

How FLOSS Participation Supports Lifelong Learning and Working: Apprenticeship Across Time and Spatialities

Aditya Johri

George Mason University

Fairfax, VA, USA

johri@gmu.edu

ABSTRACT

In this paper I draw on two case studies to examine participatory learning in Free/Libre and Open Source Software (FLOSS). I contribute to prior work on learning within FLOSS and also to the learning sciences by illustrating how FLOSS supports lifelong learning and working by providing an ecosystem that allows participants to grow their knowledge of both technical and non-technical skills over time through their association with different projects and people. I trace the learning trajectories of two participants from high school until they enter the professional workforce and beyond. I argue that FLOSS participation represents an ideal networked form of learning as it provides both socio-cognitive support for short term activities and also socio-temporal support for long term participation and learning. It is a unique form of apprenticeship that exists concurrently with formal educational experiences but unlike traditional apprenticeship experiences it succeeds by spanning different spatialities – place/space and technology mix – and temporal scales.

Author Keywords

FLOSS, situated cognition, learning across scales.

ACM Classification Keywords

H.5.m. Information interfaces and presentation (e.g., HCI): Miscellaneous.

INTRODUCTION

Free/Libre and Open Source Software (FLOSS) provides a unique context to examine how people learn. In FLOSS participation in technology development is both an outcome and a mechanism for learning. There are also no restrictions on who can participate and when participation can occur and by supporting and encouraging participation, the community is able to both sustain itself and be innovative. Therefore, unlike most formal educational environments

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like schools, FLOSS provides a novel context to study learning.

Consistent with decades of work in the Learning Sciences on how people learn, there is evidence that learning in FLOSS emerges out of intense participation by learners that is supported by a community [13, 30]. FLOSS development is a notable example of collaborative knowledge sharing and learning as it combines the contributions of individuals from across the world, builds specific practices around the use of technology, and results in innovative and useful products [3, 12, 16, 24, 25]. Central to the everyday practices of open source is the idea of the development of a community; a community that is epistemic in nature with shared beliefs and goals [11]. The shared goals and meanings that emerge among the developers leads to a community of practice and learning occurs as newcomers move from peripheral to full participation [13].

Although seemingly a ‘free for all’ FLOSS communities are highly structured environments that rely on and encourage volunteers and community members create efficient mechanisms to support participation, especially by newcomers [3]. Given the centrality of the idea of community and newcomer participation, it is not surprising that prior work on learning within FLOSS has focused largely on newcomer participation related issues [7, 8, 20, 28]. The findings from this line of research highlight that newcomers are motivated to participate as they need modifications to existing software for themselves and being able to understand and map the mental model of the community in which they want to participate facilitates their participation. Recent reviews of learning in FLOSS outline concisely how the context shapes learning, largely in an informal manner [17]. Participants join FLOSS forums to get help with problem solving and soon reciprocate by helping others. Information is collected and shared and over time knowledge builds that is useful to everyone who contributes and even to others [22]. [9] studied the KDE community to better understanding learning in OSS and their findings demonstrate that creation of discursive practices supported by technology allows participants to have a concrete experience and supports other aspects of learning including reflective observation, abstract conceptualization, and active experimentation at the individual level. Individual learning is further reinforced by collective reflection and conceptualization integration of participative practice at the social level.

In terms of mechanisms for learning, Singh and Holt [22] did a review and a survey based study of learning in open source software communities and found that participation in forums associated with OSS was critical for learning as the forums provided a sense of community for new participants based on their shared interest. They further outlined the different forms of learning that are evident in OSS such as learning how to get help in the forums, learning the content, learning about expectations for participation, being able to keep abreast of latest product development news, and learning how to help others. Participation in forums, they argue, is a pre-requisite for any community to exist and any learning to happen.

In this paper, examine how the FLOSS ecosystem supports learning and working across a participant's lifespan. Increasingly, research by Learning Sciences and Cognitive Science community is pointing to the critical role of environments beyond formal schooling in supporting learning. Starting with the family, learners develop more knowledge and skills through activities such as after school activities, sports, participation in extra-curricular activities, and participation in the workforce than through formal schooling. Courses and curriculum also is available while learners are often not a part of a formal learning environment, for example, through YouTube videos, Khan Academy or MOOCs. Within this context of learning, I advance research on FLOSS learning by: (1) introducing a personal perspective on learning as opposed the commonly used community or project level approach [18]; and, (2) examining longitudinal participation in a learning ecosystem to illustrate the long-term personal trajectories of learners for both learning and working [9, 10, 34].

