

# Representations of a project process as a means for reflection

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**Abstract.** The technique of using timeline and experience curves as representations of a project process have previously been shown to be useful for reflection on the process in the project team. In an ongoing study, reflection workshops are introduced in a number of software engineering student projects, in the middle of the projects and at their end. The study investigates how the representations support the development of insights about project challenges and lessons learned. Preliminary findings suggest that the workshops have been useful for helping teams identify their project challenges. The relationship between the representations in the first and second workshops of a team can be used for learning more about the effect of the first workshops. Also, comparison of the representations can provide insights on the difference between memory of a project process from the point of view of its middle and its end.

## 1 Introduction

Learning from the experience of collaborative work and thereby improving the work process is often very hard. Project postmortem evaluations are arranged to help individual project participants, project teams and their organizations learn from the project experience and improve their work processes (Dingsøy 2005; Kerth 2001). Visual representations are often used to aid the reflection. Among these are timelines of project events, and curves illustrating the experience of being in the project for each project participant. The study reported in this paper aims to develop the understanding of how these techniques aid the identification

of project challenges and lessons learned, and how they may effectively be included and supported in reflection workshops with a restricted time schedule.

## 2 Background

In project retrospectives, visual representations are often used to aid the reflection. Among these are timelines of project events, and curves illustrating the experience of the individual project members (e.g. ups and downs) along the curves (Derby et al. 2006; Kerth 2001). This approach has been shown to be successful to aid project based learning (Thomas 2000) through short workshops in software engineering student teams (Krogstie and Divitini 2009). The drawing of timelines and curves helped teams at the end of their project reflect on the process and identify lessons learned.

One of the things that may improve the outcome of postmortem evaluations is access to better data about the project reflected upon (Kasi et al. 2008; Schindler and Eppler 2003). One possible source of such data are collaboration tools used in the daily project work, as these tools typically store data relating to, and originating in, the work process. A previous study showed that in a postmortem evaluation workshop at the end of a software engineering project, data stored in a lightweight project management tool through its daily use in the project helped team members recall projects events that they had not recalled by memory alone, and also helped them change their view of important aspects of their project process (Krogstie and Divitini 2010). Particular characteristics of the tool were found to be useful to aid reflection, particularly the chronological overview of changes to project artifacts. This use of collaboration tools can be seen as a way of bridging work and learning from work, which has applicability within the educational context of project based learning as well as in industry.

This paper reports ongoing work for which the original research agenda was twofold. Firstly, the aim of the study was to continue the work of developing efficient approaches to retrospective reflection in project-based learning, this time focusing not only on lessons learned but support for the ongoing process by aiding process improvement. Secondly, the aim was to see if the use of historical data in collaboration tools could be introduced into the relatively short reflection workshops and thereby improve the reflection. Introducing this tool use in the workshops could give an opportunity for research on the potential change in use of collaboration tools in project work when they also become tools for reflection.

As will be explained in what follows, whereas the study was originally designed to include both of these aspects, the second aspect had to be abandoned.

### 3 Case and research method

The case is an undergraduate project taking up 50% of the students' workload in the last (6<sup>th</sup>) semester of a Bachelor of IT program. The teams develop software for genuine customers, and the projects are intended to be as authentic as possible. Each team receives one grade and has a supervisor from course staff. Deliveries include a software product, a project report in several versions and an oral presentation. In 2010 there are 12 teams, most of which have 5 members. There are altogether 58 students in the course.

As part of the project course, retrospective reflection workshops have been introduced. The aim is threefold: helping the students learn from their project, providing the students with some hands-on experience with industry standard reflection techniques, and learning about how the organization of the course works. A technique of drawing project timelines and individual experience curves along the timelines had been adopted in the course with success in 2008. In 2010, it was decided that reflection workshops be arranged not only at the end of the course but also in the middle. The purpose of the mid semester workshop (WS1) is to help the project team identify challenges in their project work and ways of addressing them (i.e. appropriate actions), i.e. *process improvement within the project*. In the workshop at the end of the project (WS2), two months after WS1, the aim is to identify *lessons learned*, benefiting the team members' work in subsequent projects. The timeline and experience curve technique would be used in both rounds, and the workshop duration would be 90 minutes.

The author of this paper is the workshop facilitator with no role in evaluating the students. The setting of all the workshops is as follows: The participants sit by a table in a room with a large-size whiteboard. Each participant is provided with an A3 paper form containing a timeline marked with some major project events common to all teams (e.g. main deadlines). On top of the sheet is a smiley face, and at the bottom a sad face. Other equipment includes pens and whiteboard markers in different colors, and a flip-over.

