

Understanding Trajectories of Experience in Situated Learning Field Trips

Ilaria Canova Calori ¹, Chiara Rossitto ^{1,2}, Monica Divitini ¹

¹ Department of Computer and Information Science, Norwegian University of Science and Technology, Sem Sælandsv. 7-9, 7491 Trondheim, Norway
{canovaca, divitini}@idi.ntnu.no

² Department of Computer and Systems Sciences, Stockholm University, Kista, Sweden, chiara@dsv.su.se

Abstract. This paper discusses the role context plays in promoting engagement and exploration in situated learning experiences during field trips. We look at field trips where children engage with the physical and social context in order to learn about cultural and social aspects of the city they live in. By drawing on empirical data collected by means of qualitative methods, we discuss how learning unfolds along trajectories of experience towards pre-defined and emerging learning objectives. We reflect of the role technology can play in supporting learning experiences outside the classroom.

Keywords: situated learning, learning experience, trajectory of experience, field trip.

1 Introduction

The city has always been an important arena for learning [9] and schools have taken advantage of the urban environment and all its resources to promote learning activities [3]. Recent development and diffusion of mobile and ubiquitous technologies throughout the cities increase people mobility and opportunities to engage with the environment [7], [12]. This allows for more support for learning to continue outside the classroom, providing possibilities for mobile learning experiences [8].

The work presented is part of the FABULA project whose objectives are to design and develop a platform of services to support different forms of learning in a city-wide context. The project focuses on the experience of learning a city by being in it, through an exploration of its physical places and cultural aspects. This paper contributes to the discourse on smart cities by reflecting on the role technology could play in supporting learning experiences outside the classroom. We look at real field trips where primary schools children engage with the physical environment in order to learn about cultural and social aspects of the city they live in. On the one hand, we focus on the strategies the teacher and facilitators enact in order to keep the students focused on the main topic. We relate to this aspect as convergence. The teacher always strives to engage the students, scaffolding the learning by triggering their reflection and dynamically orchestrating [4] the activities to guide them along a *hypothet-*

ical learning trajectory [15] towards defined learning objectives. On the other hand, we focus on the *actual learning trajectory* the students follow by taking advantage of the opportunities emerging from being present in authentic settings, and able to explore the physical and social context. These opportunities can potentially trigger new interests and learning objectives, and we refer to them as divergence. Both convergence and divergence open up a space of opportunities for reflection about the experience and hence for learning. Limited work has been carried out to support both the ongoing learning activity and emerging opportunities [5]. It is hence necessary to broaden the understanding of how learning experiences unfold in authentic settings in order to exploit convergence and divergence opportunities.

2 Related Work

A body of research has focused on how to complement school activities with the ones carried outside the classroom taking advantage of the opportunities offered by the context. Many projects have focused on promoting learning by supporting data collection in the field and reflection and elaboration of the data mostly when back in the classroom [2], [14]. The systems proposed in these projects could be employed in different contexts (not being customized for a particular venue), lacking support for reflection in situ. Other projects have focused on enhancing reflection while out in the field: Ambient Wood [13] supported student-initiated scientific inquiry by providing different sources of digital augmentation of the physical environment; the M3 system [17] is an example of how mobile technology can become an “object-to-think-with” supporting a treasure hunt game in informal learning settings; and the nQuire toolkit [11] support students in inquiry-based learning (to formulate questions, collect data and test hypothesis) both in formal and informal settings with the support of facilitators. These projects [11, 13, 17] outlined the importance of reviewing collected materials in the field. However, they provided customized solutions for specific settings and facilitators played an important role throughout the experiences. Cromar [10], instead, is an example of an application providing support for reflection on crowd management situations that could be employed in a variety of settings without facilitation. All the above mentioned projects outline the usefulness of the possibility to keep track of, to review, to reflect (either in situ or later in classroom) and to elaborate on contextualized collected data, e.g. by selecting specific views or ‘trails’ [14] through the data. However, the above mentioned research focuses on supporting a specific learning objective, without providing means to take advantage of other learning opportunities offered by the same experience, e.g. exploring alternative trajectories, aiming at emerging learning objectives.

