outcome to the qualitative assessment on usability from the two facilitators in the interviews. The responses on the questions on *perceived usefulness* (PU) were interpreted by combining them with the main themes emerging from the interviews. These themes were: *the concept of trilemma learning* and *relevance of the learning content.*

5. Results and Discussion

The results presented in this section are obtained from the survey responses and the two interviews with the two facilitators. The results will be presented in two sub-sections related to the two research questions we presented in the introduction.

82 % of the respondents of the survey had never used the application before. The figure below gives some more information on the background of the respondents to the survey.

Age	Years in the organisation	I use many different applications on my phone everyday	I like to explore and use new applications
<25 (1) 25-35 (5) 36-45 (6) >45 (7)	<5 (14) 5-10 (2) >10 (3)	Strongly disagree (0) Disagree (0) Neutral (1) Agree (7) Strongly agree (9)	Strongly disagree (0) Disagree (2) Neutral (7) Agree (7) Strongly agree (1)

One of the facilitators has worked more than fifteen years in the organization and the other facilitator has worked more than five years there. Both have worked more than five years in their current job position within the field of cybersecurity. They have for many years been the facilitators of the arrangement of the annual cyber security month for the organization.

Perceived Ease of Use

The average SUS score was 66.83. The score indicates an overall ok user-friendly rating [17]. The lowest individual score was 57.5 and the highest individual score was 75. Again, with a response rate of under 10% we can't draw firm conclusions from this figure, but the suggestion that perceived user friendliness is acceptable, is supported by the results from the semi-structured interviews. It was expressed that it was known that the technology was in beta version, and the expectations were adjusted accordingly.

It was emphasized by the facilitators that easy onboarding of participants was of major importance. It was considered beneficial that VOXT did not require the participants to create user profiles or accounts with passwords to enter the system – and the use of QR codes seemed to function well despite some minor bugs: the facilitators did not recall receiving any negative feedback from any of the participants – which was interpretated as a positive thing. In addition, the quality of the privacy policy was a positive factor:

"There were no challenges regarding the legislation in terms of privacy since they have done a good job with it. If they don't need the data, they don't collect it. That's very good." – Facilitator 2

An important success factor for the facilitators was the number of participants of 192 unique devices despite a decrease of participants. The log data show a steady decrease in the number of participants over the four weeks. The highest number of participants was registered the day the managers in the organization talked about using VOXT as part of the cybersecurity month in a workshop with all the employees. The top manager and the facilitators wore the QR- code for VOXT on their t-shirts to be scanned at the workshop.

Even though they could reach out to all the employees in a time-efficient way with an asynchronous version, there were also some challenges with asynchronous interaction, e.g., creating awareness about the initiative and information beforehand:

"Asynchronous use was a bit challenging because they received information about the usage in writing" – Facilitator 2

The facilitators used the visualizations from the reports from the sessions at the security day where they met with employees physically to discuss cybersecurity. They printed the pie charts and placed them on the wall next to where the facilitators stood and asked the employees what made them curious based on those results and charts, e.g., why were there big disagreements on some of the trilemmas. The facilitators used this to discuss with the employees and the employees seemed very interested in the discussions. This resulted in different types of dialogues that lasted longer than usual. This could however also be because of other activities outside the use of VOXT on that day.

" We used it asynchronously so that the employees could participate when they had the time and occasion to do so. I think there are benefits and challenges with both synchronous and asynchronous use. For us it was necessary, but I think we could have used it differently synchronously. With asynchronous use it is more up to the participants if they complete or skip things" – Facilitator 1

A challenge with synchronous use would be time because of the onboarding of the system and for participants to understand the concept of trilemma learning. However, one of the facilitators thought it would be useful to use it more synchronous, e.g., in frequent or regular meetings where they could use 15 minutes every month to discuss dilemmas with the employees.

Perceived Usefulness

The objective of the use of VOXT was to foster reflection and gain insight into the employees practice in their everyday work life regarding cybersecurity instead of testing if the participants were able to answer questions correctly. This study tried to explore whether this objective was achieved. The empirical data showed two important themes related to perceived usefulness: the concept of trilemma learning and the relevance of the learning material.

The Concept of Trilemma Learning

Most of the participants assessed the tool as being useful in the context of learning about cybersecurity (46% agreed and 15% strongly agreed), and 77% of the responses in the survey show a positive attitude towards trilemma learning. The questionnaire, however, indicates that there was not much discussion outside the use of the application between colleagues since 77% of the respondents were neutral or disagreed with the statement that they had discussed many dilemmas with their colleagues during the process.

