Undergraduate Research Track 2020-2021

Is there a community of practice on the Dhis2 online Community of Practice website?

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Abstract

Community of practice is a widely used social learning theory coined by Lave and Wenger in 1991, which has been applied to a range of contexts within IS research. The Health Information System Program group at the University of Oslo created a website referred to as the Dhis2 Community of Practice in 2018 for one of the world's largest open source public good software systems. This was with the intention that it would reap the benefits of being a community of practice, as described in the literature. This research investigates whether the main elements of the social learning theory are indeed experienced by members of the website. To answer this question we did a case study, and used semi structured interviews as our main data source, and gained an understanding of our case through participatory observations and open-ended questionnaires. This report contributes to the literature by suggesting that a community of practice can exist at a global online website, with the way members participate being the most distinct element compared to other cases in the literature. The report emphasises the importance time has on participation at the Dhis2 online CoP. Allocated time ensures a continuity of use so a shared history of learning can emerge, however it's the main factor for non-participation. A way of logging time spent on the CoP that is accepted by management is important to promote participation, and there should be ways for members to make the time they spend at the website more effective, for example by the use of tags that identify relevant questions. The main motivation for people to participate is to solve their local issues and problems with the Dhis2. Topics of further research could be the effects bordering communities using different communication tools have on the CoP, and to what degree language affects the sustainability of a global and online CoP.

1 Introduction

1.1 Description of motivation for the project

Learning is a continuous need in an ever developing world. Effective and structured learning within organisations is, specially in the field of information technology, a strategy to success as this makes the organisation resilient to changes. In the information technology field, we have gotten used to a constant stream of new versions of software, with new functionalities and more security. One easily forgotten aspect of this is the necessity of learning to adjust to new software. These learning processes are especially present and especially global in the world of Free and Open Source software (FOSS), as free and open source software has a

global, dispersed and undefined audience and user group (Alami, 2020, pp.99-100). Implementation and development usually runs without boundaries.

Community of practice (CoP) is social learning theory, created as a conceptual framework to understand social learning within a community (Farnsworth et al., 2016; Schwen & Hara, 2003; Wenger, 1998). The term "Community of Practice" was defined by Jane Lave and Etinne Wenger in 1991 (Lave & Wenger, 1991).It identifies learning as a social system where people "share a concern or a passion for something they do and learn how to do it better as they interact regularly" (Wenger, 2015, p. 1). Concepts of identity, meaning and learning are cornerstones in Wenger's theory. These concepts create regimes of competence and accountability which set boundaries and practices within a community (Wenger, 2010). The learning happens through practice and reification, which again is motivated by identity-making and shared domain of interest (meaning) (Farnsworth et al., 2016; Wenger, 1998).

The study you are about to read shows how a social learning theory can be used to understand how learning happens through a global, online community of developers and implementers of a free and open source software. Much in line with earlier studies on online communities, our study adds to the CoP theory with empirical material on what an online community of practice can look like (Schwen & Hara, 2003; Smith et al., 2017; McLure Wasko & Faraj, 2005). The case of study is the online community website made to connect users of the FOSS Dhis2, the world's largest health information system. This online Dhis2 Community of Practice website was created with the intention of being a platform for international and cross hierarchical collaboration, bringing forth innovation and horizontal and vertical learning processes. The motivation of our study is to give insights into whether this is the case through analysing the website through the CoP theory. The study will give a better understanding of how learning online can happen.

1.2 Purpose, objectives and research question

The purpose of our research is to understand the emerging practices on an online website; whether there is a degree of learning, meaning and identity-making in an online website-community consisting of a dispersed, global member-group.

The objectives of our research is to concretize whether there are CoP characteristics present in the Dhis2 online collaboration website and give empirical data on the challenges and motivations of a global, online community of practice.

Our research question is:
"What elements of the social learning theory "community of practice" is present in the HISP online web forum referred to as the Dhis2 Community of Practice?"

To answer the research question, we have conducted a case study across 6 months, with theoretically motivated, semi-structured interviews, participatory observations on the website, surveyed a portion of users of the Dhis2 (to be elaborated on) and used theoretical thematic analysis to identify the possible elements of a community of practice in our case. All research has been done digitally, from Oslo.

1.3 Context

In this section we will describe the different terminology used in this article to paint a picture of the broad Dhis2 community. When we refer to “the broader community / of Dhis2” we allude to everyone involved in the development of Dhis2. We will refer to the website as the Dhis2 online CoP, and by “its community” we are referring to its registered members.

HISP

HISP is an acronym for Health Information System Programme. The acronym is used as an umbrella for the economic administration and the developers, implementers and researchers of the Dhis2 platform. The HISP organization was established in the 1990-2000’s and is organized with a distributed governance structure, where the development and administrative core team is located in Norway and different HISP groups are located in 15 countries across the global south. Some of the HISP groups are related to universities and respective health departments, close to all have emerged by local initiative and are governing the implementation and use of the Dhis2 software in their expanded area.

Dhis2

Dhis2 is an acronym for District Health Information Software 2, a free and open-source software (FOSS) made as a digital public good to manage health information, targeted at countries in the global south. In 2021 it was used as the main health management information system in 73 countries. The system has a platform architecture, enabling distributed governance and local adaptation through innovation on the system (Grisot et al., 2014; Roland et al., 2017). This makes for an ever-evolving software and community, as anyone who has the skills and interest can add innovative functionalities to the platform.

The Dhis2 online Community of Practice website

The Dhis2 online Community of Practice (Dhis2 online CoP) website is a communication forum where anyone can connect to the Dhis2 community. By Dhis2 community we are referring to anyone with an interest in the Dhis2; developers and implementers of the software, HISP employees, partners, donors, NGOs and/or health ministries. By the fact that Dhis2 is open and available to anyone, by principle anyone can identify themselves as part of the Dhis2 community.

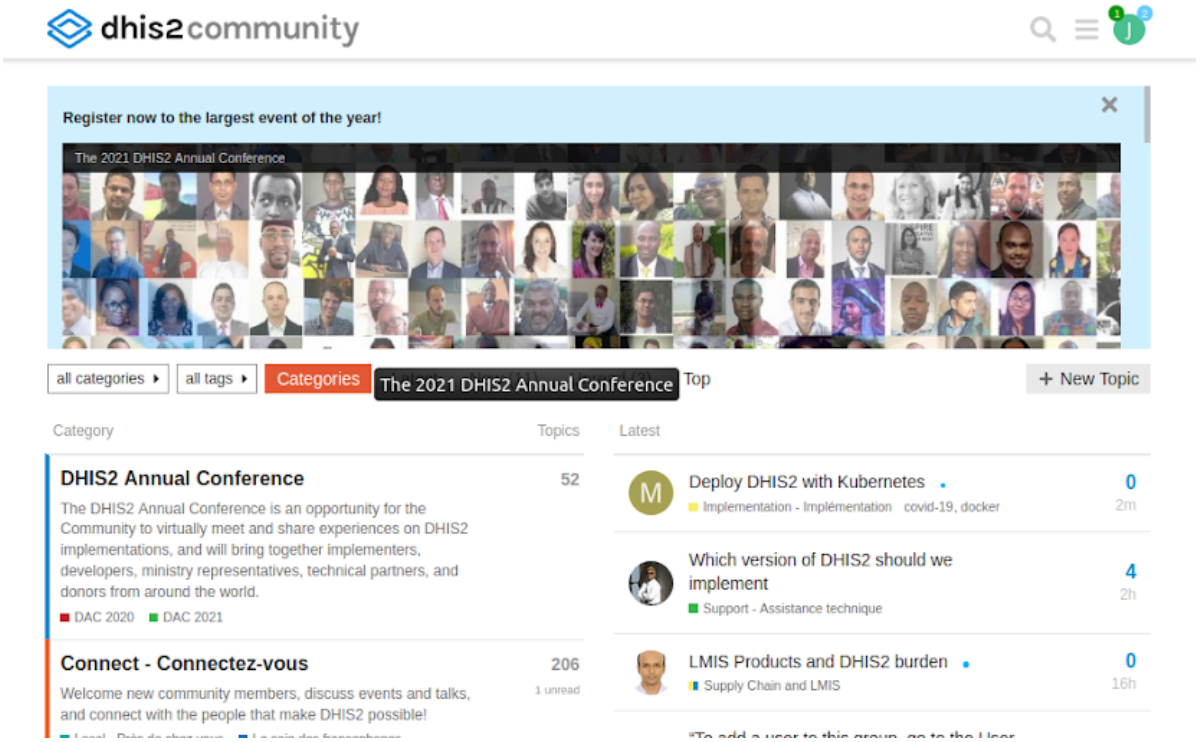


Figure 1: The Dhis2 online CoP website, Photo: Screenshot, July 2021.

The Dhis2 online CoP has been part of the HISP organization since fall 2018. It builds on HISP's strategy plan for 2019-2022 for global action research, capacity building and balancing tensions of local and global development and stability and innovation (Roland et al., 2017). The online forum was created for more communication, easily accessible information and problem solving and transparency in development issues. The term "one-stop-shop" has been used to describe it; offering a range of services at once.

Table 1 shows the incentives (gaps to be filled) to build the Dhis2 online CoP in more detail. We have included these to give context to the driving force and subjectivity of our study, as well as the mentality of the managers of the Dhis2 online CoP.

Gap...	**..to be filled**
1. Building on current community engagement	by attracting the user and developer mailing list to the Dhis2 online CoP.
2. Crowdsource solutions to complex implementation problems	by bringing together and documenting solutions to implementation problems.
3. Connect sector specific implementers	by facilitating collaboration across sectors and topics in the broader Dhis2 community.
4. Contributions to the roadmap and place to discuss and prioritize improvements	by being a place for the HISP Core Team to publish the Dhis2 roadmap, and get comments and feedback from the community.
5. Bridging developers from UiO and	communication and monitoring of the topics

Dhis2 users from the field	and forums.

Table 1: Objective goals of the Dhis2 online CoP as laid out in the project proposal, 2017.

The Dhis2 online CoP replaced a continuously growing mailing list, which had been used by a range of implementers and developers. The Dhis2 online CoP soon became a forum for implementers to ask and answer questions, share resources and best practices of Dhis2. New members of the Dhis2 online CoP log in with their email address and a username. In June 2021 the website had 3528 members.