LEARNING ACROSS TIME AND SPATIALITIES

A long standing criticism of research on learning, especially research pertaining to learning technologies has been a disproportionate determinist focus on the technology in vogue without a reflective understanding of its long term uptake and implications [4, 6]. In response, many scholars have started to take a slightly long term perspective on learning and many researchers now focus on students' learning trajectories [1]. Theoretically, there have been several calls for an emphasis on longer time and social scales, for instance, in Lemke's emphasis on 'ecosocial systems' [15]. In a recent paper Roth [19] also observes that within cultural-historical activity theory the focus has largely been on activities at the smaller time scale although the original intent of the theory was on longer term social transformations or what he calls 'ensemble of societal relations'. Roth [19] and Lemke [14] also emphasize that in addition to a theoretical gap, there is also an empirical gap as methodologically the focus has largely been at a micro or macro level with very little research that looks at multiple levels. In recent years learning sciences scholars have started to bridge this gap and look at multiple levels, most notably the work of Suthers et al. [23], to build an understanding that examines learning across scales.

Across time, what changes for learners, among other elements that support learning, are the contexts in which they learn. Increasingly, this means learning in contexts that digital in nature, particularly when it comes to how learners communicate. Since the advent of digital communication, there has been extensive research on their effect on communication and reviewing this work on mediated communication spaces in the form of real places – complete with navigational maps [41]. Harrison and Dourish [40] articulated an analytical distinction between a "space" and a "place" to propose that a "space" is a geometrical arrangement that structures, constrains, and enables certain forms of movement and interaction. Whereas, a "place" refers to ways in which settings acquire recognizable and persistent social meaning. In other words, "space is the opportunity; place is the (understood) reality (p. 67)." This distinction was important when the initial digital environments that a physical aspect to them – for instance, map based textual communication systems. In a review of this work ten years later, Dourish [42] revisits the concept of space in light of recent advances in information technology such mobile technologies and argues that space is a social product "every bit as much as place (p. 300)." He goes on to propose that, "we need to understand, first, something of the relationship between spatiality and practices, and, second, how multiple spatialities might intersect (p. 301)." Introduction of technology, in his view, does not simple create new opportunities for sociality or new places, but transforms the opportunities for developing new spatialities. According to him, "What we need to understand, then, is how spatiality arises, and the role that technology plays in these practices (p. 301)." Reflecting on the relationship between space and place he [42] argues that (p. 304), "The technology mediated world does not stand apart from the physical world...[t]echnology mediation supports and conditions the emergence of new cultural practices." With increase in the proliferation of mobile devices and ever more digitization of learning practices and ways of communicating, the spaces and places available for learning are multiplying further increasing the possibilities of creating new spatialities. To further examine the issue of spatialities, it is important to discuss the overall ecology of learning.

Increasingly, physical spaces have a universal digital component, either through screens or artifacts that are large in shape or through the use of mobile phones or tablets. These devices allow different channels of communicating thereby shaping the spatialities in different ways. Within FLOSS, research shows that diversity of spatialities is common whether it is people working from home, from an office, or even from coworking places. In each of these contexts, they find interaction support through email, instant messaging and apps similar to that, and even through social media. This has implications for learning and working across the lifespan as this suggests that learning similarly is supported by different spatialities. This, as the

literature review next suggests, shapes the way apprenticeship learning can take place in FLOSS.

