



Supporting Teacher Reflection based on Everyday Evidence

(Target venue: BJET - Maximum length: 6000w)

Improving educational practice through reflection is one of the most widespread emphases of teacher professional development (TPD) approaches. However, given the immediacy of teaching and the strong timing constraints of everyday school practice, such teacher reflection is often done based on long-term memories, or on infrequent peer/supervisor observations or recordings. This paper describes three design-based research iterations of an effort towards technological support of teacher reflection based on everyday evidence. We collaborated with teachers from two Swiss secondary schools, using a variety of prototype technologies (from paper prototypes to web applications or wearable sensors). The iterative evaluation of such prototypes lead us from a high-tech-focused approach to a more nuanced socio-technical one, based on lightweight technologies and 'envelope routines' involving also students. After illustrating the potential of this approach to change teacher practice and students' learning experience, we also present a series of guidelines for the design of technology that supports such reflection based on everyday evidence.

Introduction (500w)

- Teacher Professional Development (TPD) is one of the main strategies governments and institutions have for improving education. TPD definition
- Among the main approaches to TPD in literature, one of the main categories tries to promote reflection
- Albeit reflection is generally regarded as a good thing, there is much less emphasis on how to do it, and it is often more based on prescriptive ideas than on actual evidence
- Teacher reflection is currently supported by a variety of technological means (video recording, blogs/journals, discussion forums, audio/video analysis)
- However, such support generally relies on long-term memory (journals), or requires conspicuous action (observer present, setting up and recording video). These problems are not trivial, given the classroom's high immediacy and charge of history
- We aim at investigating technological support for gathering everyday evidence for reflective TPD.
- We conducted three iterations of design-based research, with a total of 16 teachers. During these iterations, teachers used paper prototypes, wearable sensors and web technologies, gathering data from their own practice for several weeks, multiple times a day
- The structure of the paper: related work, methodology, evidence and conclusions for three iterations, guidelines for technological support, limitations and future work.

Related Work (900w)

Effective Teacher Professional Development (300w)

- Three main approaches to TPD (non-exclusive): training of individual teachers; focus on teachers as part of a group or a community; focus on the usage of artifacts taken from authentic teacher practice (often, as a focus for reflection)
- There is extensive literature on TPD in general, a complete review is beyond our scope
- What makes an effective TPD: support the needs/goals of individuals, school and/or district; relevant and authentic to the daily practice/responsibilities; focus on both subject area content and how to teach it; collaborative (active and interactive); ongoing over time.
- Caveats on these effectiveness: what is effectiveness? mostly, to improve learning (or at least, to change practice); hence, it is unlikely to find out broad, generally-applicable guidelines



In-service Teacher Professional Development through Reflection (300w)

- Common approach of TPD is based on the notion of prompting reflection, to create a "reflective practitioner"
- Common ways of supporting reflection: learning journals, classroom artifacts like observations or video recordings (see following section)
- Despite general opinion that reflection is a good thing, their implementation still encounters practical problems:
- The traditional reflection tools (e.g., keeping journals, recording videos of lessons) are often cumbersome and intrusive in everyday classroom practice
- Reflection is prone to several biases, most prominently that very often it is insufficiently based on evidence, as opposed to beliefs

Technological Support for Teacher Reflection (300w)

- Some of the practical problems of reflective approaches to TPD relate to the supportive tooling. Aside from pen-and-paper journals and peer observation notes, current tooling includes:
- The recording and analysis of video lessons has been used for a very long time to support reflection, which requires just video recording equipment and (in some cases) video annotation/coding software
- Other technological support for reflection classically includes e-portfolios, blogs, or online discussions
- Recently, tools to capture snippets of practice and reflections, e.g., using mobile devices have been proposed
- Also recently, multimodal/Video approaches in PD are starting to appear: the Classroom Discourse Analyzer still requires costly manual steps (e.g., the transcription of a video)
- Remaining problems of existing technological support for reflection: Cumbersomeness vs. lack of time; mental overload of classroom management vs. need for evidence gathering; ethical and privacy issues with the use of many classroom-generated practice artifacts (e.g., videos) which remain unresolved

Methodology (500w)

