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Mobile probes

A scaffold for local learning with online resources?

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Mobile probes: A scaffold for local learning with online resources?

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A project investigating the effectiveness of a collection of online resources for teachers' professional development used mobile probes as a data collection method. Teachers received questions and tasks on their mobile in a dialogic manner while in their everyday context as opposed to in an interview. This method provided valuable insight into the contextual use, i.e. how did the online resource transfer to the work practice. However, the research team also found that mobile probes may provide the scaffolding necessary for individual and peer learning at a very local (intra-school) community level. This paper is an initial investigation of how the mobile probes process proved to engage teachers in their efforts to improve teaching. It also highlights some of the barriers emerging when applying mobile probes as a scaffold for learning.

Keywords: mobile probes, learning scaffold, online open learning, distributed learning environments, professional development

INTRODUCTION

This paper reports on the mobile probes phase of a large empirical project with science teachers in Danish elementary schools. This project designs and implements a collection of online multimedia materials that teachers can work with and apply to their teaching. In this paper, this collection of multimedia materials is referred to as the Online Resource (OR). The research is a design-based research (DBR) project (Amiel & Reeves, 2008) which commenced in 2013. DBR is an intervention research approach, characterised by iterative cycles of testing and refinement of solutions in practice and in collaboration with practitioners. DBR tries to simultaneously understand and contribute to the improvement of a specific educational practice (Amiel & Reeves, 2008). This paper presents findings from a phase which took place approximately two years into the larger

project. The researchers discovered that a digital mobile data collection method, *mobile probes*, provided an opportunity for scaffolding learning-in-practice process at the individual and peer level.

The area of open online learning has grown in recent years in higher education and continuous learning. *Massive open online courses (MOOC)* are a rapidly growing trend in eLearning. There are two most commonly known types: xMOOC often have standardised structure (video tutorials, readings and often computer graded assignments), where the instructor is viewed as the expert and the learner as a knowledge consumer. cMOOCs have an open structure and see knowledge as a networked state, where learners' participate in the collaborative process of sharing knowledge that others can connect to and with (Siemens 2013).

Few professional development activities for teachers are defined as MOOCs and further research on their effectiveness is needed (Jobe et al. 2014). The OR can best be described in terms of the quasi-MOOC format which does not provide the social interaction of cMOOCs or the automated grading and tutorial-driven format of xMOOCs. Quasi-MOOCs are loosely linked asynchronous learning resources that are not packaged as a course (Siemens, 2013). This OR likewise does not provide ready-made teaching plans and other activities to use as is. Rather, the focus is on the pedagogical and process level of inquiry-based teaching. On the other hand, it is also not an open space for sharing, as the OR in itself is not a Web 2.0 resource.

When dealing with large-scale professional development in geographically distributed environments, changes to professional practices often require the learners to partake in activities isolated from their workplaces. Referring to renowned teacher professional development researchers such as Borko, Elmore and Little, Schlager and Fusco discuss the argument: 'that teacher professional development is more than a series of training workshops, institutes, meetings, and in-service days. It is a process of learning how to put knowledge into practice through engagement in practice within a community of practitioners' (Schlager & Fusco, 2003, p. 205). They illustrate how a large body of studies on technology-driven learning relies on the notion that online learning can provide such a community of practice. However, they draw attention to the fact that many of the implemented online communities are isolated from the existing local communities of practice at the workplace, and further argue that there is great potential if the Internet is used to support these local communities (Schlager & Fusco, 2003).

The research scope and questions for this paper were not formulated prior to the commencement of the research project, but instead emerged during the research process as follows:

- What can be learned from mobile probes studies in the context of eLearning and professional development?
- How do the participants experience and change due to the mobile probes process?
- What signs are there that the mobile probes scaffold learning?