APPRENTICESHIP LEARNING

According to Dennen [37], apprenticeship is a social learning method that has a long tradition of helping novices become experts in fields as diverse as tailoring, midwifery, construction, and law. The apprenticeship model predates the traditional schooling that is now commonplace [39]. The core concept behind apprenticeship is that more experienced people help those with less experience by providing them structure and examples, usually hands-on, to support their learning goals. A lot of the literature on apprenticeship has focused on professions where becoming a skilled craftsperson or tradesperson was the goal and this required the ability to apply knowledge and skills that were conceptual but often also psychomotor. In the past decade as experts have studied formal schooling and its constraints in terms of learning, the concept of apprenticeship has garnered interest afresh as there is a recognition that learning from others through social interaction might be a productive approach regardless of the context. Cognitive apprenticeship, or the use of the apprentice model to support learning in the cognitive domain, is a now a relatively common approach and concept. It refers to scaffolding, modeling, mentoring, and coaching like models. Education research has adopted the apprenticeship concept to both examine and design learning environments but there is no research as yet to examine FLOSS as a context for apprenticeship. Although the concept of apprenticeship has been used to study workplace, there is also limited research on apprenticeship in novel contexts where digital technology is central and where apprenticeship occurs over a long time period and often across the entire life span [38].

RESEARCH APPROACH AND DATA COLLECTION

The research approach used to develop these case studies can be characterized as “netnography” [35, 36]. In netnography, a significant proportion of the data collection and participant-observation originates in the data shared freely and publicly through the Internet. Netnographic data collection does not preclude face-to-face or place-based data collection and extends to interviews conducted via email, Skype, in person, or by using other methods. Netnography’s emphasis on Internet data does not ameliorate the need to establish those data in context and its great strength is contextualized data [35]. This approach is suitable for this research not only because FLOSS leaves a trace of digital artifacts online but also because netnography has emerged as a way to both analyze and to chronicle the emerging cultural conceptions of community and culture. Both communities and cultures are now less stabled and consistent than what earlier theories have research has suggested. Communities in particular are a lot more transient in nature and are sustained by many weak ties. Especially in the digital context, a more temporary and impermanent form of contact is prevalent.

I first met both participants whose cases are presented here in 2008 while I was conducting a large scale study of professional global engineering work practices. As part of the research, I was interviewing and observing engineers across several different countries. Both participants provided me with information about themselves through interviews and also through their blogs and other online contributions. This research was covered by the Institutional Review Board (IRB) and all consent procedures were followed. To protect participants’ identity I am using pseudonym and have also suppressed some specific information. Over the years, I have interacted with the participants through email but the majority of the data collection has occurred through public sources including their online FLOSS participation, their profiles and activities on Github and on social media sites including LinkedIn. Given their profession and FLOSS participation, both are active online sites and their information is always current. One significant resource has been their blogs. Although both participants blog, one of them is more regular than the other and writes about all life changes as well as lessons learned through different experiences.

CASE STUDIES

To empirically examine socio-temporal aspects of learning, I now present case studies of two open source software developers. When I met them both Roberto and Bruno were working in Ireland with a large engineering firm in the area of computing hardware and associated software. Neither of them was from Ireland but a small island in Southern Europe and had moved to Ireland for their jobs. I interviewed them as part of an effort to understand how their team worked with its counterparts in the USA, UK, and China. During the interview I realized that neither of them had taken a traditional route to their current professional position; by traditional route I mean a formal education followed by a fulltime job. They started contributing to open source projects when they were in high school and built a reputation among other contributors. This helped them land an internship while they were still in their undergraduate programs. Subsequently, they joined the firm full time while still completing their degree. They currently work for two of the largest technology firms in the world.

Case Study 1: Roberto

I first interviewed Roberto in November 2008. At that time he had just started in the company as a full time employee after working as an intern for a year. Roberto was originally from Spain and had moved to Ireland when he started his internship. Roberto was hired as an intern largely because of his open source experience and to help the firm with an open source project. When he was hired his work entailed helping the firm open source a propriety product. He was involved with the webpage development for that product, with creating a code repository, and helping find, and subsequently developing, a community to share code with. The open source product he contributed to was called GNOME which is desktop software similar to Microsoft

Windows™. At the time of the interview he was involved in organizing the next developer summit for the product and was also working on improving the overall platform to attract more developers. He stated that by active participation he meant “people know me and they know what I’ve contributed.” He started out as a lurker and slowly moved to a helping position, improving his English all the while.