Connect	...a forum to present yourself, job advertisment and events of interest.
Announcements	...a forum for Dhis2 version releases and Dhis2 events.
Implementation	...the forum for implementation of different Dhis2 applications.
Support	..any support.
Development	...forum for any info on development.
Capacity building	...information and connect to Dhis2 Academy and training material.
Research	...information on research and connect to Dhis2 Researchers.
Resources	...newsletter and examples on how to use Dhis2.
Translation	...anything on translation.
Forum feedback	...good and bad feedback.

Table 2: The different subforums on the Dhis2 online CoP, shows how different fora have different uses.

Little is known about the members on the website, and our research has not covered *who* the people on the website are, as they can be anyone with an interest in Dhis2. The different subforums are available to any member of the website.

The installed base and the network of communities in HISP

In order to understand the possibilities to prescribe an online community of practice for an organization, it is necessary to map out the organization's installed base (Schwen & Hara, 2003). We use the term installed base to describe the existing communication tools and work practices that exist within the broader HISP community (Hanseth & Lyytinen, 2010).

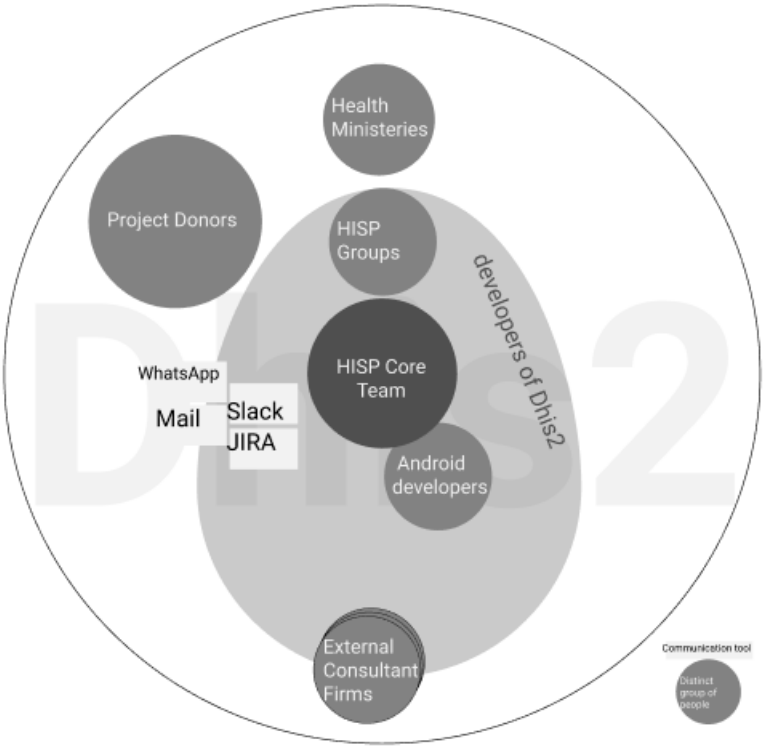


Figure 2: Installed communication base of the Dhis2 community. Outer circle illustrates the community of Dhis2, the inner circle the developers / decision makers of Dhis2. Within this community there are different small communities, with different communication tools.

The HISP Core Team is based in Oslo, where roadmap decisions are made, but the core development is done by a both geographically and consultative dispersed group of employees; located across the globe. The different consultant firms have their own ways of collaborating, however, they still have to adhere to the changes and issues in the Dhis2. All core developers use Slack for internal, core team/expert communication. Slack membership is invitation only. One group of developers uses Gather.Town as a virtual office space, hence increasing their daily communication. Most external communication goes through mail, while urgent cases can be communicated through WhatsApp. But, this is limited, as you have to know the expert to message about the emergency. The Jira platform is used to structure the development process, by logging to-do's, bugs, feature updates and more. Jira for Dhis2 is open to everyone, but its complexity reduces its use. The Dhis2 online CoP arose to create more transparency and collaboration between the different HISP groups, and its openness makes room for all Dhis2 interests to get involved in implementation and usage problems.

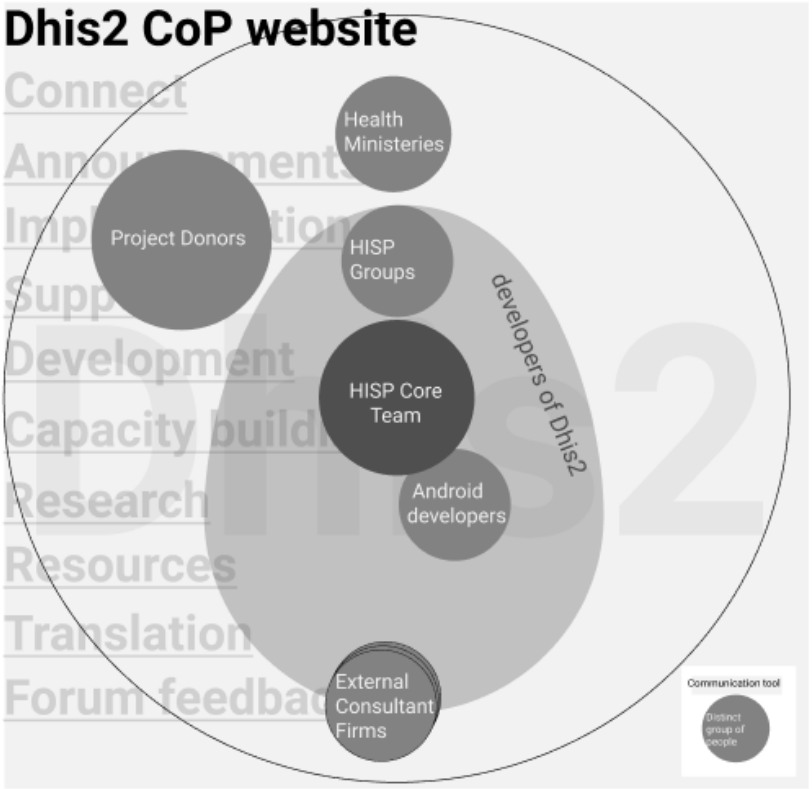


Figure 3: The Dhis2 CoP website is meant to be a website for everyone in the broad community of Dhis2 to communicate and find information.

2. Literature

In this section we will take a look at different studies on online communities of practice and establish how our study fills a gap in the literature. Our study also tries to fill a practical gap for the case of study; whether it is a community of practice. Then we will explain important concepts of CoP, to establish the theoretical framework of our study.

2.1 Gaps

Practical gap

The Dhis2 online CoP was chosen as a case based on the practical implications for it to be identified as a community of practice. There are reports on members' satisfaction with the forum, but not any scientific inquiries into if it actually works in relation to the CoP theory. Being identified as a community of practice gives an opportunity to use this social learning theory as a guideline to cultivate the learning happening through the community.

Theoretical gap: What have others done

The CoP theory has been used in a wide range of case studies within and outside of IS research. Wenger based his theory on physically co-located communities, and key concepts such as face-to-face communication reflects this (Wenger, 1998). However, the research on online communities of practice in recent years have confirmed that the theory can be applied online as well (Smith et al., 2017; Schwen & Hara, 2003; Probst & Borzillo, 2008).

Use of the CoP theory within the field of IS research has focused on how to create a framework for design for online learning (Probst & Borzillo, 2008; Schwen & Hara, 2003). Probst and Borzillo (2008) generated a steering wheel to management of online CoPs, while Schwen and Hara (2003) provided a four phase design approach to generate a sustainable community of practice. These studies give great insights into the possibilities of online CoPs, but have not undertaken an online community at the size of our study.

What has not been done

To our knowledge, the scale of organization, as well as the geographical and cultural distribution of members in the community of our case study is larger than that which has been covered in earlier research (Probst & Borzillo, 2008). With members from Yemen, Tanzania, Vietnam and India, to mention a few, this distinguishes it from the more culturally similar online communities investigated by earlier researchers, such as the law firm online communities (McLure Wasko & Faraj, 2005), or exclusive european or american online CoPs (Probst & Borzillo, 2008).

A literature review on CoP studies from 2014 uncovered that only 17 out of 60 research articles using the CoP theory published between 2000 and 2014 made use of the theory substantially and grounded their research in the CoP framework and their own analysis (Smith et al., 2017, p.217-21). The authors of the literature review call for more nuanced research on CoPs, where we find ourselves covering the "articulation in detail [of] the functions and uses of the technological tools that most effectively support and mediate a community's social and intellectual engagement" (Smith et al., 2017, p.224).

2.3 Positioning

Our target audience is the HISP organization and community, as well as the theorists of CoP and other cases of global and online communities. We believe our research broadens the understanding of online global community learning and that this contributes to the debate on learning in globally distributed organizations and the cultivation of such online communities of practice. In addition, we contribute to the field by studying a global, public good organization, where the scale of community is great, culturally dispersed, with a high degree of meaningfulness within the community (Russpatrick, 2020, p.6). We have yet to see a case study on this context, or one similar to it.

2.4 Theory

In this section we will describe the different concepts we have used to identify a community of practice based on Smith et al. (2017). We will also concetizise the emergence of a community of practice and the power structures that lay within it, as this is essential to understand the discussion around our findings.

Central Concepts

The Domain, The Community and The Practice

A community of practice can be viewed as a simple social system, or as a collection of interrelated social systems (Wenger, 2010). A community of practice is defined by three central features: a domain, a shared practice and a sense of community. The domain provides

the members with a shared identity which gives direction to their thoughts and actions, while at the same time providing meaning and value to those actions. In this case, the domain would be the development and support of the Dhis2. The community is where interactions happen and relationships are built through reciprocation and mutual understanding. The community in the case of this article would be the Dhis2 online CoP website, which is different from the *teams* the members of the community work in on a daily basis. The shared practice is how the members of the Dhis2 online CoP actually do things within the domain.

Participation & Reification

A member's negotiation between participation and reification is the key element of CoP. With participation, as in actively taking part, we shape our identity and the practices that identify a distinct community (Wenger, 2011, p.55-57). Reification, in terms of CoPs, is the generation of meaning onto objects and things. It describes "our engagement in the world as productive of meaning" (Wenger, 2011, p.58). In this research we are referring to participation as being a part of the Dhis2 online CoP by reading posts, and reification by creating content online.