- Overall (design) research question: "What set of tools and practices support teacher reflection based on everyday evidence?"
- Design-based research. Rationale: emphasis in daily classroom practice, and fitting in contextual constraints (but still we want mini-theory of designing technology for this purpose)
- Structure: initial informal pilots (by LAS and ourselves), plus three formal iterations (see sections below)
- Evolving focus of each iteration: 1) wearable sensors, advanced visualizations; 2) teacher self-observation vs. student reported experience; 3) teacher and student observations
- Two different contexts (LAS and ISL, Switzerland), due to different degrees and modes of access to the field
- Focus not only on the technology, but rather the co-evolution of technology and practice/routines of use

Iteration 1: Exploring Reflection on Multimodal Data with Wearable Sensors (500w)

- Rationale: following previous research with eyetrackers on teacher cognitive load, we wanted to explore potential of such rich sensor data for reflection, without breaking the flow of the lesson
- Research question: What aspects of these rich data are found useful/interesting?
- Given expense of the data gathering, initial exploration using a single qualitative case study



Context

- Swiss private school
- 1 experienced teacher, had participated in previous experiments with wearable sensors

Method

- Guide the teacher through a "teacher inquiry" process
 - a. Initial interview, to set interests and inquiry questions
 - b. Recording of 8 sessions during 4 weeks (session pairs with two different cohorts of students). Mobile eye-tracker + indoor location with iBeacons
 - c. Building of "classroom mirror" website with visualizations
 - d. Show classroom mirror on interview with teacher, and ask for reflections on process and data
- Analysis: qualitative analysis of interview and researcher observations (open coding + thematic clustering)

Results

- The data visualizations confirmed some teacher suspicions (e.g., too much time in front of the classroom, one group is more "difficult" than the other)
- Very detailed temporal data (cognitive load, orchestration graph) were found less interesting (or actionable)
- Certain aggregated data were surprising, e.g.: more time around left-side student desks -- potential explanation in desks layout
- Deciphering of data and reflection were time-consuming -- evidenced in lack of time and energy after a full day of work!

Iteration 2: Exploring Reflection In-Action through Paper Prototypes (500w)

- Rationale: Since much of the passively-gathered sensor data was not found interesting, we tried a more 'active data gathering' approach
- Included school professional development specialist in the process
- Two main approaches: teacher-centred (teacher makes observation/recording of relevant event) or student-centred (students make the observation from the point of view of their own experience)
- In both cases, the concrete events/experiences to report were decided with the school specialist, on the basis of classroom behaviors school wanted to promote (e.g., collaboration, concentration, students presenting)
- Research question: what is the most adequate form factor and approach for the active data gathering? (teacher vs. student-centred approach, mobile vs. desktop, event- vs. time-period based)
- Compare/explore these options in a field study using paper prototypes

Context

- (Different) Swiss private secondary school
- Local professional development approach based on mix of trainings with personal teacher inquiry (facilitated by school specialist)
- Goal of specialist: "gather non-threatening evidence to spark up conversations about teaching practice"
- Nine teachers (varying degrees of experience) volunteered for the study

Method

- Developed multiple paper prototypes mimicking different form factors: mobile phone (in pocket or around the neck), desktop (A4), wall-mounted (poster), student-oriented



- Teachers used one approach's prototypes (student-oriented or teacher-oriented) for one week, then switched to the other approach for another week
- Procedure:
 - a. Initial interview to explain the experiment, consent and give prototypes
 - b. One week of usage on daily practice (the instructions were to use it on every lesson that week)
 - c. Mid-experiment interview to gather any troubles and initial comments, and exchange the prototypes
 - d. One week of usage of the other approach prototypes
 - e. Final interview including profile, impressions, assessment of potential usage
- Analysis: quantitative analysis of recorded events in paper prototypes; qualitative analysis of interviews.

Results

- In total, the 9 teachers did 132 teacher-oriented annotations during a total of 75 different lessons. There were 551 student-oriented annotations from 57 different sessions.
- In the teacher-oriented approach, more annotations were on desktop form, and delayed (to the end of the lesson, at least). Teachers reported difficulty in remembering to do it during the lesson. Most teacher annotations would go without any kind of media (audio, video) attached
- Student-oriented approach was generally preferred (it was easier to remember, and the routine of asking students to do something is already ingrained).
- Several teachers asserted they found both perspectives (student-oriented and teacher-oriented) interesting
- From the TPD specialist point of view, student-oriented approach also gave a clearer idea of the overall practices state of the school

Iteration 3: Exploring Joint Teacher-Student Data Gathering (500w)