WS1 lasted 90 minutes and was divided into three main tasks (see Table 1): Drawing the timeline of important project events (first individually on paper, next collaboratively on the whiteboard), drawing individual experience curves along the timeline (first individually on paper, next on the whiteboard, using colors to distinguish the individual team members; see Figure 1), and identifying project challenges (first individually then in a collaborative round), prioritizing them and discussing actions to address them. In the schedule, the duration of each task is approximate, allowing for some adaptation to the needs of the specific team.

The students got to keep the flip over sheets with the challenges and actions. Also, they got a picture of the timeline and experience curves on the whiteboard (sent via email after the workshop).

Table 1: Schedule for the reflection workshops (WS1)

Main activity	Activity	Equipment	Who writes	Duration
<b>Intro</b> 10 min	Intro/purpose <ul style="list-style-type: none"> <li>Explain about the purpose of the workshop and about the research agenda. Get written permission to record, collect and store data</li> </ul>	Consent forms	Facilitator	10 min
<b>Important events in the project (timeline)</b> 20 min	Individual brainstorming: <b>Important events in the project</b> (mark along timeline on paper, individually)	For each participant: pen and paper (pre-printed timeline form)	Team	5 min
	Common brainstorming: Mark events on the whiteboard timeline (events listed around the table)	Whiteboard, pen and paper (pre-printed timeline form)	Facilitator	15 min
<b>Individual experience of the project (curves along the timeline)</b> 25 min	Individual brainstorming: <b>Ups and downs (job satisfaction) along the timeline</b>	For each participant: pen and paper (pre-printed timeline form)	Team	5 min
	Comparing satisfaction curves: Everyone drawing their line on the whiteboard and explaining	Whiteboard	Team	20 min
<b>Project challenges &amp; actions</b> 25 min	Individual brainstorming: Write down the main challenges (1-3) in your project	For each participant: pen and paper	Team	5 min
	Making a shared, unsorted list based on participants' lists (around the table).	Flip over (NB whiteboard still needs to be visible!)	Facilitator	5 min
	Prioritizing: You have three votes; assign them to one, two or three of the challenges	For each participant: make three marks with your pen on the flipover Facilitator: Mark top 3 as <b>Challenges 1, 2 and 3</b> . Stick flipover sheet to the wall.	Team + Facilitator	5 min
	Discussion: which actions to address these challenges?	Round the table – what action(s)? Write actions on flipover, with reference to challenges.		10 min

An example of a timeline with experience curves is shown in Figure 1. The timeline belongs to a team which will be coined ‘team X’ here. The picture shows the left part of the whiteboard. The right part contained the (relatively empty) timeline for the remaining half of the project. The list of challenges identified by team X is shown in Figure 2. Among the challenges are (translated from Norwegian): ”Attendance. Finding times that fit all” and “Coordination of tasks. Division, assignment, follow-up.”