The use of trilemmas was referred to as a different way of learning which required a different mindset compared to traditional nano learning programs and e-learning systems:

"The biggest challenge is that there is no right answer. You must realize that it is a bit different. This takes some time. You must use dilemmas to create a discussion" – Facilitator 1

With the concept of trilemma learning the aim was to use the results to discuss and learn more about the attitudes and behaviors in the organization which is double loop learning as described by Cartwright [8]. The application can help to identify possible gaps between guidelines and actual practice since employees can reflect on what they automatically do versus what they perhaps should do:

"If we manage to discuss in the teams what is important for people, we can identify the gap between guidelines and what employees actually thinks is important" – Facilitator 1

A challenge with trilemma learning was to understand how to get the participants to share their own experiences and dilemmas instead of selecting what they thought was the correct answer – turning the focus from factual knowledge to experiential sharing. The facilitators had to think differently than usual when preparing pre-made trilemmas to avoid that employees would answer what they thought was the right answer instead of answering based on their practice and share their own experiences. It is important that the facilitators have enough time to learn how to write good trilemmas and finding time for this could be a challenge.

Even though only 18 trilemmas were co-created by the participants, the result from the survey showed that it was perceived as important to have the option to co-create trilemmas by 54% of the respondents. Flexibility seems to be important regarding the co-creation of trilemmas where it could be good enough for the facilitators that employees contribute with a new solution or one answer, and not necessarily a whole trilemma. This could perhaps lower the threshold for co-creating trilemmas.

With the concept of trilemma learning, VOXT aims to support the upper levels of Blooms taxonomy compared to nano learning programs and the usage of applications where the aim is to answer correctly as fast as possible. With the application VOXT the aim was to create a common ground and not to explain an idea or make employees memorize or repeat information. This type of learning might require more time than traditional ways of learning, but one benefit seems to be the relevance of the learning content.

Relevance of the Learning Content

The facilitators received feedback from the participants that the information and content presented were situations they could relate to because of the sharing of experiences between colleagues, focus on practice, and co-creation of trilemmas. Many therefore found the content to be more relevant for them compared to traditional e-learning programs and lectures. One size fits all strategy does not work here – learning content needs to be tailored to the context. This confirms what Seale & Cann [15] says about the context of the technology use and the specific group of learners involved. Different departments have different situations they face in handling cybersecurity issues:

"It is an excellent tool to make cybersecurity learning more relevant. Different departments have different challenges so we must adjust the learning content to both language used and disciplines" – Facilitator 1

18 trilemmas were co-created by the participants, and these were used as pre-made trilemmas that the colleagues would answer to in the sessions that followed. While pre-made trilemmas made by the facilitators can be time efficient and give insight into what the facilitators would like to know, having the option to co-create trilemmas enables employees to share their experiences which makes it more relevant for the co-workers that face similar situations. A combination of both pre-made and co- created trilemmas seems to be a good combination because it can give the participants an introduction to the concept of trilemma learning and at the same time give them the opportunity to contribute with their own trilemmas if they have other trilemmas that they feel is important to share with their co- workers.

By using VOXT, the facilitators can create a better interaction between those who work with cybersecurity and those that needs to follow up the guidelines in practice, e.g., by enabling them to discuss topics the employees can relate to and is important for them.

Concluding Remarks

The SUS score was good enough to assume a positive impact on the user's attitude toward the application. The perceived ease of use questions indicates a positive user experience even though there is potential for improvement. The usefulness questions indicate a positive evaluation. With respect to usefulness, three important conclusions can be drawn. The concept of situational trilemma learning takes time to understand

properly but is perceived as very useful for reflective learning. Using situational trilemma learning makes the learning more relevant. Using the application in an asynchronous mode enables more users to participate, but it requires follow-up by physical meetings to enable the dialogue required for reflective learning. The results indicate that the application could function as a digital tool to operationalize double-loop learning in organizations.

The response rate was relatively low, but we think that the data indicates interesting findings. We would like to do more extensive studies with a higher response rate. It is also a limitation that we only focused on one case, and it would be interesting to see how the application would be used in other situations. Another limitation was that the application was in beta version so future work would be based on an improved version of the application.

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