MOBILE PROBES

The term 'mobile probes' refers to mobile approaches used to collect digital data in various situations from and/or with participants, e.g. when investigating traffic situations or for gaining information from potential customers. In human–computer interaction (HCI), probes are often inspired by the cultural probe method, which is a very explorative and user-participative approach (e.g. Gaver & Penningtong, 2004). The cultural probes method involves activities where the researcher hands out or mails packages containing, for example, postcards or disposable cameras to the participants. The packages include largely open-ended questions and tasks for the participant to answer and return. Hence, the cultural probe method provides user-generated data, and the content of this data cannot be predicted beforehand. The data collecting process is seen as preceding the design phase and contributes to the qualitative knowledge base about users (as, e.g. presented in Gaver & Penningtong, 2004).

Rikke Ørngreen developed in 2013 a type of mobile probes approach, which was inspired by the cultural probes method, and by qualitative interviews. It was developed as the means to obtain insights about work situations and discover new (not yet identified) contextual factors when designing for online learning and knowledge sharing. This approach uses SMS/text messages with questions or tasks in a dialogical manner (Duvaa et al., 2013).This approach proved valuable in obtaining knowledge about users and their work with tasks, particularly when these users are geographically distributed and work asynchronous.

Duvaa et al. (2013) argue that though semi-structured interviews (as in Kvale, 1997) can aid in generating rich descriptions of the context, they only address issues that the researcher is able to address. Cultural probes add an element of uncertainty (Gaver & Penningtong, 2004), which

provides an opportunity to uncover issues that were unknown to the researcher, but which could be important for the design. Similarly, the mobile probes method makes it possible for the researcher to ask questions by SMS about the user's daily tasks and reflections on these tasks while they are still in the context of their daily work life. These unknown issues may not surface in an interview, as the users may not even be aware of their importance. By using the mobile probes, the researcher is able to ask about here-and-now issues (e.g. what are you doing/seeing/discussing right now?), and the user may also receive a task to perform in practice. These questions and tasks then unfold in a dialog with the user. Inspired by Darsø and Polainy, this is called 'uncovering non-knowledge': 'Non-knowledge is the knowledge that depends on context, social relations and artifacts in order to become understood or recognized as significant and to be codified' (Duvaa et al., 2013, p. 163).

The mobile probes developed by Duvaa et al. (2013) have a longer timespan than cultural probes or semi-structured interviews. The participant would typically receive three messages with questions or small tasks a day for one week / five work days. The authors found the method successful in that it generated new insights, also there was a very high response rate to the questions. The interpretation by the researchers in the study was that the dialogical nature of this type of mobile probes (unlike cultural probes) would support the 'unravelling' of complex relations and identify key issues for the design process. However, even though the dialogical approach seemed to work, the researchers in the study concluded that it was difficult to engage users to give in-depth explanations, which seem easier in synchronous dialogs (whether online or face-to-face) (see Duvaa et al., 2013). In a similar study, an SMS probe was used, and the study also highlights the 'on-the-spot' answers of the method: 'The context you're in when you get the question will influence what you answer or how you do your assignment' (Jönsson et al., 2002, p. 19).