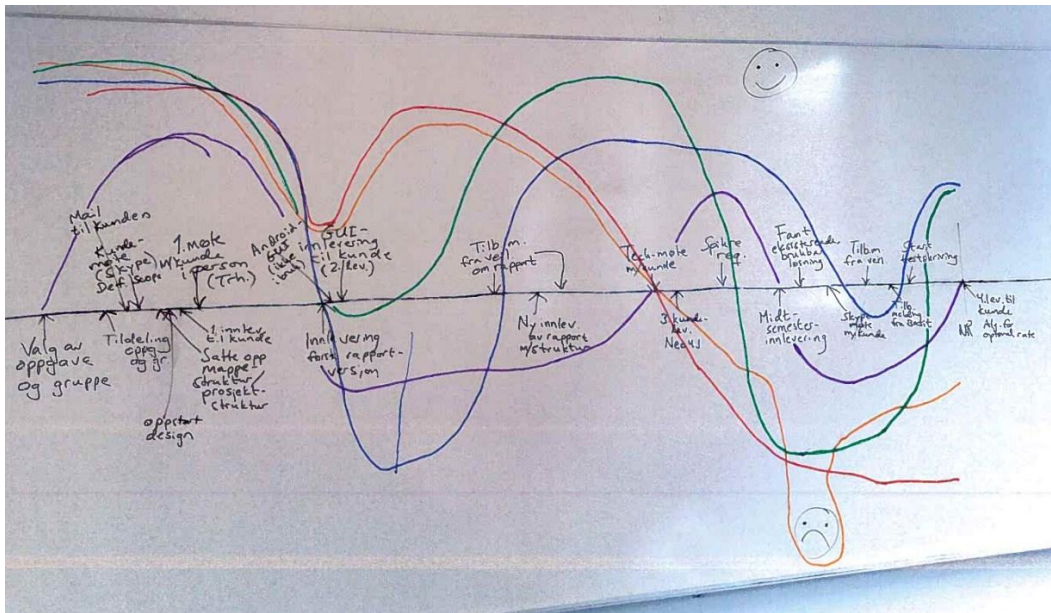


Figure 1: Timeline and experience curves for the first half of the project of team X (Photo of the whiteboard, processed by use of ink pens to make the curves more visible)

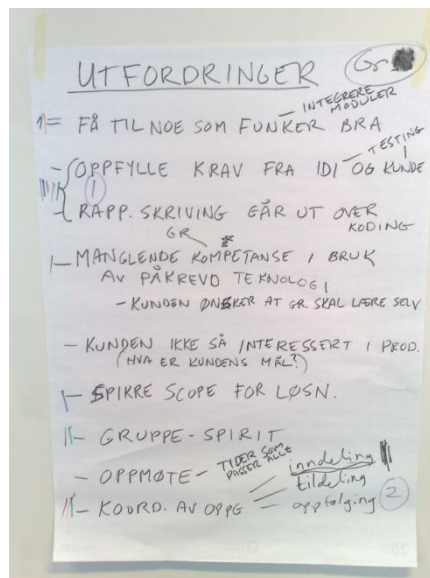


Figure 2: Challenges identified by team X and quickly prioritized for further discussion (In Norwegian)

All but 2 students showed up for WS1, which had been presented as mandatory.

The overall research approach of the study can be considered as interpretive (Klein and Myers 1999) and based on participant observation. The author's dual role of researcher and facilitator is considered, with heed to the pros and cons of doing insider research (Robson 2002). Data are collected, by participants' consent, by audio recording the workshops and taking photos of the flip over sheets and the whiteboard. Also, the individual paper sheets containing the individual timelines

and experience curves as well as the challenges proposed by the team members, are kept as data sources. In addition, data about the teams and their supervision may be gathered from project supervisors at need, and administrative information about the course is available. Further, the team rooms have been visited to have a look at the whiteboards, but other observation of the work in the team rooms has not been planned.

4 weeks after WS1 a follow-up survey was distributed to the team members, mainly to get some information about the extent to which the workshop had had any impact on the work in the teams. The questions asked were:

1. Have you taken up anything from the workshop with your supervisor? (Yes/No)
2. Have you taken up anything from the workshop internally in the team? (Yes/No)
3. To what extent has the workshop had an impact on the planning of your further project work? (1-5; 1 = not at all, 5 = to a great extent)
4. To what extent has the workshop had an impact on your way of collaborating within the team? (1-5; 1 = not at all, 5 = to a great extent)
5. How useful do you think the workshop has been to the project? (1-5; 1 = of no value, 5 = very useful)

20 out of 58 students answered the survey (as of 23 April 2010). 10 out of 12 teams were represented in these answers.

## 4 Preliminary findings and discussion

The findings from our study are preliminary, analysis of WS1 not being completed and WS2 not yet conducted. This section is structured as a discussion around questions that seem pertinent at this point in the research process, starting with an overview of findings from the survey.

### 4.1 Preliminary findings

The following results from the survey indicate that the students generally perceive the workshop as useful (Figure 7). The majority says they have taken up issues from the workshop internally in the team (Figure 4), but only a minority has done so with their supervisor (Figure 3). The workshop is reported to have had some impact on the planning of further project work (Figure 5), whereas the impact on collaboration within the team is perceived to be low (Figure 6).

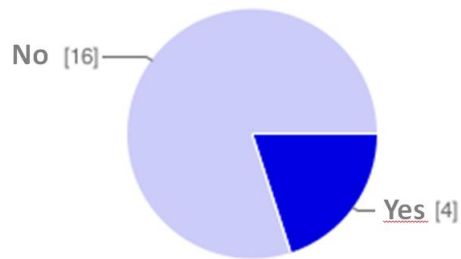


Figure 3: Answers to Question 1: “Have you taken up anything from the workshop with your supervisor?”