- Rationale: from previous iteration, idea to combine teacher- and student-centred approaches in a simultaneous routine (mini-reflection) at the end of the lesson
- Implemented Prolearning¹: a lightweight web platform to support this kind of routine
- Research questions: Are teachers able to perform this routine in every lesson? Is there any evidence of changes in practice or student experience? How would the school roll this out?
- Studied it in another two-week field study, with aforementioned web technology prototype

Context

- Same Swiss school as Iteration 2
- 6 teachers with different amounts of experience participated

Method

- Similar to previous study:
 - a. Initial meeting to explain usage of the tool, study and consent
 - b. Two weeks of usage in everyday practice (teachers were instructed to use it in every lesson, if possible)
 - c. Interview to gather impressions on usage, future use, etc.
- Analysis: quantitative analysis of recorded events in the platform; qualitative analysis of interviews.

¹ See <http://prolearning.realto.ch>



Results

- Generally, reported experience of use was good, but varied widely (from "horrible" to "painless" or "I liked it"). However, if part of a school-wide TPD effort, teachers reported preferring Prolearning to most other TPD options they know
- Usage in a lesson was reported to last for 2 minutes (in the logs, median duration per session is 151 secs)
- Teachers reported using it for most of the lessons (avg. 70% of the lessons). The main reasons for forgetting were "being in the flow" of the school day, or some clash with the classroom habits (e.g., take away student computers impeded students from using the tool). No one reported not having enough time to do it
- Several teachers reported thinking more about the issues that were being asked about (e.g., "did I allow enough time for their questions?")
- Teachers reported a variety of student attitudes, with questions about what would be the consequences for the teacher, etc.
- Teachers got better at predicting (on average, each day the predictions were closer by 0.64 in the 1-100 scale, $p=0.0065$). Student experiences in most cases got better with time (but not for all items, and not significantly)
- Most teachers did not use the reflection notes field upon closing a session and seeing the results (32 out of 125 sessions, most of them from a single teacher)
- Teachers would not do it for every lesson every day forever. There was a lot of talk about what would be the right frequency and duration of use in an eventual roll-out (no consensus, most teachers advocated using it as a sort of "check the pulse periodically")

Discussion: Design Guidelines for Teacher Reflection Support (500w)

- The concrete form of our current tool and practices is the result of the DBR inquiry in our particular contexts and local restrictions. It may not be directly applicable to others!
- However, our process served uncover guidelines and factors that technology designers promoting everyday data gathering for reflection in other contexts can also face, and should consider:
 - Design the socio-technical pair (technology+routine) together, within the classroom constraints (see also work on automaticity and routines)
 - Design for overload: teachers' lack of energy, attention, etc. were ubiquitous in our iterations. Make it impossible to forget to do the reflection (students can help on this, see below).
 - Do not forget the students: has implications about the ethics of recording classroom data, but they can also be a valuable source of information!
 - Data: Space & Time, Activity & Experience: aggregate measures of time spent in activities or places, as well as teaching actions and student experiences, were judged most interesting and easy to interpret
 - Attention to ownership: Let school and/or teachers personalize the items of reflection (e.g., subject-specific questions). Also, be very careful about the data gathered and whether people are comfortable with it, who owns and can see the data, what will be done with it (especially, for heads trying to roll TPD out). In our context, we opted for anonymous student data and personal ownership of the data by teachers, but your mileage may vary.
- Value of this design-based research: our efforts led to fulfilling several already-known guidelines for effective TPD (e.g., TPD should be collaborative), but in unexpected ways (e.g., not so much collaboration among teachers, but with students!)



Limitations and future work (300w)

- Limitations: context-bound study, limited sample of teachers... and limited look into the ultimate goal (better student achievement). We collaborated with the school's TPD specialist, but did not look at the effectiveness of the actual TPD program over time (only its technological support)
- Prolearning development: We have implemented school-level and teacher personalization of observation items
- Although we cannot claim Prolearning works for everywhere, it is being used in actual TPD in the same school this year, and several other schools have shown interest and are testing it out (in Germany, Switzerland, ...others?)
- Future work: Combine passive, privacy-friendly data gathering for automated teacher activity tracking (similar but less intrusive than), with active, teacher-and-student-oriented data gathering (like Prolearning), along with assessments of learning. Goal: to track changes of practice, student experience and effects on learning.

References (1000w)