THE PROJECT FRAME

The OR is targeted at science teachers (primarily K1–6) and was developed by the Kata Foundation. The foundation partners with various stakeholders and research allies, including Aalborg University in this case. Figure 1 and 2 show screenshots from the OR, which gives an impression of the kind of interface the teachers are navigating in.
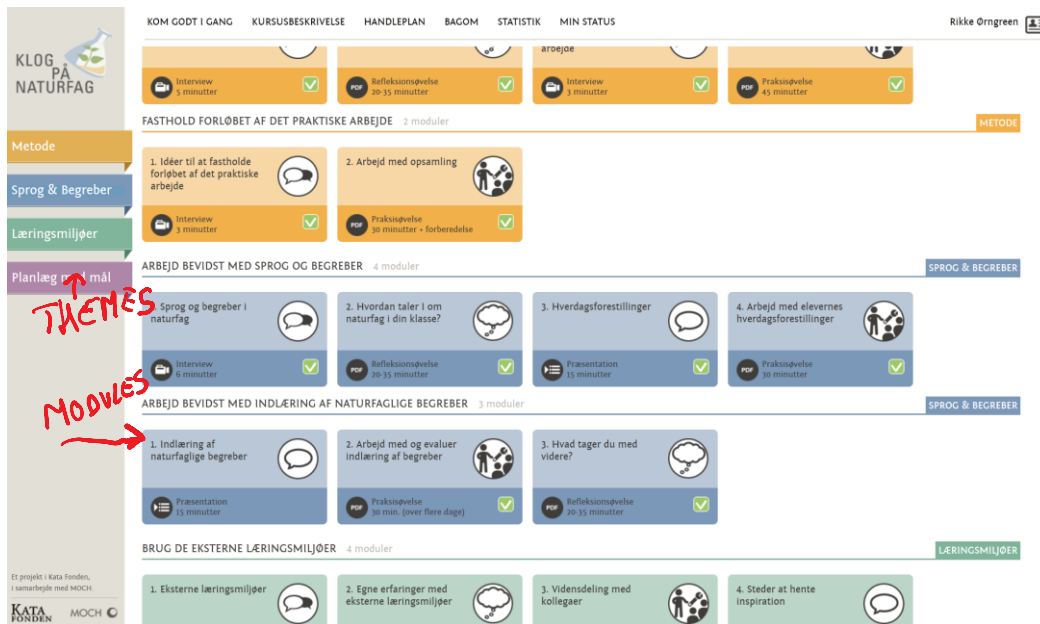
Figure 1.;A screenshot of the front page of the OR
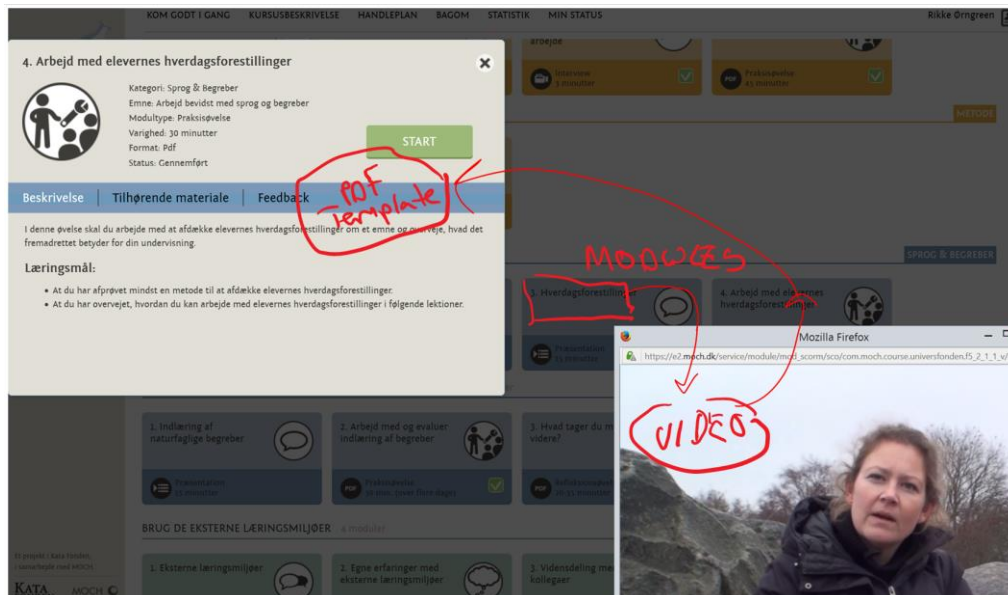
Figure 2.; A screenshot from the content pages of a module