The goal in this paper is to better understand how to provide support for situated learning experiences, both in terms of pre-defined and emerging learning objectives by suggesting a model based on trajectories of experience. Our research questions are: what is the role of context in supporting converging and diverging learning trajectories? How is it possible to take advantage of opportunities offered by situated learning experiences?

3 Understanding Experience and Trajectories

Kolb suggests that “Learning is best conceived as a process, not in terms of outcomes” [7]. To understand a learning experience as a process, we look at it in terms of a trajectory. Learning trajectories have traditionally been used by teachers to inform and plan their instructional interventions. Simon [15] defines a *hypothetical learning trajectory* as the teacher prediction of “the path by which learning might proceed”. This is characterized by a learning goal that defines a direction, learning activities, and a hypothetical learning process, i.e. “a prediction of how students’ thinking and understanding will evolve in the context of the learning activities” [15]. The *actual learning trajectory* cannot be known in advance and is not necessarily unique. Learning trajectories are useful tools for supporting teachers in achieving certain pedagogical objectives; however they provide limited insight for taking advantage of emerging opportunities for learning and for designing technology to support situated learning experiences. In this perspective, we adopt the concept of trajectory as defined by Strauss: “the course of any experienced phenomenon as it evolves over time and the actions and interactions contributing to its evolution” [16]. In particular, we look at the work suggested in CSCW and HCI fields by Benford and colleagues [1] that can broaden our understanding on how to design experiences that promote engagement and physical exploration while dealing with multiple and interconnected trajectories. Situated learning experiences in fact are not just about kids learning something, they are about kids exploring a place, referring to past visit experiences whilst engaging in new ones, comparing what is being experienced with everyday life and wandering along unforeseen paths. Benford et al. [1] suggest a conceptual framework of trajectories that outlines the role of *space, time, roles* people may assume and *interfaces* used to support interaction and collaboration [1]. *Interleaved trajectories* have also been identified to express the collaborative aspects of experiences (e.g. possibilities for encounters) [1]. In the present paper, we focus on how the actual learning trajectory of the whole class was shaped by the teacher and the guides through orchestration to converge towards a hypothetical learning trajectory, but also how the students exploring different places and resources got engaged and moved towards emerging learning objectives. We also pay attention to how the field trips were tight to other experiences (e.g. previous and everyday experiences).

4 Method and Settings

The exploratory study presented was carried out at an international school, where we followed a fourth grade class to two different field trips: one to an open-air folk museum, and the other to a cathedral and its museum. Children were between 9 and 10 years old and 20 pupils were present during both trips. During this phase of the project we decided not to intervene with any technology to focus, instead, on the social interactions and the actions with the physical context that might help characterizing and explaining the convergence and divergence of learning trajectories. The data were collected mainly through qualitative methods: observations, audio-recordings, note-

takings, and a follow-up interview with the teacher. Both excursions lasted about six hours from the moment we arrived at the school, to when we departed after the field trips were over. The interview with the teacher aimed at understanding the role of the field trips within the school pedagogical objectives, and gaining insights on the classroom activities organized as a preparation and as further elaborating on what was learnt.

The class followed an inquiry-based approach to learning (formulate questions, collect data and test hypothesis) focused on a central idea. When the study was carried out, the class was working on a six-week unit of inquiry about Norway. The central idea was defined as “Understanding our host country’s culture, geography and history helps us develop our identity and perspective on the world”. The first trip was concerned with the relationships between Norway’s climate and its culture. During the first trip, the class visited the local open-air folk museum, where traditional buildings (e.g. farms, churches and houses from different periods) had been moved from all over the country. The second trip focused on the cultural influence of religion in Norwegian society. This excursion included two separate visits: one to the museum where original sculptures from the cathedral and archaeological exhibitions were displayed, and one to the cathedral itself. Each visit was led by a different guide and lasted for about one hour. The two trips offered two interesting settings to understand the situatedness of a learning experience, and to explore how learning experiences unfolds and what contextual aspects contribute to emerging learning opportunities. The trips allowed us to understand the roles of context in allowing the teacher and the guides to stir the students towards pre-defined learning objectives while also letting the children explore emerging ones.