Legitimate Peripheral Participation

When approaching a community, it's negotiation integrating the newcomer as part of the community is referred to as the legitimate peripheral participation. This process of being an outsider to a member includes an understanding of the reification and participation happening in that community through learning how meaning and identity is created within the community (Smith et al., 2017, p.213). We are referring to legitimate peripheral participation as the process of not having to have an account at the Dhis2 online CoP website to being an active member of the website by posting issues and giving solutions.

Shared history of learning – regimes of competence and accountability

A community's constant negotiation between participation and reification creates social structures and identity, as people spend more time learning together (Wenger, 2010, p.180). A community of practice will through its history of learning create a regime of competence for its members; "a set of criteria and expectations by which they recognize membership" (Wenger, 2010, p.180). This includes understanding what matters for the community, the purpose of the community, how this shapes perspective, how to engage productively with other members of the community and how to appropriately make use of the repertoire of resources the community has aggregated through reification over time.

Individuals within a community of practice will also produce a social identity for themself within the community (Wenger, 2010, p.181-182). When you identify yourself with a community, you become a part of the regime of accountability. As a member of a community you are accountable to know what it is about, to its open issues and challenges, to its history. Your willingness to follow this regime depends on your degree of identification with the community (Wenger, 2010, p.186).

Identity and identification

Identity is defined by a members alignment and acknowledgement within the community, shaped by the regime of competence and community. A person's identity will always be influenced by many communities. It can be more or less self-motivated by the imagination of who you want to be, but identification will include the alignment of what it takes to become *it* and the engagement in a community that identifies you as *such* (Farnsworth & Wenger, 2016,

p.12). As participants of a community of practice, the learning will change a person's sense of who they are – change their identity (Wenger cited by Smith et al., 2017, p.213).

Knowledge

Knowledge is generated when a community helps each other and solves problems. Together with reification this establishes a regime of competence, in which newcomers can be included and gain and give even more knowledge. Hence, a community's knowledge is dynamic (Smith et al., 2017, p.213).

Boundaries and Brokering

People in one community of practice will interact with other communities of practice, and the boundaries between them are bridged by brokering and interaction with boundary objects. This is the process of bringing practices from one community onto another (Wenger, 1998, p.103-113).

Learning architecture

A learning architecture is a collection of components that may allow learning to take place (Tummons, 2014, p.121). This may include books, interactive technologies, joint tasks or activities that encourage mutual engagement. In itself learning is "a claim to competence" (Wenger, 2010, p.181). Learning within a community of practice includes a couple of dualities. We have touched upon one element that helps people claim competence within a community of practice: the participation and reification duality. Wenger has also identified the duality between the designed/emergent, the local/global and identification/negotiability as dimensions of design for learning (Smith et al., 2017, p.214; Wenger, 1998, p.230-235). In our research we have used these dualities to identify where learning manifests.

Value Creation

Value creation is a way of assessing the social learning within a community of practice, which happens in five cycles; immediate value, potential value, applied value, realized value and reframed value (Smith et al., 2017, p. 215). The cycle is steered "by members' activities and in their interactions with others in informal networks" (Smith et al., 2017, p.214).

Emergence of a community of practice

There are several challenges with developing an online community of practice. One major challenge has to do with how Wenger describes his theory in its original form; it is a descriptive, social, middle-level theory that starts with an empirical phenomenon that is not intentionally designed. A descriptive theory describes what is present, not how to make it, which would fall more into the prescriptive realm of theory (Schwen & Hara, 2003, p.262). The Dhis2 online CoP was purposefully created, which has become commonplace in the last few years (McDermott & Archibald, 2010). However, there will be a degree of uncertainty when it comes to how a community unfolds. Wenger describes it with the following:

"Communities of practice [will ultimately] decide what they need to learn, what it takes to be a full participant, and how newcomers should be introduced into the community" (Wenger, 1998, p.234)

This brings to light another challenge: The early stages of one community of practice may not resemble the general early stages that have been observed in other communities of practice.

Thus it can be difficult to recognize when a community of practice is in the making, and when it is not present at all (Schwen & Hara, 2003, p.262).

Power

Social learning within a community of practice brings up issues of power; what matters, in what directions the community should develop and what counts as learning. Wenger highlights different forms of power, in the form of horizontal and vertical accountability, in order to understand the emergence of a community of practice (Wenger, 2010, pp.190-196).

The regime of accountability is an example of horizontal accountability, where the members of the community feel accountable to their peers. This regime emerges from standards of practice, peer recognition and commitment to collective learning (Wenger, 2010, p.194). Conversations and mutual negotiation are favored processes for deciding what matters and in which directions the community should develop.

Institutions on the other hand, typically adhere to vertical accountability, in the form of organization hierarchies, policies and management of resources. This form of power favors tools that can travel across levels within the organization easily, like numbers (Wenger, 2010, p.196).

A challenge for managing a community of practice is that these two forms of accountability are not easily visible to each other, which hinders the fostering of learning capabilities (Wenger, 2010, 196). There is a need for transversality, the ability to increase the visibility between the horizontal and vertical forms of accountability, to increase the credibility of both towards the other (Wenger, 2010, p.196). There are examples of how this can be done on a minor scale, like sending letters to management about subordinates that are championing within peer-to-peer relations (Wenger, 2010, pp.195-196).

3 Method

In order to answer the research question we have done an intrinsic case study with a deductive approach, spanning from January to July 2021. We chose a case study method, as our research tries to provide evidence or non-existence of a certain behavior. Case study gave us a possibility to triangulate between methods and data sources, which brings forth a variety of aspects within the identified context (Lazar et al., 2017, p.180-181). The choice of methods within the case study was decided as we got to know the case of study.

3.1 Data Collection

The research was conducted over a six months span, with it being a small side project for the first five months and an intensive full time project for the sixth month.

Figure 4 shows the process.

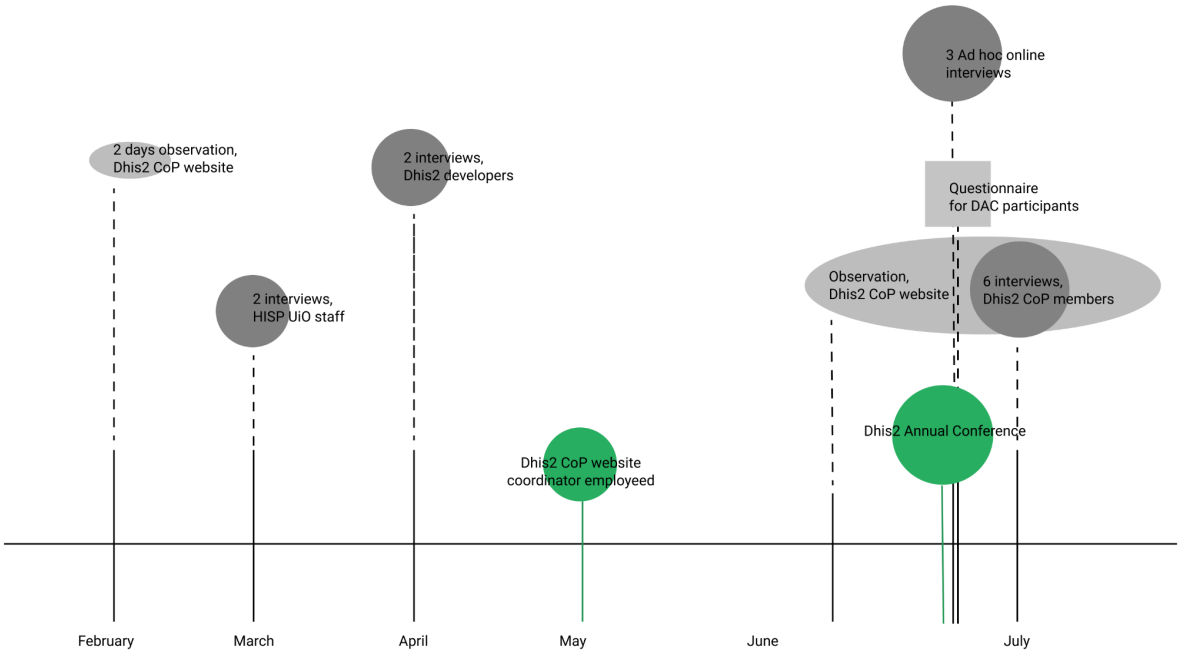


Figure 4: Timeline of data collection.

Initial data collection: the purpose of the Dhis2 online CoP

We started out investigating the use of the Dhis2 online CoP by observing the website and its subforums. We asked the questions: "What is the purpose of the Dhis2 online CoP? Who are the members, why are they there? Does this align? Does the use align with the purpose dictated by the HISP Core Team?". To answer these questions we made an interview guide for a semi structured interview, and hence performed a pilot interview. Then we interviewed two administrative members from HISP UiO, partly employed as Dhis2 online CoP managers.

After the interviews, we did an analysis of the broader socio-technical information infrastructure around the Dhis2 online CoP. We investigated how the organization had been influenced by the introduction of the website and whether and how this had created more complexity within the organizational infrastructure. We gained an understanding of the structure of the organization and asked whether it had the potential to be present at the Dhis2 online CoP. We held three interviews with employees of the HISP Core Team, where one was an external consultant. We also did an observation of the activity present at the Dhis2 online CoP. The interview subjects were all key actors of the development of Dhis2.

The data from our second round of interviews identified a knowledge-void on the outcomes of the Dhis2 online CoP; whether it actually is a place for people to learn and share knowledge. This led us to investigate whether the website can be labelled as a community of practice.

All our insights into the community around the Dhis2 online CoP and the observations, interviews, documentation reading and meetings with managers of the website gave us enough data to define an area of interest that we believe will be influential to understand the

practices of global online forums. With our contextual knowledge we defined the overarching research question to lead the semi structured interviews.

Second round of data collection: Is there a CoP on the Dhis2 online CoP website?

While we carved out the methods to answer the question: "Is there a community of practice at the Dhis2 online CoP?", HISP hired a coordinator of the Dhis2 online CoP and held their yearly conference, where conference participants were prompted to use the website.