Figure 3 depicts a possible pathway of how users are intended to work with the solution: The learning material is structured into modules that can be completed in any sequence, though a specific sequence is suggested for each module.
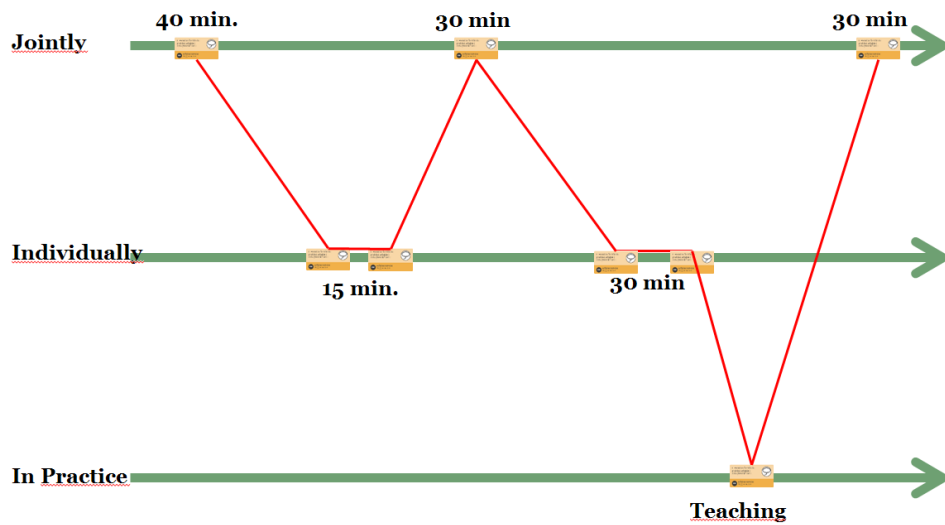
Figure 3: Suggested sequence from the module: 'work practically with students' (by project manager Jesper Ingerslev).

A timewise linear view of the DBR-based iterative process is depicted in figure 4. The development of the first version of the online resource (OR1) took place during the first year of the project in 2013. Simultaneously, the researchers established knowledge about science teachers' current practices through explorative field studies at two schools (RS1, as reported in Noesgaard, 2014). Once the first version was ready to test (OR1), a number of qualitative empirical studies were carried out during 2014 involving seven teachers at three Danish elementary schools (RS2, as reported in Noesgaard & Ørngreen, 2015).
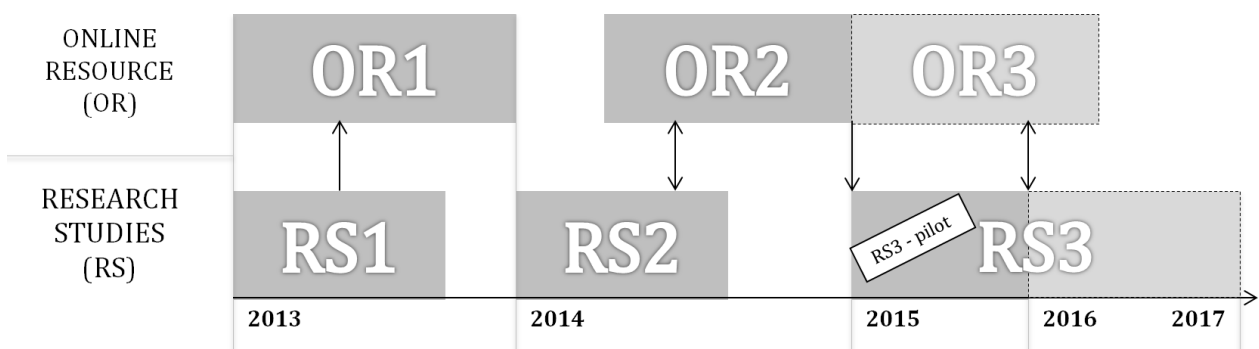
Figure 4: An overview of the interplay between research and design

Though the OR suggests that the teachers complete the modules in a sequential order, the 2014 RS2 indicated that teachers could not always be expected to work through the material as suggested. Even when the researchers were present, some teachers would skip through parts of

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the material and did not explicitly talk to each other about their current practices as requested in the exercises. However, three of the teachers noticeably changed their teaching in the process; nevertheless, most teachers used strategies to show that applying the material in their teaching was not necessary (Noesgaard & Ørngreen, 2015). In 2014, more modules were developed (OR2), and in the late spring/summer of 2015, the OR was made available for all K1–12 teachers in Denmark via an online login system governed by the state called uni-login. At the same time, preparations for a large-scale longitudinal empirical data collection process began (RS3).