The concepts presented in Section 2 were used as sensitizing concepts during the analysis, which was iterative. The first two authors collected the data and carried out the analysis together. The intermediate results were then discussed and expanded through discussion among the authors.

5 Shaping Learning Experiences along Trajectories

In this section we discuss how the field trip learning experiences were tailored to the pre-defined learning objectives, and how new objectives emerged through exploration of authentic settings. The teacher embraced an open but focused approach during the field trips. In the interview she explained: “*The process comes alive as you do it*”. There was not a strict plan (no script) to be followed during the visits: “*I have a plan that I like to have, but if children have an interest in something else, as long as it’s staying in the central idea, we can move over there...that’s allowed because we want to keep the children excited about, we want to keep them interested*”. This approach allowed the students to contribute with their own ideas and interests pursuing both convergence and divergence. The guides knew about the unit of inquiry and the central idea, but they had not agreed with the teacher what path to follow and what exhibitions to show to the students. These elements allowed for a flexible, unanticipated process to unfold during the visits.

5.1 Starting the Visit: Recalling and Contextualizing

Our observations started in the class waiting for all the kids to arrive. Preparation was done the days before the visits, no recall and no material was gathered before leaving the school the day of the visits. However, as soon as we arrived to the museums we observed how the teacher and the guide enacted different strategies to recall kids attention and engage them with the environment they were about to explore. On our arrival to the museums the teacher asked questions to the kids to recall goals and relevant events. For instance, before entering the folk museum, the teacher asked “*Does anybody remember why we are here?*” The students had to recall the goal of the visit and how it was connected to the inquiry they were carrying out.

After meeting the guides, the kids would receive an introduction about the place they were about to visit; and the guides would ask the kids to pay attention to resources around them. During the first trip the guide, standing by the entrance of the folk museum, pointed out a hill and explained “*We’re on an historical ground [...] 800 years ago there was a fort to protect the city up there and a fight took place in the same spot where we are standing now*”. The kids got very curious about, and wanted to know more about the place and its history. Then a kid noticed a construction on one side of the hill and asks what it was. The guide explained it was a small hut used by the Sami to store food. The kids asked to visit them. Unfortunately, even if the class was interested in knowing how food was preserved, there was no time to visit the huts.

In the early phases of a visit it was important to create connections to what the class knew from before and build up anticipation for what it would come next, creating bridges with past and future episode of an experience. Particularly, at the beginning of the visit, the teacher would make an effort to connect the visit to things that the class had discussed or seen before (e.g. “*Do you remember the Birkebeiner?*” to recall a previous discussion and link it to the story of the folk museum) or things they were about to see (e.g. “*And when you walk around now, you will see that the construction of other buildings are completely different from this one*”). It seems that it was crucial to create a strong bond between past and present of an experience and to stimulate kids’ engagement to explore the context early in the visits.

5.2 During the Visit: Roles of Questions, Objects and Kids’ Experiences

During the visits, exploration and reflection were encouraged in different ways. Questions played an important role in keeping the students engaged. In this way students were not just passive audience, but were invited to take a more active role as inquirers. Objects were used to tell stories and make the environment comes alive by populating it with people and activities. Elements in the context were sources of both convergent and divergent opportunities, exploited by the guide or discovered by the students. Objects acted also as connectors between different experiences (e.g. across class and museum, across different museums, or across past and present of a place).

The guide encouraged exploration and reflection with probing questions often linked to specific objects or the surrounding environment. At the folk museum, while

kids were sitting inside a farmhouse from the 17th century surrounded by objects to recreate the original settings, the guide said: *“This was the main building, this was where the people lived and in this room, this was the living room which they use every day. And this wasn’t just a living room, was it?”* All the objects and furniture around the room suggested how the living room was used for. A bed made a boy wonder *“Sleeping room?”* A girl referring to the open fire asked *“Kitchen?”* And another kid suggested *“They spin the wool here”* pointing at a wool spinning wheel.

Objects would not only be used by the guide for engaging the kids, they would also trigger kids’ attention and exploration. At the folk museum while still inside the farmhouse, a girl was interested in knowing more about a pendulum clock and asked clarification about it to the guide. This led to an emerging opportunity for learning:

Guide: “This, actually, came like a fashion from the US. And...do you know why? Because a lot of Norwegians in the 1850s, where did they go?”