He had started working on open source software when he was fifteen years old, in high school, and had been contributing in some capacity for the past 9 years. He said that his father had an old UNIX machine that he wanted ported to Linux and he could not find any local expertise in their small town to help him. So Roberto took on the task and so his journey in open source software began. After high school he joined the local university and in his second year there a positioned opened open source office of the university. The university was actively promoting the integration of open source software across the university and Roberto started working on this project. As part of his job he organized talks by open source experts. When the programming language Java was released as an open source language in 2006, a Java contributor from Spain working in Dublin was invited to give a talk. After talk he went to lunch with the speaker and the speaker informed him about internship opportunities with his company in Ireland. This led to his current position. When he started working on open source software he first starting by reading software code and messages on discussion forums associated with the FLOSS. He said that he realized that it was important to make a visible contribution to the FLOSS and bring something new to the community. He started making small contributions and then blogging about it and posting it on mailing lists. Slowly he started to get credit for his work and became recognized with the community. In this interview he mentioned that contributing code is the most important thing in FLOSS. In addition his contributions he also started becoming active locally and organized several events. He mentioned that IRC and mailing lists were the most commonly used collaboration tools. Bugzilla was another tool that he used a lot. He said IRC afforded multi-tasking as he could monitor as needed and contribute when required. With Skype he had to pay attention continuously. Furthermore, language was an issue as most project contributors did not speak English as their first language.

He learned to work across time zone using virtual technologies. He collaborated with developers across the globe including France, UK, US, Germany, and Canada. To work with them he used email, IRC, and many other tools that he picked up as he worked on code and problems. He picked up many nuances of such collaboration such as a lack of use of audio technology due to language issues and a preference for written communication. Informal communication was often preferred over formal communication and IRC was used commonly. Plus, phone demands immediate attention whereas with IRC you can

finish what you are doing/check and get back or easier to switch and multi-task; IRC leaves a track of everything. In some sense this can be seen as a practice or norm within his professional community.

Roberto’s participation in the open source community and thereafter in a traditional software role within a large company provided him with the opportunity to learn about different work environments. In his interview he commented on the different levels of hierarchy in different environments and also on roles taken within the firm. He observed that comparing his FLOSS participation and working in a traditional large technology company he was amazed at the power differentials and authority issues. In particular, he commented on the approval process that one had to go through to get anything done at his current company. He also said that compared to FLOSS, he felt as if he was involved very late in the decision making process. He said that through his participation and conversations with other developers he had realized that different communities have different norms – images, testing are important in some, here it was code. He commented that GDK development was technical as well as organizational participation and he had learned a lot about how a community thrives and barriers to reaching that by his current organization. Over a 15 year period, he had worked in four countries, four companies, multiple open source projects in addition to these formal positions, and developed skills both technical and professional. Throughout his career, Roberto received help from others and in his blog there are many references to the people who helped him on different projects and even assisted him in finding jobs when he wanted to move on for professional or personal reasons.

Case Study 2: Bruno

Bruno was working as an intern and had been the firm for six months when I first interviewed him in November 2008. He was confident of getting a full time position after his internship was over and did indeed work for them fulltime. He started out in open source by working on the GNOME project and then became a regular contributor to Ubuntu. In his current position he was working on a team that was open sourcing a product and his job was to figure out ways in which to make contributions to code repositories easier for outside contributors. Bruno studied in an American school in Spain and then spent his sophomore year of High School in Denver, Colorado, USA. He was from a small town in Spain and after starting at a local university he moved to Madrid after his first years. He was still finishing his classes. He had been working on open source projects for the past five years. He started looking at Debian packing 3/3.5 years ago and for the last two years he was an official Ubuntu developer. He has significant experience on packaging and integrating software and porting software. He had experience with both GPL and BSD. He had been offered a fulltime position by another FLOSS company Canonical but he preferred his current

firm as he wanted to gain experience working face-to-face rather than in a virtual firm. He said this he had learned how to work across time zones.

Bruno liked working on multimedia related applications and when he found out that there was a new project in Ubuntu looking for multimedia integration he started making contributions. When the project leader stepped down due to other commitments, Bruno took over the project leadership. His project has 10-12 people spread all over the world and they communicate through IRC and email but prefer Skype. He has met face-to-face with most of his colleagues as there is an Ubuntu developer summit every six months. He had learned that making a useful contribution to FLOSS was hard. He said that in Ubuntu people grab the easy and more visible stuff and not the hard stuff. He said that many people get started but cannot stick round for long. He gave an analogy with playing guitar. The cost of participation is low but very few people stick around; people have to be self-motivated and learn the basics such as reading music. He got started by reading documentation about the project and the examples and codes. Once he made a contribution if he ran into trouble he posted on the list and got a lot of help.