For the research studies in 2015–2016 (RS3), a series of digital and remotely qualitative and quantitative research activities are planned. For example, a back-end statistical module provides information about which modules a certain uni-login has used. Similarly, a pre- and post-survey has been developed. The RS3 pilot took place in June 2015. The mobile probes were conducted at one school with two teachers. The pre- and post-surveys were given to two schools, with a total of five teachers completing the survey. Focus group interviews were held after both surveys and after the mobile probes process with all five teachers. Despite a small cohort, it was possible to detect the relevance of the mobile probes as a scaffold because this relatively new mobile probes approach had already been used in three other projects as an empirical data collection method. The case of mobile probes as a learning scaffold can be viewed as an exemplary single case, which can inform science (Flyvbjerg, 2006) and indicate areas of further research. While stating that scaffolding and facilitating a learning process is vital to online distributed education may seem obvious and perhaps even naïve, the elements in this mobile probes approach were different from other facilitating processes that the researchers had previously seen in eLearning approaches.

MOBILE PROBES IN PILOT RS3

The RS1 investigated the current practices of science teachers and found that when designing for learning transfer, extra attention to the learners' work environment (context) is necessary (Noesgaard, 2014). Mobile probes were thus chosen because they provide an opportunity to follow people, who work at multiple locations and at different hours of the day. In addition, there are situations that are perhaps best 'seen' when the researcher is not present due to the private nature of a classroom setting. Of course, this is also a cost-effective approach compared to being

physically present, which requires more man-hours and travel funds. Furthermore, it is an explicit choice to focus on the teachers' change process and inner thoughts (motivation, frustration etc.).

The RS2, where participants used the OR1, found that the teachers are able to self-report on learning effectiveness that involves parameters of satisfaction and transfer to practice - a finding which was in alignment with other studies in the literature (see Noesgaard & Ørngreen, 2015). The mobile probes could thus act as a self-reporting process.

As it emerged, the process showed that the mobile probes may not only act as self-reporting, but also as an act of scaffolding. Scaffolding can be defined as a process where the learner receives just-in-time support to solve problems or achieve learning goals, which this person without support had not been able to solve / reach (Belland 2014, Holton & Clarke, 2006). In education, scaffolding is usually used to refer to how teachers support their students. Holton and Clarke (2006) noted that not everything a teacher does can be viewed as scaffolding and that the following two components need to be present in order to count as scaffolding: to support the immediate construction of knowledge and to support the basis for independent learning in the future. Self-scaffolding and metacognition is considered an important component of problem solving and learning processes. Metacognition can be defined as 'the awareness that individuals have of their own thinking; their evaluation of that thinking; and their regulation of that thinking' (Holton & Clarke, 2006, p. 133, with reference to Wilson and Clarke).

The pilot began with (texting) a series of practical questions concerning which days the teacher teaches science topics, with which classes and if and how much they had already looked into the material online. This provided a framework for which new questions to text and when to text them (during the 2-week period). Prior to the commencement of the process, an array of themes (questions and tasks) had been identified as possible starting points for the dialogs. The intention with the pilot was to see if the themes and the process were meaningful to work with. The process included the perspective that the following question would depend on the answers received (as in a semi-structured interview, Kvale, 1997). This means that the researchers interpret the material when it is received and act upon it immediately. As such, analysis and interpretation of data was an ongoing process - in accordance with the DBR-thinking of the project.

The example in Figure 5 shows the teacher's reflections prior to her teaching. The correspondence shows that she does not normally micro plan a session in this way, and that she is considering if

she will be more or less confined in her actions. While it is not possible to conclude that she would not have the same reflections without the probe, the question makes this issue explicit at this point.