Kids: “In the US? America?”

Guide: “To the US! They immigrated.”

Teacher: “Do you know why they decided they wanted to go over to America?”

Guide: “[...] Have you heard about the industrial revolution? Going from being self-supplied like they are on this farm, and then starting to deal, to trade with money. And then they needed the mass production, factories started to produce stuff [...]”

In this example, the pendulum clock triggered an interesting discussion about the industrial revolution, its influences on Norwegian living and immigration to US that the kids had not discussed before creating a learning opportunity that had not been planned. Other times looking at and discussing about an object could raise a subject that had been encountered before offering the possibility to investigate them through new perspectives. Kids could build their understanding on several interconnected experiences, some they have shared together (during previous visits or in class) and some personal experiences (e.g. their everyday life). For instance, during the visit inside the cathedral, the guide showed the kids a baptizing font and the kids recalled what they had heard during the first visit to the folk museum. They remembered there was a habit to spit in the font if there was no water and that the Pope forbade it afterwards. This episode also offered the opportunity for kids of different beliefs to discuss the meaning of baptism. Other times, this chance to connect experiences was missed. During the second trip, no activities were organized by the guides in order to relate what was seen inside the museum with what was presented inside the cathedral (e.g. the statues of the Saints, the painting and story of St. Olav).

One thing seemed very important, that is to always relate to what kids were familiar with (in their everyday life and in the present situated experience). The teacher and the guides often related concepts, stories and experiences to everyday situations (*“Is it warm in your basement?”* or *“Do we do that today?”*). Taking advantage of the present experience, the guide at the folk museum connected to how cold it was that day; so when a student asked *“Was that little warmer before?”* the guide replied *“Not at all. It was like here, like we have today”*. In this way kids could better understand the conditions people were living in the past and relate to them, crossing a traversal between past and present of a place.

5.3 Ending the Visit: Brief Recall in Situ and Connections to Be Made Later

At the end of the visits, before leaving the museums and go back to school, we observed only a brief, informal recalling of interesting events and favorite things. The teacher asked individual questions while kids sat together, resting and having some snacks. Further reflection and elaboration on the visits were carried out in classroom, however not the same day of the visits. The teacher was aware that not everything the kids listen to during the visit would be remembered, but she still valued the fact that they got to experience things in authentic settings and they would retain this later on. This is what the teacher said in the interview *“I don’t think they [the children] got even half of what was being talked about, but they made... a connection, they have a ...sort of file folder in their head...They might remember this field trip later. They have a connection to make. I think that’s really important [...] just being there and being in the city they live in, this is something that they may take for granted but then they will be making connections later.”*

6 Discussion

In this section we will point out some interesting aspects to look at when designing for situated learning experiences exploiting the opportunities offered by the context, as outlined in the previous section. In this paper, we want to look at the field trips’ learning experience as a process and describe it in terms of a trajectory. Looking at different aspects of a trajectory, as suggested in [1], i.e. role of space, time, resources and other interconnected experiences, can point out how to exploit opportunities for supporting reflection and learning offered by situated learning experiences. We refer to the actual learning trajectory followed by the whole class as the path that is made up of actions and interactions that unfolds over time [16] during the visits, while the hypothetical learning trajectory is represented by an ideal path aiming at the visits’ pre-defined learning objectives.

Previous work (see Section 2) showed the usefulness to support collection of and reflection on a stream of data, both during and after the experience. Being able to capture the actions and interactions characterizing a situated learning experience and to relate them with a hypothetical trajectory could help, not only the teacher orchestrating the process, but the students as well. Prompting the students to reflect on their experience, wondering if an action is related to the pre-defined learning objective or to an emerging one (*Does the immigration to US relate to the influence of climate on Norwegian culture? How?*), could lead to an increased awareness of how things connect or not with each other throughout the experience.