He said that he had learned how communities work and how one can participate in them and he was using his knowledge to support newcomers to the community. He makes sure that the first contribution for a newcomer is relatively easy as newcomers need to be able to make that first contribution as it is a great motivational exercise. He also said that he ensured that there is a balanced learning whereby archival resources are supported by first hand feedback. There has to be effort from both sides – learner and mentor and the learner has to be given tasks and opportunities to provide themselves. The mentor has to model good effort and then that leads to efforts from others. In open source the other important thing is meritocracy and visibility of that “you’ve to show-off what you are doing as well.” He also commented that it is important to show that you can finish what you’ve started. He said that small demos and prototypes are important but the effort needs to go beyond that and result in a meaningful contribution the community.

Their workplace participation provided opportunities for learning often through comparison with open source practices [31, 32]. Bruno commented on many of the same organizational practices that Roberto did and in particular he also found the current company a lot more bureaucratic than Ubuntu. He also commented that he found the decision making in Ubuntu a lot more democratic as compared to his present company. He said that he had learned at both places that working with ‘coders’ is not easy as they are not very social and friendly people. He said that his experience had made him realize the benefit of non-technical skills and he had realized that they go hand in hand if the goal is to achieve something like completing a project. He said that in

his internship he was applying many things he learned working on Ubuntu as a FLOSS participant. He had realized that it is important to keep things interesting for contributors to keep them motivated in contributing. He had learned that it was important to provide a mix of tasks to contributors – mix what people want to do with what needs to get done. He made sure that if contributors got a boring task to do, they also got a really cool task to go with it. He said that he admired the current horizontal structure and liked the fact that in the company, similar to FLOSS, employees were not judged by what they have in their CVs, like a PhD or 10 years with the company, but you expertise and ability to get the job done.

After working with the large company for some time, Bruno he worked fulltime in an open source company that made collaboration software and then in the open source research lab of an electronics company. Now he works for a large technology firm on their video projects. He still contributes to open source software projects and in his online profiles he described himself as open source developer, Linux hacker, and a curious geek. He maintains an active Github page.

DISCUSSION

Through the case study of two youths participating in open source software communities, I highlight the complex socio-temporal nature of learning across a life span. I argue for an expansion of what we think of as the boundaries of a distributed system or a community. In many ways, we are approaching a vast networked learning landscape as has been recently conceptualized by Siemens [21]. These networked environments themselves are nested within larger social structures extending beyond formal educational opportunities to informal participation across other communities of practices. Both Roberto and Bruno moved across countries and interacted with people in dozens of other locations and countries. They crossed boundaries with ease to leverage new opportunities for learning and working. Although both Roberto and Bruno followed a similar trajectory, their paths started to diverge and whereas Roberto continued to work on open source projects as part of a large open source company, Bruno ended up using his technical expertise to work on similar projects but as part of a larger technology company that was not solely open source but had some open source projects. He continued to contribute though to projects he was part of when he started out in open source.

As illustrated by these case studies, FLOSS participation supports many of the core socio-cognitive factors necessary for learning such as collaboration, knowledge sharing infrastructure, and meaning-making by joint activity, and grounds them through apprenticeship. But what it also does, which many formal educational environments fail to do, is provide an opportunity to learn at a large socio-temporal scale largely though a community [33]. This allows for learning of skills that extend beyond technical knowledge

such as leadership, task assignment, and timely completion of work, among others. In a typical classroom, a teacher is the central character and holds both power and expertise and the responsibility for knowledge sharing and learning. Invariably, the teacher is often older than the students. Often teenagers are the leaders of modules and other contributors are senior in terms of age but not necessarily in terms of experience and expertise. The other unique characteristic that follows from this is that power relationships are determined through the display of expertise, primarily through contributions, rather than tenure of age. This changes the nature of interaction among the community members making it more equitable and on task – contributions determine the social nature of the entire enterprise. This observation lends credence to the conception of “new schools” by John Dewey as early as early 20th century. Dewey [5] argued that,

“The conclusion is that in what are called the new schools, the primary source of social control resides in the very nature of the work done as a social enterprise in which all individuals have an opportunity to contribute and to which all feel a responsibility (p. 56).”