In this period of our research we discussed whether interventions on the conference could help our research, as well as the productivity and collaboration on the Dhis2 online CoP. We asked – with the managers of HISP – whether one or more interventions would give insight into what factors could activate and generate members. The idea was to monitor the different Dhis2 online CoP fora before and after the interventions in order to answer this question. However, when considering the short timespan of our studies, the hiring of a coordinator and the big influence of summer holidays on member's activity, made this plan fall through. We saw these "interventions" more influential than the ones we managed to do at the conference. Hence, we decided to do a more thorough round of interviews and created an interview guide based on the CoP theory, with the intention of answering the research question:

"What elements of the social learning theory "community of practice" is present in the HISP online web forum referred to as the Dhis2 Community of Practice?"

We chose participants with the motivation of covering a range of Dhis online CoP members. We met two of the participants at the Digital Annual Conference. We also reached out to 15 different members of the Dhis2 online CoP, aiming for members from the periphery of the HISP network, as our last round of interviews was with HISPers from HISP UiO, and we wanted a broader perspective on the Dhise online CoP. The participants were found on the HISP-network website (https://dhis2.org/hisp-network/, 23.06.21) and contacted them through email. Six responded and had time for an interview within the given timeframe of two weeks. We interviewed them based on the same, new semi-structured interview guide, and the numbering system for anonymisation from the first round of interviews was continued.

3.2 Methods

The case study has been triangulated by participant observation, document analysis (HISP UiO Strategy Update 2019-2022, Dhis2 Community of Practice Proposal and 6-month review of the Dhis2 Community of Practice), one open-ended questionnaire and two series of semi-structured interviews. We have based our data analysis on the interviews and used the rest of our data as a schaffold to understand the themes and topics found in the interviews.

Participant observation was chosen as a method to experience the reality of being a Dhis2 online CoP member and being part of the broader Dhis2 community (Marshall & Rossman, 2016, p.145). Questionnaire was chosen to get access to a large number of people from the target population (the broader Dhis2 community) (Lazar et al., 2017, p.108). Semi-structured interview was chosen as the main method as this is a good way to gain insight into participants' practices and mindsets within a social context (Lazar et al., 2017, p.188-189).

The participant observation was done through monitoring the Dhis2 online CoP website and attending two strategy meetings for how the website could be promoted at the Annual Conference. This has given us an understanding of the dynamics between the members on the website, as well as the number of people active and frequency of activity happening there. In addition, participating in strategy meetings for the Annual Conference gave us a better knowledge of how the HISP UiO Core Team positioned themselves in relation to and understood the Dhis2 online CoP.

Our open-ended questionnaire was sent out to all the participants at the Digital Annual Conference. We ended up not using the data material for our analysis, as the response rate was 2,47% compared to the number of Digital Annual Conference participants.

The conducted interviews have followed three different interview guides to identify elements of the CoP theory. The first round focused on understanding the use of Dhis2 online CoP, the second the community around the website (the installed base) and the last, more rigorous, focused on identifying the CoP theory among the Dhis2 online CoP members. All of the interviews have been done and recorded through a digital video conference tool. The informed consent form was sent and agreed upon in advance. We never started recording before a consent was confirmed. In three of the interviews the interviewee did not have cameras on, due to bad internet connection. Four interviews were done with one interviewer, the rest with two; where one interviewer took notes. Each interview lasted about 45-60 mins. The interviews have given us an in-depth understanding of how the Dhis2 online CoP is perceived, used and how it is thought to be used.

3.3 Analysis

In order to successfully conduct an analysis of the data collected in our case study, we used a theoretical, latent thematic analysis (Braun & Clarke, 2006). After getting to know our data set, we saw it was purposeful to do both a deductive and inductive analysis. Our case study's data corpus was the Dhis2 online CoP website, documentation on Dhis2, the questionnaire and all our semi-structured interviews. The Dhis2 CoP was seen as one unit of analysis as a whole, as we were interested in the forum as a whole, and not the differences between the sub-forums (Lazar et al., 2017). For our thematic analysis our data set was transcriptions of recordings of the six interviews from the second round of interviews.

Thematic analysis is used extensively within social science, often in relation to interpretivism (Braun & Clarke, 2006). We initially choose a theoretical thematic analysis as it is recommended for new researchers who wish to analyze qualitative data in a structured, theoretically driven way (Clark & Brown, 2006, p.86).

After transcribing our interviews, we set out to deductively analyse the data set on the basis of Smith et.al's (2017) ten identified categories of the CoP theory. We read through the transcriptions with ten different markers in hand and ExCel sheets to note down quotations to each category. We then structured our findings on a board, where we rediscovered and compared them.

As we got to know the data set, by transcribing, discussing and rereading it, we saw certain similarities across the data items that did not fit in any of the categories of the CoP theory. We asked ourselves whether this could contribute to the gap in literature on characteristics of global online communities of practice. Hence, we decided to do a semi-inductive thematic

analysis of the data set as well, which provides more flexibility than the theoretical thematic analysis (Braun & Clarke, 2006). We did this by rereading the data items, structuring the similarities into categories, discussing the findings and then mapping them into themes. Our report therefore contains two levels of analysis.

3.4 Our role

In our analysis we took the role as interpreters of the insights we have gained from the interviews in relation to what we have observed as members of the website and the HISP organization for six months. Throughout the case study we have, with Walshman's guide on interpretive studies in mind, taken a semi-active role as involved researchers; we have given advice and participated when questioned, but tried to stay objective when we could, in order to give back to the organization we have studied (Walsham, 2006, p.21-22). We want to acknowledge the bias that is present in our analysis in the form of serving the HISP organization and the people we have gotten to know throughout our study.

During our research, different interventions were made by the organisation to create a better collaboration and learning environment on and through the website; a coordinator was hired in May 2021 and the Digital Annual Conference of the global Dhis2 Community was held in June 2021, which both researchers attended. The researchers have had a continuous dialogue with the coordinator since May.

Through being a part of the HISP community for a year, we have accessed all our interview subjects through our own close relation to the HISP Core Team and HISP management. Without this connection we believe our data gathering would have fallen through, as the people we have tried to reach without the help from the HISP management have not gotten back to us. However, we have to acknowledge the bias that comes with data gathering based on a hierarchical network. The subjects of our interviews have known our connection to the management in HISP, which automatically brings some skewness in the data (KILDE?).

Ethics and privacy

The data should have included a broader variety of people in the community. All our participants are at a moderate to expert level on the knowledge scale of Dhis2 with close connections with the management within HISP Core Team.

The data from the interviews was anonymized, and all participants have signed an informed consent sheet. There is a risk that a dedicated investigator can narrow down the group of possible participants, because some of the teams mentioned in the quotes are very small, and the website used for recruitment contains a limited number of people.

We have not intentionally accessed any sensitive information. Any sensitive information has been deleted. Data has been stored on researchers' computers and UiO's G-suite. Without the close relation to the management of HISP, this study would not have been possible.

4 Findings

The findings from the analysis will be presented in this section in two parts; the first concerns the presence of ten elements of the CoP theory, based on how the theory is described by Smith et al. (2014). The second section describes the challenges they face with the Dhis2 online CoP[1].

4.1 Elements of CoP in the Dhis2 online CoP website

The domain, community and practice for the Dhis2 online CoP website

As described in the Theory chapter, a CoP has three main features, the domain, community and practice (Wenger, 2010). In this case, the domain would be the development and support of the Dhis2. The community in the case of this article would be the Dhis2 online CoP, which is different from the formal *teams* the members of the community work in on a daily basis, as the website is global and, to a certain degree, unfamiliar. The shared practice is developing and implementing Dhis2, making Jira tickets, fixing bugs and posting/ answering support questions.

Participation and reification

In the following we present how participation and reification happens on the Dhis2 online CoP.

The members interviewed participate in the community to a varying degree. All report that they read posts, while only some of the members make posts that are either questions or stories from the field.

Participant 11:
"You won't see me post as much [support], but you will see me writing stories from the field."

Participant 5:
"I only participate when I have some support, I have not made a post"

The members interviewed seldom contact anyone directly on the website, but rather talk to the community as a whole.

Participant 11
"I interact with no one in particular, I interact with the community […] I don't think the CoP was made for one on one conversations"

The exception was when they tagged specific teams or groups on posts, hoping for a quicker answer, or used established personal connections with experts which were contacted through other channels, like Slack and WhatsApp to get answers to technical questions.

Half of the participants produced new posts on the Dhis2 online CoP website on a regular basis, and the degree and mode of reification varied. The majority of the participants,

[1] The participant quotations refer to the Dhis2 online CoP as 'Community of practice' or 'the CoP', and the broader Dhis2 community as 'the Community' or 'the HISP network'.

regardless of role, explained that they have been answering questions on the Dhis2 online CoP website at some point during their membership, ranging from a few times a year when they were asked to do it, to several times a day in a systematic manner. The reasons for this are elaborated in the next section of findings. One developer had created a system of tags on the Dhis2 online CoP that identified questions related to their team's software, and visited the Dhis2 online CoP every day at work to answer questions.

Participants 6:
"Before the CoP, reaching the devs was very difficult, using these tags we can give an answer as fast as possible."

The majority of participants employed in a coordinator role reported spending little to no time producing answers to technical questions, despite extensive formal education and experience in the field of information technology and Dhis2. The posts they made were mostly focused on stories from the field.

As with the rest of the world, Covid moved close to all interaction in the global HISP community to online mediums. It digitalised the Annual Conference and exchange between local communities, but it also allowed remote HISP groups to interact more frequently. Our participants described this factor as increasing the chance to reach the community.

Participant 11:
"Covid gave less travel but more online interaction"

Regime of Competence

Based on our findings, there seems to exist a regime of competence in the Dhis2 online CoP. The members of the community differentiate peripheral non-active members of the website from active members of the community, by identifying a mutual understanding of the domain:

Participant 10:
"It's easier to communicate through the CoP or HISP network because we understand each other."

Participant 11:
"You [write about the creation of some apps on the CoP] and then the community identifies you as a potential collaborator."