In Fig. 1, the class actual trajectory¹ (continuous line) diverges from and/or converges towards the hypothetical learning trajectory (dashed line). The grey area represents the converging area characterized by possible actions and interactions connected

¹ We refer to the class trajectory as we observed the dynamics of the group. Focusing on the actions and interaction of each pupil, it would be possible to define individual trajectories.

to the central idea of the inquiry unit the students were studying². The actual trajectory moves outside this area when (a) divergence occurs, i.e. topics outside the central idea are explored (e.g. immigration to US) and emerging learning objectives may arise; or (b) when kids get distracted or disengaged. During the visits, the teacher and the guide try to limit the actual trajectory of the class within the converging area through orchestration (rectangles in Fig. 1) by: (1) keeping engagement (e.g. asking questions, recalling events or presenting a new object); (2) re-establishing convergence; and (3) limiting distraction. The children had the possibility to explore the context and follow different paths than the hypothetical learning trajectory. However, it is important to notice that divergence and distraction are not necessarily negative aspects during a visit. In fact sometimes students needed them to maintain engagement throughout the visits.

Elements in the context (starts in Fig. 1) influenced the students' actual trajectory by triggering kids' attention (e.g. the Sami huts on the hill); by being exploited by the guide or the teacher to keep kids engaged (e.g. the bed and wool spin wheel inside the farmhouse); or by raising a topic, inside or outside the central idea (e.g. the pendulum clock).

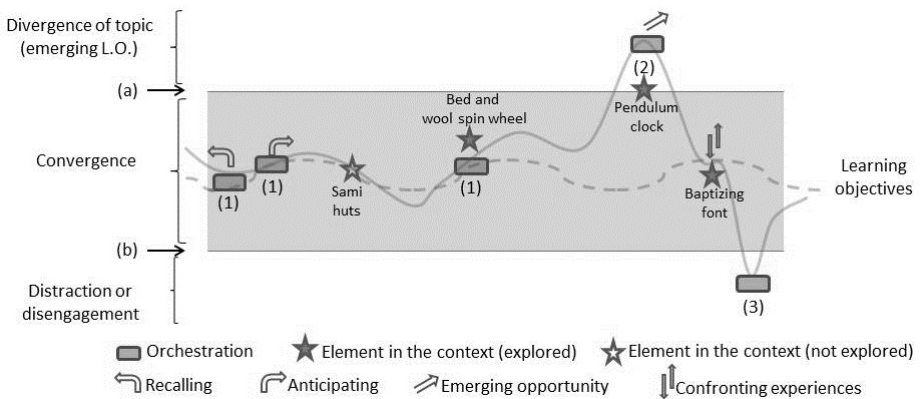


Fig. 1. The actual trajectory characterized by actions and interactions

The authors in [1] suggest thinking of trajectories in terms of space, time, roles and resources. We should therefore think to support different representations and means for navigation of trajectories that outline how actions and interactions are connected through time, places visited, roles played by the students (e.g. passive audience vs. active inquirer) and elements encountered in context.

The pervasiveness and proactivity of smart city technologies could offer great potential to automatically capture the actions and interactions occurring during situated learning experiences, to trigger reflection or to suggest connections across related episodes during the present experience or across past and present experiences. Tech-

² Where to place actions and interactions on an absolute scale is not crucial, but it is important to identify and outline if they pertain to convergence and/or divergence.

nology should support further exploration of the elements encountered and explored during the situated experience and trigger a more thorough reflection on aspects the students experienced simply as passive audience. It would be useful to provide means to explore elements that were not examined, like the Sami huts (e.g. through virtual visits, or by making available resources collected by other visitors). During the visits the students together with the guides unveiled also some interesting stories that could be of interest for the students for later elaboration, but also to other visitors as well (e.g. the discussion about immigration to US connected to the pendulum clock) creating learning opportunities for later exploration and for other visitors. In this perspective, technology could promote learning across social and physical contexts.

As observed in the field trips, situated learning experiences are often bridged to and enriched by past and future experiences. Experiences could be connected for different reasons: to recall previous learning events, goals or related topics; to create anticipation for future events; to confront with personal experience; or to generate emerging learning opportunities (see arrows in Fig. 1). When designing technology to enhance situated learning experiences, a challenge is then represented by supporting multi-scale experiences: triggering recalling of goals and allow reviewing past events at crucial times; promoting anticipation to foster engagement; prompting connections to be made with previous experiences and encouraging reflection on how things relate to everyday life.