Figure 5: Participant on choice of module and micro planning (translated from Danish)

The length of the received messages ranges from a few words up to 200 words. An example of a lengthier answer is shown below in Figure 6, where the same teacher reflects in her preparation after the teaching. Two interesting matters should be noted from this example. First, by means of a relatively simple text message, the teachers reflect on and relate to how the material connects to their own practice, which in turn gives the research team meaningful knowledge about the context. When comparing the answers from before the teaching (Figure 5) with after the teaching (Figure 6), this teacher evaluates her steps and changes her mind regarding whether the model was useful as a planning tool for a single lesson. Second, this is an example of what was seen in both the mobile probes as well as the focus group interviews in the pilot: The teachers tend to over-plan, which leads to frustration. Many of the teachers plan with too much content and others plan with too many activities that they are not able to fit in the sessions.

Good Afternoon! Would you like to tell us a little bit about your science class today

Hello. Yes, I had science teaching today in the first grade. I had planned the class based on the model. I only achieved a fraction of what I had planned. The subject was the trees' leaf. The objective is that the pupils learn to tell the difference between hardwoods and softwoods, and wonder where the leaves disappear to, when they fall from the trees. This may possibly lead to a new topic about decomposers. We went to the moor where they in teams should gather leaves and pick out one leaf, which they would like to continue working with. We only managed to gather the leaves and put them in pressure between newspapers. Hopefully, they will be able to investigate what they have collected based on the dried leaves. I think it is difficult to structure the session according to a model as I may restrict the children's' initiative because I have set up a goal in advance. However, the planning phase based on the model was good. I think, the model is better suited for planning a whole learning process than just one lesson. But based on that planning, one can of course then place the individual lessons. Best Regards [name]

How does it affect you/your thoughts/teaching or anything else, when you try out something new?

It is exiting, and it gets me thinking a lot about how to address it/approach it and .....

blue = researcher   green = science teacher

Figure 6: Participant on how the chosen module then worked in class (translated from Danish)

Figure 7 provides an example of the richness of the material received from the participants. In this particular situation, the 'wise word wall' [DK: Klog Ord Væg] situation from the dialog above. These pictures aid in understanding the context and the situation that took place. However, the act of taking the pictures and describing what they represent also requires an evaluative and reflective stance from the teachers, forcing them to see their own decisions from an 'outside' position.

Figure 7. Contextual material returned by a participant (faces and names scratched out by researchers)

Though this is not a quantitative analysis, an overview of the number of messages to/from the two teachers in the pilot RS3 is seen as meaningful, as it shows that this method seems to motivate to a dialog. 58 text messages, 32 questions, and 3 bigger tasks were sent from the researchers to the participants, and 40 text messages, 29 directly answered questions and 1 big task were returned from the participants - app.150 SMS in total. The response rate for the questions was 91%.

DISCUSSION

As professional development often occurs in real-world settings that are complex and include many intervening variables, causal interference is not possible. Furthermore, many schools are involved in several reform programs at the same time, which means that, 'isolating the effects of a single program or activity under such conditions is usually impossible' (Guskey, 2002, p. 50). Nevertheless, Guskey often stresses that professional development initiatives should seek to focus on the relationship between professional development activities and the signs of improved learning among the students. This project focuses on signs of transfer of the OR to practice through teachers' self-evaluation. However, it has thus far proven to be difficult to get teachers to carry out tasks that are directed at getting more knowledge from their students. For example, a teacher was asked to interview her pupils about their experiences during the break immediately after the lesson. She was then supposed to record herself as she reflects aloud afterwards and send this recording to the research team. She misunderstood this task a little and instead recorded the short interview with her pupils. From the video it is clear that she did not manage to get the children to evaluate or to give their opinions; rather, they gave a summary of activities in the lesson. Though not the exact task that was asked for, this dialog provided her with feedback regarding whether the children understood the lesson. The recording also shows that the children were very engaged, which is a sign of motivation. It cannot be concluded that the teacher learned from this and thought about what to change/keep, as she did not offer any specific reflection in this regard. However, it can be argued that the mobile probes questions and tasks provide a space for doing so.