Based on these case studies, we can see also how FLOSS-based apprenticeship differs from opportunities offered by more traditional forms of apprenticeship in terms of who has access to these opportunities and how they can participate. Just in terms of both space and time, FLOSS allows participation without any physical boundaries (granted, there are other barriers to participation such as bandwidth and prior knowledge). Still, unlike other traditional apprenticeship that occurred in crafts or trades such as tailoring or midwifery, the lack of physical boundaries makes FLOSS-based apprenticeship more accessible. The other advantage is that of time -- when you can participate not just in terms of time of the day but also time in your lifespan. Most traditional apprenticeship is predicated on the novices being young and entering the apprenticeship structure earlier in their lifespan. FLOSS does allow that but allows those who come to the domain later in life to be able to learn as well. In this paper I use open source software development, and FLOSS participation, as an exemplar of lifelong learning as it impacts learners’ identity and cognitive trajectory by breaking down traditional boundaries between school and work, by creating virtual apprenticeship infrastructures, and by integrating learning and working within professional practice.

Open source software development showcases the future of what learning might look like across a range of professions in the future. In particular, the spatialities of learning that are present in FLOSS are in many ways nurturing of learning over time. For instance, even though they found the physical workplace restricting and bureaucratic, they appreciated the easy access to new knowledge and the ability to form relationships with their coworkers [26, 27].

Being able to interact with colleagues, engaging in action, they realized was a strong supporter of learning in the workplace [29]. The concept of spatialities is evident beyond the immediate learning context in terms of the countries and cities that Roberto and Bruno lived in. In their blogs they often write about how much they have enjoyed living in different places, languages they have learned, people they have met, experiences that they have had. Another spatiality they reference is open source conference that they attended and even organized. They found them to have their own norms but served a purpose in terms of learning and knowledge sharing, problem solving, and outlining what needed to be done on a project.

There are some limitations of this work and this study provides a cautionary tale if we think about all those who are unable to participate in the new knowledge economy and are unable to build the kinds of expertise, networks, and mobility that is needed to participate. Both the informants in this study were lucky that they not only had access to technology but also that they could physically move across borders and legally participate in opportunities. This is not the case, more often than not. When we think about equity and access, we need to think about how these opportunities can be created. Language was an issue for both participants but they managed to work through their issues and leverage opportunities that helped them overcome their problems with the English language. On the other hand, the symbolic power of access cannot be denied and new ways of turning that into learning opportunities need to be designed and implemented. Not every is capable of or interested in participating in FLOSS communities and in many ways there is criticism of FLOSS in terms of its lack of diversity. Therefore, for the future, it is critical to examine what lessons can be learned here that are applicable to other learning and working ecosystems.

CONCLUSION

In this paper I present a case study of two youths participating in FLOSS. I follow their life trajectory for over two decades and highlight the complex socio-temporal nature of learning in an era of digital connectivity and digital tools. Digital access and tools shape who students interact with and how those interactions occur. Learning becomes a skill whereby gaining technical or domain knowledge goes hand in hand with managing the resources that can lead to that knowledge. I also demonstrate the value of ecosystems such as the open source software communities that thrive on non-traditional modes of collaboration and partnerships among its members. The backbone of the open source movement is the capability of sharing the work of individuals with a wider community and building products that develop incrementally overtime. The fascinating aspect of open source movement is that from outside it does not seem to follow the traditional common practices of learning used in higher education. Yet, there is some indication that several aspects of learning such as apprenticeship and guided participation are present

in these communities and FLOSS can serve as a model for creating similar environments. The novelty of the FLOSS learning ecology though is the support you can find over a lifespan and the spatialities – places and spaces in conjunction – that are present and that emerge and provide affordance for learning. Through virtual communities or even-placed based communities such as the workplace and even emerging spatialities such as coworking spaces, learning is supported as novices advance to becoming an expert and, often, as technology changes, morph into becoming experts at something else. In FLOSS what is unique is a lifelong community for learning and working that goes beyond institutions and organizations.

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