The participants agreed that the negotiation of what direction the Dhis2 online CoP should evolve in, and what the purpose of the website's community is, is a joint process. There is a clear pattern of horizontal accountability, while little in the way of vertical accountability and hierarchy, as expressed by one participant:

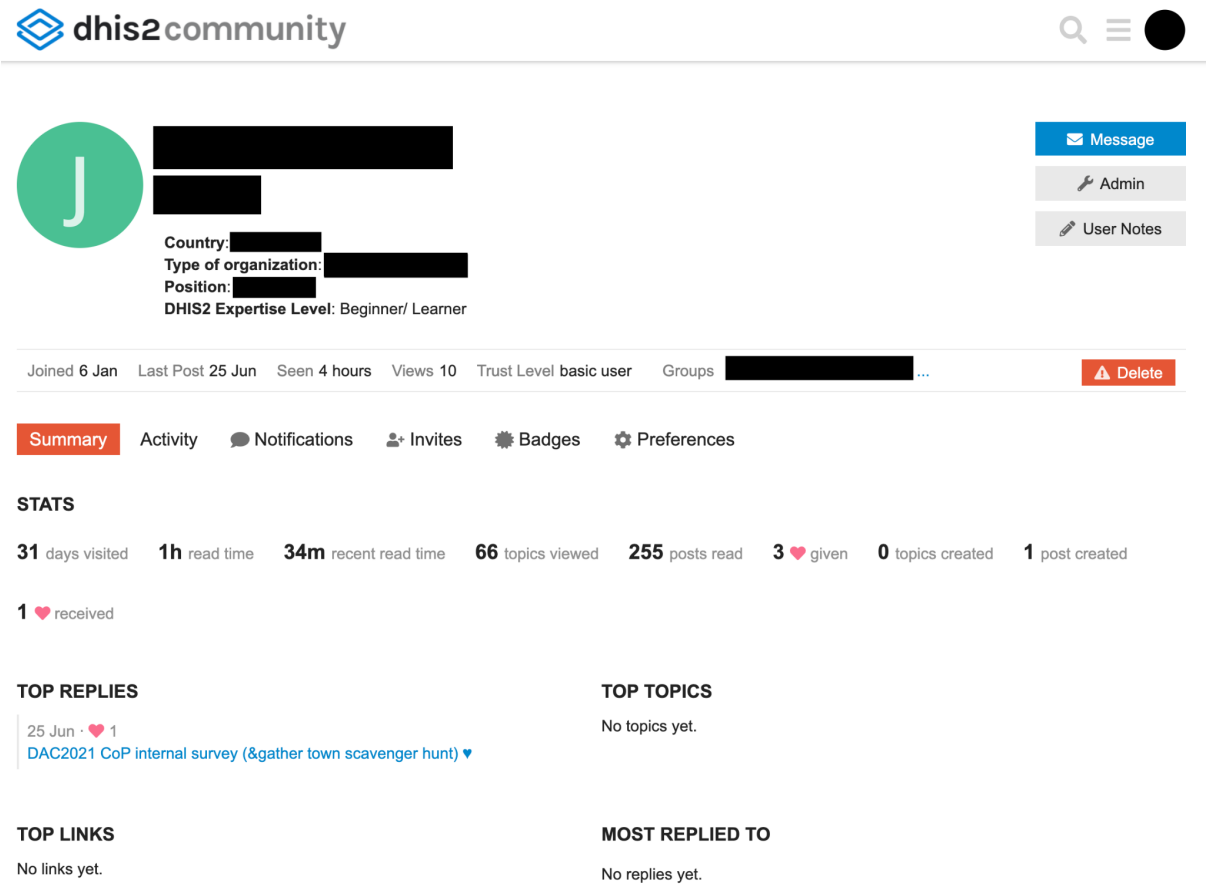
Participant 10:
"Nobody feels that someone has power in the community, I think it's a good thing."

Some of the members of the website that are identified as competent are given access to other communities of experts, like the core developers and academic staff, by being invited to specific Slack channels and WhatsApp groups. The communication on these instant channels

is perceived as more effective, and answers can be obtained from experts at a faster rate. This limited the time they spent on the Dhis2 online CoP; if the answers they were looking for were not already posted on the website, they often instant messaged an expert. The consequence of this is that the expert answers that were received did not reach the community on the Dhis2 online CoP.

Participant 11:
"For me, first of all, uh, I have to declare that have not really kind of asked direct question in the CoP. I don't think if you search there you'll find me asking a question but you see me writing some stories from the from the field. So that's, uh, that's the thing. Yeah, maybe because I'm quite closer to, you know either the UiO team, the developers who are there. So I used the slack directly to check onto. Yeah, I think yeah, I think at least because we have that you know access to the developers so it's easier for us to go through that. And I think for us, Slack is more. […]We refer also the CoP to our new developers or new implementers too. If they are faced on anything they could go to there and see some challenges."

The participants explain that it is difficult to understand who knows what. The researchers personal observations of the website confirm that there is little information about the members on the most profiles the researchers visited. This lack of identifying information may undermine the effects of a regime of competence within the Dhis2 online CoP, as the members report having trouble identifying each other's competence.



Figur X: A Dhis2 online CoP Profile. Where identifiable information such as country, type of organization, position and Dhis2 expertise level can be applied.

Identification

To some degree, we found data that confirms a need to get one's identity recognized within the Dhis2 online CoP. A recurring story was the comfort of imagining that someone else was working on the same challenges, and that you could connect to them through the website.

Participant 5:
"It's kind of comforting knowing you are not alone. Also, you find a solution!"

This also helped the members align with what was going on in the broader HISP network.

Participant 9:
"I think in our community it's important to know what's happening in a different location so that you become aware... how you should deal with it, or who you should reach out to."

Participant 8:
"You get to know the [HISP] network and that also inspires us, you know? You get to be a part of that network"

The participants reported that seeing the impact of their work being used by others with the same mission as themselves, either through user stories or support requests, set the work in HISP apart from other technical jobs, and was a central motivator for several of them. They identified the Dhis2 online CoP website as a catalyst to connect to a whole network of like-minded people.

On the Dhis2 online CoP the tone was perceived to be friendly and formal, and this was described by the participants to be how one should behave as a member of the website. The experienced members on the website did not bicker with or belittle the new members:

Participant 10:
"I would say it's welcoming because people don't see anyone threatening them or bullying people. Everyone is very polite and nice to people."

Boundaries

The Dhis2 online CoP is one of several communities formed by HISPers. All participants expressed both their identification with the Dhis2 online CoP and with bordering communities. These could be local HISP groups, informal networks, other communication channels and instant messaging channels. Within the Dhis2 online CoP there are also boundaries between the language communities, especially the english and the French-speaking community. This creates some double work with support questions, as explained by one coordinator:

Participant 10:
"But, uh, in general, the French speaking countries, uh, they seldom engage with the Community of practice platforms. [...] Everything is more English centered [...] That's why we are doing a lot of webinars and so forth to encourage them to be more frequent on the CoP [...] whenever there is a problem they reach out to us. Systematically, when you have this kind of issue of not coming and sharing with the Community, we [as a HISP group] have assigned some people to do it, but that is not yet systematically done… Because we want to. I mean, we don't want to be receiving the same question in two different languages".

There also seem to be created more boundaries between HISPers sharing the same domain, when one part of the group is not being present on the Dhis2 online CoP, forming a community proves difficult:

Participant 5:
"We have tried to engage with the [other Android] developers. We know they are out using Android, but we don't know who they are."

Brokering

Several of the participants functioned as knowledge brokers to other communities, for example between the Dhis2 online CoP and the UiO developers,

Participant 11:
"When solutions [posted on the CoP] were not working, they were reported onwards by HISP Tanzania to UiO [to be removed]."

between Slack and website:

Participant 5:
"Conversations with developers on CoP always moves into slack"

or between solutions written in english and french speaking subforums:

Participant 10:
"Uh, if replies [are in english]... I'll go there and read it... most of [those who message us] are also French-speaking, so, and uh. The issues are generally in English, so we just provide the answer to that."

These brokers mitigate some of the challenges with boundaries between the French and English speaking community, and express wishes for better language support. Neither our own research, published research or documentation we have found cover a diversity of languages within the same community, like the Arabic or Spanish, so the status and challenges for these communities are unknown.

Identity

At the Dhis2 online CoP website, members can write about who they are, their expertise in Dhis2 and what they are interested in. However, our participants seldom noticed members doing this. The same was noticed during our own observations of the website.

All participants were asked who the typical user of the Dhis2 online CoP is, and whether they identified themself as one. A common answer was:

Participant 10:
"In some ways, I am a user. But I don't describe myself as a typical user."

Additionally, our participants told us that they have a speciality which they identify with within the community, by which they expect to be noticed for:

Participant 11:
"We wear some hats, which identify certain work or specialisations […] The CoP gives access to gloat"

The participant's impression was that most of the active users on the Dhis2 online CoP were either UiO staff or implementors. This finding is difficult to manifest, as many members don't have an identifying biography. However, there is a clear identification on who the most active user is:

Participant 10:
"Those who are more in the technical fields are more active on the CoP than myself [HISP group coordinator]"

The participants expressed that they seldom interact with staff from the HISP Core Team on the Dhis2 online CoP, they would rather use other communication tools to get in touch with them. Those with highly technical skills or from an administrative background seem to not use the website. When asked why this was the case, one participant explained:

Participant 10:
"[...] so far you will hardly see people from the ministry of health there, because you don't have these highly skilled people within the Ministry of health, because, when they have good skills, they prefer going to work with banks [where they are paid well]."

Knowledge

Through their interactions with questions, posts and messages, the users of the Dhis2 online CoP website generate a lot of knowledge, which is stored on the plattform. In addition, the number of members tells of a lot of knowledge within the community. The participants explains that this makes the Dhis2 online CoP one of the first places they check when encountering issues with the software;

Participant 8:
"The CoP is the first backstop if they are stuck, because someone else is probably also stuck with the same thing"

With many different versions running simultaneously on different implementations of the software, the complexity can be quite daunting for new developers and implementers. A solution which works for one implementation of the software, may not be compatible with another.