The professional development initiative with the OR3 is voluntary and thus the time and energy invested by the teachers is their own choice. Teachers in Denmark have a culture of working relatively autonomously with a lot of pedagogical freedom. Participants in this pilot are clearly collaborating (they refer to each other and to meetings in the mobile probes and post-interview).

This is also seen in some of the newer mobile probes, which were initiated in January 2016 (RS3). However, since participation is voluntary, the research team now finds that getting teachers to begin the mobile process is quite difficult. Many teachers sign up, but fewer actually begin answering the first questions. This is the same dilemma that many MOOC providers face (Siemens, 2013).

These issues may be reinforced when it comes to quasi-MOOC solutions that rely on collaborative learning at local levels. In a report on open educational resources, a chapter on teachers' professional development concludes that there is a need to change the community culture around sharing: 'This is because teachers and instructors often show a reluctance to share or collaborate in open networks.' (OECD 2015, p. 48).

From the pre- and post-surveys in this project [RS3], it is evident that very few teachers collaborate with other teachers on planning, conducting and evaluating specific teaching. The discussions with teachers revealed that when they collaborate it is on a more practical daily administrative level and then primarily across subject/curricular boundaries, because teacher teams are formed around a grade-year or in subject matter teams which discuss themes of interest not a specific session. This reinforces that initiatives that ensure a sharing culture may need to be scaffolded from outside in order to change the practices and current work culture in small steps.

Follow-up activities are important to support sustainable large-scale change, e.g. an analysis of approximately 1300 studies confirmed the vital importance of follow-up (Guskey & Yoon, 2009). As previously mentioned, the intention of this project became to create an environment that supports and strengthens existing local communities, rather than just creating online communities (similar to the arguments of Schlager & Fusco, 2003). The mobile probes approach can provide such a space for local facilitation at the individual and peer level by providing just-in-time support to solve problems or ask direct questions that prompt evaluation and reflection.

In this light, mobile probes may be viewed as a heuristic scaffolding (Holton & Clarke, 2006), which encompasses open and generic questions (e.g. What are you doing? Why are you doing it? How does it help you?) that prompt metacognitive thinking, and as opposed to a conceptual scaffold, which is related to domain knowledge. The researchers' (in the analysis of the empirical material) and the participants' (in their verbal reflection on the process in the focus group interview) experience that the mobile probes pilot had a positive influence on self-awareness and requires

self-assessment (self-evaluation); however, signs of sustainable self-regulation have not yet been documented.

Teachers in general, as in many other professions, are reflective about their own everyday practice. The experience in this project, however, is that there is a difference between the reflections that involve thinking by oneself and those that are explicitly recorded (written or spoken) with an audience in mind. There is also a difference in reflecting on everyday descriptions or on a specific incident that is experienced as critical/profound. One of the participants compared the approach to 'having a weight watcher in your pocket' (from the post focus group). When one signs up for the Weight Watchers program, even though it is voluntary, one needs a gentle push once in a while to eat a carrot rather than the chocolate bar. Similarly, the mobile probes, though voluntary, can serve a disciplinary function.

Although too much frustration is not constructive for learning, reflective learning processes often have an element of productive frustration (Illeris, 2006). The teachers in the pilot showed signs of productive frustration. However, in the future use of mobile probes in this project (RS3), it is suggested that further investigations are conducted to examine what factors result in excessive frustration, at what moment do teachers 'give up' and whether there are circumstances where over-frustration can be turned into productive frustration.