7 Conclusions

In this paper we presented an account of situated learning experience in terms of trajectories to outline the role technology could play in supporting both pre-defined and emerging learning objectives, promoting engagement and exploration of the physical context. As part of our future work, we plan to validate the model of trajectories in different settings, also considering informal and work related situated learning experiences. For taking advantage of both converging and diverging learning opportunities, the solution is not to be found in the design or employment of a specific tool but more realistically in a configuration of technologies, which we plan to deploy in the future.

Acknowledgments. This research is funded by the NFR-project FABULA (<http://fabula.idi.ntnu.no>). We would like to thank the teacher and the children who made this study possible.

8 References

1. Benford, S., Giannachi, G., Koleva, B., Rodden, T.: From Interaction to Trajectories: Designing Coherent Journeys Through User Experiences. In: Proceedings of the SIGCHI Conference on Human Factors in Computing Systems, pp. 709–718, ACM (2009)

2. Bouvin, N.O., Brodersen, C., Hansen, F.A., Iversen, O.S., Nørregaard, P.: Tools of Contextualization: Extending the Classroom to the Field. In: Proceedings of the Conference on Interaction design and children, pp. 24–31, ACM (2005)
3. Curtis, E.: Walking out of the Classroom: Learning on the streets of Aberdeen. In: Ways of Walking: Ethnography and Practice on Foot, pp. 143–154, Ashgate (2008)
4. Dillenbourg, P., Jermann, P.: Technology for Classroom Orchestration. In: New Science of Learning, pp. 525–552. Springer, New York (2010)
5. Eljueidi, M., Rossitto, C., Canova Calori, I.: Focus and Exploration in Contextual Relevance. In: Proceedings of the International Conference on Mobile Ubiquitous Computing, Systems, Services and Technologies, pp. 303–308, IARIA (2011)
6. Foth, M.: Handbook of Research on Urban Informatics: The Practice and Promise of the Real-Time City, IGI Global (2009)
7. Kolb, D.A.: Experiential Learning: Experience as the Source of Learning and Development, Prentice Hall (1984)
8. Kukulska-Hulme, A., Traxler, J.: Mobile Learning: A Handbook for Educators and Trainers, Routledge, Oxon (2005)
9. Lynch, K.: The Image of the City, The MIT Press (1960)
10. Mora, S., Boron, A., Divitini, M.: CroMAR: Mobile Augmented Reality for Supporting Reflection on Crowd Management, International Journal of Mobile Human Computer Interaction, 4, pp. 88–101 (2012)
11. Mulholland, P., Anastopoulou, S., Collins, T., Feisst, M., Kerawalla, L., Paxton, M., Scanlon, E., Sharples, M., Wright, M.: nQuire: Technological Support for Personal Inquiry Learning, IEEE Transactions on Learning Technologies, 5, pp. 157–169 (2012)
12. Rheingold, H.: Smart Mobs: The Next Social Revolution. Perseus Publishing, Cambridge (2003)
13. Rogers, Y., Price, S., Fitzpatrick, G., Fleck, R., Harris, E., Smith, H., Randell, C., Muller, H., O'Malley, C., Stanton, D., Thompson, M., Weal, M.: Ambient Wood: Designing New Forms of Digital Augmentation for Learning Outdoors. In: Proceedings of the Conference on Interaction design and children, pp. 3–10. ACM (2004)
14. Sharples, M., Lonsdale, P., Meek, J., Rudman, P.D., Vavoula, G.N.: An Evaluation of MyArtSpace: a Mobile Learning Service for School Museum Trips. In: Proceedings of the Conference on Mobile Learning, pp. 238–244. (2007)
15. Simon, M.A.: Reconstructing Mathematics Pedagogy from a Constructivist Perspective. Journal for Research in Mathematics Education, 26, pp. 114–145 (1995)
16. Strauss, A.L.: Continual Permutations of Action. Aldine de Gruyter, New York (1993)
17. Wyeth, P., Smith, H., Ng, K.H., Fitzpatrick, G., Luckin, R., Walker, K., Good, J., Underwood, J., Benford, S.: Learning Through Treasure Hunting: The Role of Mobile Devices. In: Proceedings of the IADIS Conference on Mobile Learning, pp. 27–34 (2008)