Participant 11:
"There is no kind of silver bullet for this kind of system"

With the Dhis2 online CoP, discussions of problems and solutions for different versions can be accessed:

Participant 11:
"The CoP has most of the legacy information"

But the participants express a need for more effective ways of searching for the information on the website:

Participant 11:
"The content is there already, you just need a better mechanism for implementers to access the right information"

Learning Architectures

We found that the most prominent learning architecture was the duality of globality and locality on the site. Our participants state that they connect to the global community through the Dhis2 online CoP to increase their learning in local contexts. For some participants the website is the best Dhis2 learning architectures they have access to:

Participant 9:
"The community is spread around the globe and can't all get to one place. They can't come all at once to Oslo, right? And somebody from, say, a very remote country who doest have the money to fly, right? They can't come to Oslo. So what is connecting them right now? It's this tool, the web portal Community of practice. So for them the portal is everything."

Thus the website can be seen as a learning architecture in itself, as it facilitates learning. The participants confirm that it is a resource hub as well as a communication forum, which was one of the main motivations for creating the website to replace the email list.

When asked about his history as a member of the greater Dhis2 community one participant said the following:

Participant 9:
"In the last three or four years, I mean, everything got more organized like you have now on this web platform, which is really cool, because like, the initial email list was not that helpful, like only a few people got connected. And then with this web platform and everything, now it's more connected."

The same participant later elaborated on how the Dhis2 online CoP had helped him learn more about the Dhis2.

Legitimate Peripheral Participation

By registering as a member on the Dhis2 online CoP website, the user enters the periphery of the community. The journey of growing involvement from the periphery of the Dhis2 online CoP to the center is both experienced by the participants:

Participant 9:
"So that way, I mean, I kind of got friends, I mean like yeah, I got to know them and then we started communicating. Mainly around DHIS2 platform and then around different other topics such as how to implement information systems in developing countries."

and the one's activity is recorded on their public profile:

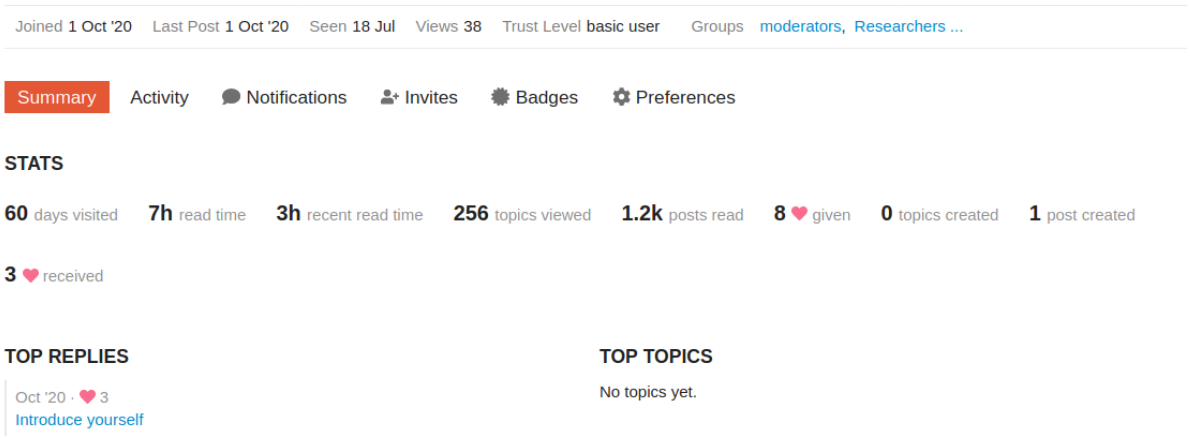


Figure 5: *Private screenshot of one of the researchers' profile on the website.*

The participants were typically introduced to the website at a Dhis2 Academy, or as a part of an onboarding procedure:

Participant 5:
"It was at an Annual Academy a couple of years ago. It was presented as a place to hang out and figure out how to configure DHIS2. They said it's for you to gather, to know each other, to serve […]"

Participants who did not know of the Dhis2 online CoP website when they started working for a HISP group describe a feeling of being overwhelmed with information while lacking a knowing of how they could find the resources they need to become a valuable member of the broader Dhis2 community:

Participant 4:
"When I joined HISP it felt like I walked into this empty library, theres documentation and all that […] But when I found the CoP, I found that there's a place to actually discuss and talk."

The participants stressed the importance of introducing the Dhis2 online CoP to new HISP employees as a part of their training, so it can facilitate the legitimate peripheral participation in the broader community:

Participant 9:
"I feel that the webpage may be the only tangible way for a new person to, you know, feel the community. So Slack is not open to everyone. And you can't whatsApp or call, say, Prof. Kristin."

Value Creation

There was a general consensus that the Dhis2 online CoP website created a lot of value for its members, in the form of technical support. It also decreased pressure on senior developers, increased networking, exposure, inspiration and the sense of community for its members.

Participant 11:
"The CoP gives knowledge […] The CoP works as a buffer for the seniors, handling basic requests. The advanced ones trickle up"

Participant 10:
“[I]t is also a good way for them to reach out to people, because, if that CoP was not there, maybe they might not be able to reach out to me. So in a way, yeah, it's helped in connecting people and sharing knowledge.”

Participant 5:
"It's useful to get to know the real people who are using the software […] As a developer, I know that something I worked on is used for the better."

The primary cost for the participants to access this value was time, which will be elaborated upon in the second section of findings.

4.2 Challenges

Time

Our inductive analysis shows that time is the most critical challenge for participation in the community. When asked about the cost of participation, every participant mentions time. Enough time is critical for both participation and reification. While one member spends his time posting an issue and waiting for a reply, another member with the same problems saves time since they can read the postes questions and answers. There is a “time trade” happening. The duality of participation and reification together forms the shared history of learning, which is essential for both a regime of competence and a regime of accountability to grow forth (Wenger, 2010, p.180).

Critical for reification

When members make new posts or answer posts in the community, they participate by reification – they create new content and information for others to use as learning artifacts. This reification is also value creation, because it gives an incentive for new HISPers to join the community. The nature of the Dhis2 online CoP website as a database of problems and issues with solutions also works as a time saver.

The participants who had a way of reporting their spend time on the Dhis2 online CoP website, which was accepted by upper management, gave us the impression that they spend more time participating in the community compared to those who did not. The people who did not have an accepted way of logging time on the Dhis2 online CoP website, had to “sneak past” management and log it using other codes, like time spent on customer projects or academies, or use the Dhis2 online CoP in their free time. The following citations show how time is of the essence:

Participant 9:
*“[I]f I had **more time** I would have loved to just answer the queries then and there.”*

Participant 6:
*“I saw the question and thought I could give an answer in a short enough **time**.[…] I guess if I had allocated time and work to do it I would do it more”*

Participant 10, when asked about the of using the website:

*“It is **time**! ...we don't necessarily have a [timesheet]-code for contribution to the [CoP] [...] When I use it, it's on my own time. I don't charge"*

Participant 11, when asked about the cost of using the website:
*“**Time** is a major factor, time is a critical resource out there.”*

One of our participants had a way to increase the efficiency of his time spent on the Dhis2 online CoP. He and his team had a tagging system, managed by an employed Dhis2 online CoP and Jira coordinator. Our participant could hence log onto the Dhis2 online CoP every day and go through these tags, contributing and answering specific questions.

Critical for participation

By participation we are referring to people spending time on the Dhis2 online CoP. This differs from reification, as it excludes contributions of posts / solutions. The following citations show how quick responses to issues are essential for people to participate in the Dhis2 online CoP:

Participant 9:
“If you post in CoP and you don't get a reply for like, depending on how urgent you, how urgent the matter is, like, a couple of days or in some cases a couple of hours, if no reply, they might directly message that person in Slack.”

Whereas participant 9 can solve his issue on other platforms, this is not the case for every website member. We identified a duality of time that plays a role when it comes to participation; the time you as a member have available to wait for a reply and the value in a community where issues are solved rapidly.

Participant 10:
“I see the CoP as a tool to not waste people's time […] I don't want to sit in my corner and sofa for many days to find the solution.”

Participant 7:
“As a typical user it will be very OK if I get solutions to my problems within the shortest time.”

Forum brain drain

Our findings suggest that as members get more competent in the Dhis2, they become less involved in the Dhis2 online CoP. We have identified two reasons for this. As they become more integrated in the broader Dhis2 community:

1. ...they find other ways to communicate with each other and with the Dhis2 experts.
2. ...their time is more on demand in order to keep the organisation running.

The following citations tell of this finding:

Participant 9:
“*So previously I was more engaged with the Community of practice helping out other people, but like now, […] I'm becoming a bit too busy […] and then you have too many modes of interactions with the community, like you have even the Slack which is faster and more*

focused. So right now I'm using Slack more, to be honest, than the Community of practice web portal. [...] *I mean, if I consider myself as the DHIS2 expert, I myself am able to troubleshoot most of the issues, right? I know how to troubleshoot. […] I tend to focus my support to like whatever the help I need from Dhis experts like from the product manager or a core developer. I just directly ask them."*

Participant 11:
"I don't think if you search there you'll find me asking a question […] maybe because I'm quite closer to, you know either the UiO team, the developers who are there. So I used Slack directly [...] And I think for us, Slack is more. You know one to one, you know where you can quickly ask there"

Participant 10, a HISP group coordinator:
"Those who are more in the field, working on technical things, that are more active in the community than myself […] "

Two of our informats tell us that they have been actively participating in the Dhis2 online CoP previously, but as they got more integrated into the broader Dhis2 community, and became connected to people in the core team, they spent less and less time at the Dhis2 onilne CoP and their active participation went down. By active participation we are here referring to not only searching or posting for their own learning, but that they were also actively reading and helping other members. As they have made their way into the inner circles of the broader Dhis2 community, they have more competence, more responsibility, more direct access to the core team (through Slack and e-mail and weekly meetings) and less time to spend on the Dhis2 online CoP website.

Issues and problems

Our data shows that local problems and issues with the Dhis2 are the main reason to participate in the Dhis2 online CoP website. Either, they search for a solution to a problem at the website and find that someone else has already encountered this issue and the solution(s) provided works in their context, or they don't find a good / working solution to a problem and might make a post to receive help. When they make a post, their participation increases, as they will monitor the Dhis2 online CoP until their own issue is resolved. This increases the chance of them answering other posts as well, as they now monitor the website, looking for a solution to their problem.