For many years, the relationship between attitude and behaviour has been discussed, and there is evidence that changes in behaviour are not always linked to changed attitudes and beliefs (Ajzen & Fishbein, 1977). The mobile probes participants showed signs of transfer from the OR to practice and also provided productive insight into the difficulties they experienced. However, the data lacks sufficient depth and was not derived from a long-enough period of time to determine if this is a sign of sustainable change in attitude/beliefs. Also, the study is not a controlled experiment that can point to the correlating factors between attitude/belief and behaviour. Nonetheless, it is an example of people volunteering to being probed to act and then actually doing so, which means they start experimenting, without necessarily changing their whole setup and their entire mind-set. This may allow them to stay at a minimum frustration level, where the changes are incremental and manageable. These factors need more investigation.

Limitations and suggestions for future research

Changes take time, and the researchers in this study found that there is a need to utilise mobile probes of a longer duration than those used until now; furthermore, perhaps a still voluntary but more collegial disciplinary sign-up at the workshop is necessary.

In some of the new rounds of mobile probes (RS3 from January 2016), it was found that it can be difficult for some participants to go beyond the descriptive level. Just as in face-to-face scaffolding, these participants require more time to reach the kind of reflectivity which is sensitive to the specific and/or extraordinary. Though a test to stretch the timeline was conducted, it seems that one of the limitations of mobile probes for some people is that it is easier to stop participating. Many issues could be at stake, including time-related priorities, lack of back-up from the organisation or simply the distance and digital nature of mobile probes, which can make it less natural and thus more difficult for some people to make a commitment. Research is therefore needed regarding why people refrain from starting and also the reasons why they drop out.

The current exemplary case, i.e. the RS3-pilot, resulted in the investigation of the 'good' case of mobile probes as a scaffolding activity in the time- and place-distributed environments of school teachers. The next sampling in this DBR project could be to investigate a 'not-so-good' situation that may shed some light regarding why early drop-out (deliberately and involuntarily) happens.

CONCLUSION

At the start of the paper, three research questions were formulated and are included here again to sum up what is now known.

What can be learned from mobile probes studies in the context of eLearning and professional development? Mobile probes are seen as useful for environments where the professional development activity is about content that teachers see, adapt and transfer to own work practice and where the tasks are carried out in different geographical areas and time intervals. The approach provides insights into the contextual situation via open and here-and-now questions, which enabled participants to evaluate what happened today rather than how things went one or two months ago, which is often the situation in courses, workshops etc. This pilot had very

engaged teachers, but in the newer RS3 studies it proved to be difficult to get the participants started and sometimes to even engage in and complete the process.

How do the participants experience and change due to the mobile probes process? If commitment and motivation are present, the mobile probes process can support the teachers to change their practice and begin further collaboration in local settings. The mobile probes process and the OR try to address change and transfer to practice in small incremental steps. The participants were very open regarding their activities and when reporting on their students' activities and own evaluation hereof. It can be difficult to move beyond the more descriptive level or to provide nuanced/full answers to mobile text questions. Also, the participants showed signs of productive frustration, but in the newest rounds there have also been signs of over-frustration.

What signs are there that the mobile probes scaffold learning? The open questions that served to uncover non-knowledge of the original mobile probes method as an empirical data gathering method, served in-line with a heuristic scaffold. The mobile probes enable participants to do a just-in-time reflection, and can support supported participants in the externalisation of metacognitive processes by prompting them to explicate and evaluate their own thinking and doing; however, the mobile probes process cannot document the sustainability of these self-regulations. As a professional development activity, the mobile probes focus on the teachers and their ability to self-report and to support self-scaffolding through an external heuristic scaffold. The approach has an explicit focus on signs of transfer, where the signs are seen in the teacher's answers.

The conclusion is that the mobile probes can function as a scaffold for learning at the individual and peer level. The probes can create a space for teachers to explicitly reflect on their own teaching processes and try out small things. In the future of this project, reasons for opting out and dropping out of this volunteer teacher professional development activities will be investigated. This can create knowledge both for research and future design in general, and in the project this will be related to both an individual, peer and organisational level.

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