Participant 9:
"He has a problem and he wants to, you know like, troubleshoot. What are the options they have? The number one option is Community of practice. […] Most of the typical users are end users who have questions."

Participant 10:
"If I go to the CoP I want to see the page because I believe someone already has the same problem. […] The typical user are the country admins who may experience some day-to-day problems"

Participant 7:
"In defining a typical user, somebody that is always there, trying to look for solutions. […] Your best bet is going to the community of practice to be able to find a solution [...] If you

have challenges we can look through it among ourselves within the team here, and if not , if there are very critical issues, then that's where we ask questions on the [CoP]"

An important aspect in this finding is the use of Dhis2 online CoP (in some cases) as the last resort for learning. Participant 7 acknowledges that his local community tries to find a solution before reaching out to the global community on the website.

Participant 7:
"Most of the challenges [posted on the CoP] are the ones that you might not have somebody around that can support you, and when you take them to the CoP there's always someone that will be able to come to your aid."

In our case, the Dhis2 online CoP kind of works as a *boundary object*, an "form of reification around which the community can organize their interconnections" (Wenger, 1998, 105), between local and global engagement. Members at the Dhis2 online CoP have to balance between different regimes of competence and have an understanding of the boundaries in their different communities. As Participant 6 gives a good example of:

Participant 6:
"I don't think my company would be happy if I said I spend time on chatting to people on the CoP when I put in like my hours on what I have worked on throughout the day […] You only go to the CoP if there was no answer internally first and then the reason you link it back [to Slack] is to try and get it higher visibility in some cases. So if we have issues on Jira we link them to [company] to get more votes, because otherwise it will not get looked at. The similar kind of thing for questions on the CoP."

Here the participant exemplifies how he brokers between his communities. First he is using his local community to help him validate an issue as relevant for the Dhis2 online CoP community, hence he gives the issue more visibility, in the form of upvotes from his colleagues, on his question at the website. He knows that visible interest in an issue will help him get answers quicker in the community at the Dhis2 online CoP and uses this to effectivise his learning.

The fact that people primarily appear when they have issues, creates discontinuity of participation. It makes the practices that emerge around the Dhis2 online CoP defined and driven by engagement in local communities, which is seldom mutual across the globe. We will discuss the implications of this finding further in the next section.

5 Discussion

Our results show that there is a community of practice at the Dhis2 online CoP, and that time, brain drain and local issues and problems are challenges in a global and online community of practice. This section will first discuss the reflexivity, strengths and weaknesses of the methods used in the study, followed by a discussion on how Dhis2 online CoP differs from CoPs described in the litterature in relation to core CoP concepts of participation and reification, and finally discuss the challenges and opportunities distinct for the Dhis2 online CoP website as a global and online community of practice.

5.1 Reflexivity, Strengths and Weaknesses of the methods

Reflexivity

Our research question was centered around identifying elements of a theoretical concept in our case. The CoP concept was chosen as a theoretical lense by the researchers since it was the central idea behind creating the website. The choice was to some degree a subjective choice, and we could have used other theories or concepts to analyse our case, like the Network of Practice theory. But the Community of Practice theory fit best in relation to the context, and it gave our research relevance for the HISP group (Walsham, 2006).

This choice has informed our data collection and analysis. A more inductive approach to the initial thematic should bring to light different aspects of global and online collaboration and learning than the ones presented here.

We first chose to do a deductive analysis, and our interview guide was formed on the basis of the theory. After identifying several of the elements, we noticed recurring themes that did not fall into any of these categories. We therefore decided on another level of analysis, and did a semi-inductive thematic analysis on the same data. This provided both a data-theory link for external validity, and the flexibility to make our findings more relevant to the HISP groups (Walsham, 2006).

Despite the short time frame for interviews of two weeks, the researchers had the impression that they had reached a satisfactory level of theoretical saturation, where the accounts they were told seemes similar enough (Crang & Cook, 2007). This led to the ending of the data collecting.

Strengths

The interview guide was based on the thoroughly documented and researched theoretical concepts as a framework, the Community of Practice. This may help the external validity of our data, as the CoP concept has been used in a multitude of other cases (Lazar et al., 2017).

The findings are based on several different data sources; semi-structured interviews, a questionnaire, documentation reading and observations of the Dhis2 online CoP. Findings from interviews were confirmed by observations and answers for the questionnaire. This triangulation with data sources helps increase the internal validity of the findings (Lazar et al., 2017).

Weaknesses

A weakness of our data collection is its lack of consistent methodological rigor from project start to finish. We chose to weigh relevance before rigour, in order to provide valuable findings for the Dhis2 online community. We explored the domain and read literature, were exposed to different supervisors, with different ideas of scope, focus and scale throughout our research. Hence, our choice of data collection methods fell rather emergently. This gave us different data sources, but has reduced the methodological rigor of the research. The methods used in this study are hence coloured by those shifts in focus.

This study has not captured the heterogeneity of people at the Dhis2 online CoP, as most of our participants were either developers, coordinator or UiO core team administrative employees. The number of participants were also low, although the researchers experienced that the data became saturated in the end. Local implementers, ministry professionals, data managers and data capturers are not represented by our findings. Among the participants there's only one woman, which also is not representative of the target population. There is a missing understanding of the degree of heterogeneity in the community, and all our attempts to get in touch with unidentified, inactive members at the Dhis2 online CoP fell through. It hence lacks valuable data that might have tilted the findings.

The use of an deductive theoretical thematic analysis brings with it the danger of confirmation bias (Walsham, 2006). The saying "when you have a hammer, everything looks like nails" may have applied in our case. We ran the risk of unintentionally interpreting statements that do not fit into or contradict the CoP theory in a way that supports the presence of a community of practice on the Dhis2 online CoP. There has also been some degree of involvement from the researchers in the planning of how the Dhis2 online CoP should be used during the Dhis2 Annual Conference, on the request of central HISP members, which may have given the researchers a feeling of being invested, which may again have colored our judgement.

The small timeframe has negatively affected this research. Even with an understanding of the time given to accomplish the study, the time needed to understand the nature of a research project was greater than expected. The inconsistent use of methods reflects this.

5.2 Participation in the Community of Practice

Participation and reification are the most basic elements of the community of practice, and need to be present for there to be any form of learning and memory in the community (Wenger, 2010). Other elements of CoP like the regime of competence, negotiation of meaning and learning architecture emerge from the dual process of participation and reification (Wenger, 1998).

Out of the ten key elements of CoP this research has investigated, the method of participation and reification also differs the most from the communities of practice described in the litterature, in three distinct patterns:

- Participation happened mainly through reification of content instead of face-to-face.
- Interaction happens between an individual and the community, instead of a one-on-one basis.
- Participation in the CoP functions as legitimate peripheral participation to smaller bordering communities

We therefore wish to focus the discussion on how these essential elements play out within the Dhis2 online CoP website.

Participation trough reification

Typical forms of participation in a community of practice are face-to-face interactions with members of the community, conversations and joined activities. Our findings suggest that this happens rarely at the Dhis2 online CoP. members mainly participate through reading and the production of text, a form of reification.

Participation and reification are not classificatory distinctions of concepts, like a scale from hot to cold, where more of one is less of the other, but complexification distinctions, where the presence of one enriches the other, like the sweet and the salty in a caramel (Farnsworth et al., 2016, 8). This suggests that participation through reification, instead of face-to-face conversations, may have positive consequences for the website; the problems and solutions are saved and archived for future reference, which the participants point out as one of the key attractors for the website.

Absence of the motivator one-on-one interaction

A low level of one-on-one interaction is one of five major reasons communities of practice fail, as regular one-on-one interaction is vital for the motivation of the members to participate in the community (Probst & Borzillo, 2008, 343). The participants in our study report very irregular participation at the Dhis2 online CoP, and little to no one-on-one interaction with the community. The participants report that when they participate through posting, they talk to no "no one in particular" on the Dhis2 online CoP, but to the community as a whole. At the same time, they report a feeling of community, meaning and identity in relation to the Dhis2 online CoP, and we have found the presence of all ten major elements of a Community of Practice on the Platform. Some participants also explained that they have found friends on the website.

This suggests that other motivational factors, like getting solutions to local issues, opportunities for networking and seeing the effects your contribution to the open source software has in the field may help mitigate the need for one-on-one interaction. Further research into other "impersonal" communities would be advised to answer these questions.

Recruitment to other communities

One-on-one interaction between members of the broader HISP community happens mostly through other communication channels, like email, Slack or WhatsApp. This is because the members get answers faster there than when they post on the Dhis2 online CoP. This may encourage the formation or strengthening of communities other places than the Dhis2 online CoP, which many of our participants point out. One reason for this can be that the mutual feeling of reciprocity, essential for the formation of a regime of accountability, is not between the members and the Dhis2 online CoP as a whole, but between the members and the other HISPers that they establish more direct communication channels with (Wenger, 2010).

In this way, participation at the Dhis2 online CoP can be seen as a form of legitimate peripheral participation for smaller, more direct and interactive communities on other channels. As time is of critical essence for the participants, our findings suggest that the Dhis2 online CoP coordinators should take a stand on the tradeoff between rapid responses for members and cultivating a competent core of members with a shared history of learning.

It is not a sure thing that the coordinators can make a decision about this on behalf of the Dhis2 online CoP. According to our findings the Dhis2 online CoP is perceived to have a flat power structure, where the purpose and direction of the forum is a result of a continuous mutual negotiation between the members, which is in itself one of the key characteristics of a functioning CoP (Wenger, 2010; Probst & Borzillo, 2008). Practice is a response to management, not a result of it: "No matter how much external effort is made to shape, dictate

or mandage practice, in the end it reflects the meanings arrived by those who engage it" (Wenger, 2010, p.181).

If changing the practice of one-on-one interaction happening on other channels than the Dhis2 online CoP is desirable, it is important to champion the cause through indirect means, like seeking agreements and alignment across the social structure (Wenger, 2010), while ensuring that the spontaneous and risk free character of the Dhis2 online CoP is not undermined (Probst & Borzillo, 2008).

The CoP as a Network of Practice

An Electronic NoP (Networks of practice) is a mostly online community that enables members to discuss challenges and exchange advice about common interests and domains (Wasko & Faraj, 2005). The reasons for why NoPs occurs are similar to why CoP occurs, but there are some distinctions between the concepts: while a CoP is usually a tight knit group of people who meet face-to-face and work together, a NoPs members are usually larger, loose knit geographically distributed groups who does not know each other, but share some common practice (Wasko & Faraj, 2005).

Members of a NoP usually address the network as a whole with questions, not anyone in particular. These networks are usually sponsored by third parties, like firms, organizations or NGOs, and interact through online mediums, conferences and newsletters. The Dhis2 online CoP website shares a lot of similarities with both concepts, but some aspects of our findings more similar to the NoP concept, like the large geographically distributed member base of the Dhis2 online CoP, third parties sponsoring of the website and the trend of addressing the community instead of anyone in particular. Further research could investigate what experience and learnings could be derived from using Networks of Practice as a theoretical lens for investigating the Dhis2 online CoP.

5.3 Challenges and opportunities for the Dhis2 online CoP

Caution to time, the number of communication channels and locally based issues and implementation troubles are main challenges for cultivating the Dhis2 online CoP. This implies that keeping the community sustainable includes a careful attention to how people spend and record their time, and the boundaries and brokering happening among the different sub communities within the global community.

Learning, time and space

We have to address the implications following the fact that members of the Dhis2 online CoP learn by negotiating between their local community and the global community on the website. Learning in the Dhis2 online CoP is getting more competent in Dhis2. The members of the Dhis2 online CoP primarily learn by taking a problem in a local context and applying solutions from a global community in this local context. Wenger emphasises that learning in a community of practice is the process of becoming; wanting to be identified with a certain competence or becoming a part of a community (Wenger, 2010, pp.181-182). This includes a dimension of people recognising you as a competent member. It takes time, and it is the space the community exists in that enables it to happen. Our findings identified time as an essential factor for members to participate, hence it is also essential for learning to happen. The feeling of the Dhis2 online CoP being a community increases with members active online within the

same timeframe, as answers to questions are provided at a faster rate. The Dhis2 online CoP then becomes a space where people learn and become more competent, helped by the global community. The physical Dhis2 online CoP website works as a boundary object between these local contexts; a thing that different communities of practice can interconnect on (Wenger, 1998, p.105). This creates a global and local duality that gives the participant the role of a broker, negotiating between the local context and the global community when he / she learns. This is something that a global and online community of practice should be aware of and cultivate for. Digging deeper into the consequences of this duality, one should look at whether similarities in local contexts works as a catalyst for learning, and the effect of effective problem solution on member participation.

5.4 Share a history of learning

The challenges presented in our case study calls for a more conscious facilitation for how members of a global and online community of practice spend time in their common practice. The fact that people don't have time to spend on the Dhis2 online CoP slows the process of creating a shared history of learning, which again degenerates the regime of competence and learning capabilities – both key concepts in the CoP theory (Wenger, 2010, p.180). We have identified two factors that we believe can help cultivate a more sustainable community of practice on a global scale.

Give allocated time

Our findings suggest that employed Dhis2 implementers and developers need to get credit for the time they spend at the Dhis2 online CoP. Logging the time spent contributing to the community forms transversality; "the ability to increase the visibility between horizontal and vertical structures of accountability", an important aspect in the CoP theory (Wenger, 2010, p. 196). Acceptance for time spent on the Dhis2 online CoP by local management, will foster continuity of use and hence more mutual engagement among the members.

Another way of giving allocated time at the Dhis2 online CoP is to embed the use of it in members' work practices. One way of doing this is to encourage the local teams to onboard efficient functionalities, such as tagging posts relevant to their team or setting up a proper coordination between the posts at the website and the member's mail. This might effectivise their work. Here, the local management should make a strategy on how the Dhis2 online CoP will be integrated.

We believe this will give the community a stronger learning capability, as when they spend more time on the Dhis2 online CoP they will be able to identify each other and inspire each other to gain competence. This assumption is based on Wenger's description of learning through becoming, where alignment between members of a community brings forth learning (Farnsworth et al., 2016, p.12).

Keep the competent core

Our interpretation is that members who have had mutual engagement within the Dhis2 online CoP and then gained a competence or more important roles in the broader Dhis2 community, faded out of the Dhis2 online CoP and into different parts of the broader community. These people were often more active than the typical member of the Dhis2 online CoP and were given a clear passage to the experts of Dhis2. This led to a preference to spend time on other platforms than the Dhis2 online CoP.

This tendency to not use the Dhis2 online CoP website when one creates a lack of continuity of members and reduced vertical accountability. An aspect of cultivating a regime of competence and vertical accountability is negotiating competence in the Dhis2 online CoP domain over time (Farnsworth et al., 2016, p.5). With vertical accountability we are referring to traditional hierarchy, which helps a community generate learning through imagination (Wenger, 2010, p.195). In our case the people higher in the hierarchy – with more knowledge about the common learning goal – spend more time in other communication channels; such as Slack, Jira and WhatsApp. This goes against other research on effective learning in communities of practice. Kirkman et al.(2017) identifies a high number of empowered and interdependent members as important (Kirkman et al. as cited in Asah, 2021, p.8). Probst & Borzillo (2008) explains that a lack of a core group, who daily interacts with the community is the number one reason for failure (Probst & Borzillo, 2008, p.343). The many ways of communicating with the same community makes it difficult for a clear regime of competence and accountability to grow forth and stabilize at the Dhis2 online CoP over time.

6 Conclusion and recommendations

We will end this report with a proper conclusion on our research question: *"What elements of the social learning theory "community of practice" is present in the HISP online web forum referred to as the Dhis2 Community of Practice?"*. In short; the emerging practices of the online website we have investigated point towards the presence of the ten elements of a community of practice as described by Smith et al. (2017) at the Dhis2 online CoP. This contributes to the literature by demonstrating that it is possible to create a community of practice, through an online website, across a globally distributed community. Our case study also identified allocated time and promoting continuity in participation to make practice and reification clear and identifiable.

6.1 Elements of a CoP present

As described in the findings, the majority of the elements of the Community of Practice theory is present within the Dhis2 online CoP website. As a consequence, experiences and literature on other online CoPs should be transferable to the Dhis2 online CoP website.

Participation and reification

The central dual processes of participation and reification, which form the communities memory and shared history of learning, seem to show three distinct patterns that differ it from the CoPs described in the literature.

Firstly, participation happens through reification, instead of face-to-face interaction, which seems to contribute positively to the value creation on the forum and the available knowledge base of the members. The emphasis on reification as key for participation might be distinct for online and global communities of practice.

Secondly, members of the Dhis2 online CoP talk to the community as a whole, instead of interacting one-on-one. This is, according to the literature, a known source of failure in CoPs, and although the Dhis2 online CoP seems to have supplementary sources of motivation, coordinators of the website may wish to investigate ways of increasing one-on-one

interaction through the forum, as literature suggests that it is essential for building motivation and a regime of accountability.

Thirdly, there is actual one-on-one interaction happening between the Dhis2 online CoP members, but mostly through other, faster responding channels than the forum. It seems like there is a form of legitimate peripheral participation to bordering communities, which the researchers advise coordinators of global and online communities of practice to take into consideration.

Other CoP elements present

There seems to be a functioning *regime of Competence* in the network, although the lack of personal information on some profiles obscures it. Wenger points out that a CoP can be seen as one community, or several bordering communities. At the Dhis2 CoP, *boundaries* exist between communities for specific languages like English, French, Spanish and Arabic, and between specific tools of communication, like Slack, WhatsApp and the forum. Different forms of *brokering* seem to be present between these bordering communities, but the literature seems to be lacking on brokering between different language groups within the same community.

The members of the Dhis2 CoP seem to have a social *identity* as members, but don't identify themself as “typical” members, as a typical member is an implementer. Being a member of the Dhis2 CoP gives the users access to extensive knowledge reacurses, in the form of answers to questions and legacy documentation, and it's often the first place the users check for questions related to DHIS2. The online forum is a key *learning architecture* for its users, and *legitimate peripheral participation* can be done through the creation of a user on the site.

There is *value creation* for members of the community in the form of technical support, decreased pressure on senior developers, increased networking opportunities, professional exposure , inspiration through seeing the impact of oneself and others work and the sense of community.

6.2 Allocated time and promoting continuity in participation

Our study suggests that, in order to cultivate a global and online community of practice, one has to pay special attention to the main buffer for participation (in our case time) and whether a regime of competence has an opportunity to grow forth, and acknowledge the motivation and value reification that happens through participation by content management.

If time is the main buffer for participation, a work around would be to have someone to monitor the different issues that are posted, to make sure that people will receive a response within a decent time. Another way is to give competent people allocated time to spend on the website within their working hours.

We believe attention to members’ actual participation and reification, and increasing the shared history of learning, can help establish a better understanding of the regime of competence among the members of an online and global community of practice. The participants in our study recommend that this is done as a part of the onboarding for new implementers and developers, which means to have a more controlled legitimate peripheral

participation phase. We believe this can be done in many ways if the regime of competence within the community is clear and identifiable to a newcomer.

6.3 Future Directions

Our study has identified time, the need for shared history of learning, and problems and issues as common themes among a semi-homogeneous participant group. We have also identified language differences as a major brokering factor for members of a global community of practice, and that elements of the Networks of Practice theory can be identified in the community we studied. Interesting aspects to investigate would hence be the following:

Does difference between a members' bordering communities affect participation and reification in global and online CoPs?

Will an online and global community of practice have the same challenges for participation as the Dhis2 online CoP?

To what degree does language affect the sustainability of a global and online community of practice?

What elements of the concept "networks of practice" are present in the HISP online web forum referred to as the Dhis2 Community of Practice?

As pointed out in section 5.1 we have not taken into account the heterogeneity of the member group on the Dhis2 online CoP. We believe further study should examine whether the tendencies we point towards exist across a more heterogeneous group of participants.

Future work should also choose rigour before relevance. Data collection and analysis should done over a longer timeframe and it should decided on whether the data should be analysed inductively or deductively.

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