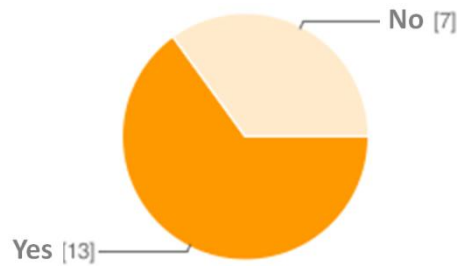


Figure 4: Answers to Question 2: “Have you taken up anything from the workshop internally in the team?”

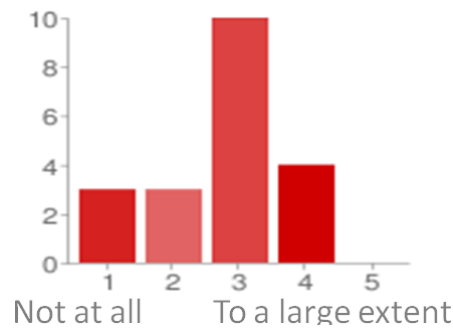


Figure 5: Answers to Question 3: “To what extent has the workshop had an impact on the planning of your further project work?”

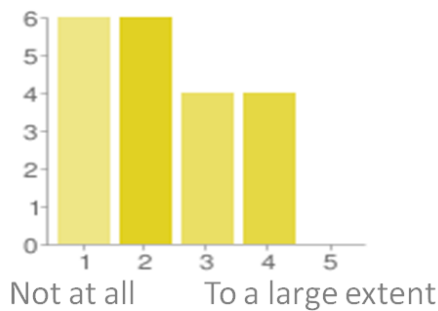


Figure 6: Answers to Question 4: “To what extent has the workshop had an impact on the collaboration within your team?”

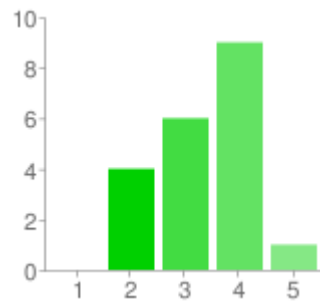


Figure 7: Answers to Question 5: “How useful do you think the workshop has been to the project?” (1 = Of no value; 5 = Very useful)

An example from the survey answers from a member of team X illustrates that the experience curves can help trigger insights and subsequent change in a project process. The team member reports, answering Question 3, that she had become “*A bit more motivated, saw that the others felt the same as I with regard to how well the work was going*”. (See Figure 1, in which, at the end of the timeline (e.g. by mid semester), the curves all have a ‘dip’ and still show mixed – and partially very low - satisfaction with the project). To Question 4, she answers: “*4 - We have become better at giving notice when something is not working, and people tell if they are being late*” (addressing the team’s identified challenges of improving attendance and coordination of work, see Figure 2). Finally, Question 5 is answered: “*4 – Good to have a summary in the middle of the project to see how the others feel the work has been*”. While these answers indicate that, in the eyes of this team member, the workshop has been useful, they also indicate communication problems in the daily work of the team: the team member was possibly unaware of the strongly negative feelings in the team. In combination with the recorded data from the workshop the survey answers also indicate that the experience curves serve not only as a means for insight for the individual, but as ‘supporting evidence’ for team members’ arguments. In this case, the team member was the project manager, eager to have the team’s commitment to more disciplined working habits and better team-internal communication. This type of findings illustrate how, in this study, the data from WS1 and the follow-up survey can be used to gain better understanding of how the project process representations support the teams’ collaborative efforts in the workshop.

#### 4.2 What makes viable the investigation of historical data in collaboration tools as an aid to reflection?

The original workshop schedule contained a task of examining historical data in the teams’ collaboration tools with the purpose of possibly enriching or adjusting the project timeline that had been reconstructed based on participants’ memory alone. To this end, the teams had been asked to bring a portable PC with their



project management tool or some tool they thought would help in showing what had happened in the project. The task was removed from the workshop schedule after the two first workshops, resulting in the modified schedule of Table 1. There were two main reasons for this change, which also implied a change to the research design.

First, there turned out to be too little time to meaningfully look into historical data in collaboration tools. The tasks of drawing timelines and experience curves together with the tasks of identifying challenges and actions easily required the 90 available minutes. Doing these tasks too superficially would negatively affect the learning outcomes – which was unacceptable given the researcher’s obligation to also provide adequate facilitation - and thereby also the quality of the research data on the use of timelines and experience curves.

Second, almost all teams organized their work in accordance with SCRUM (an agile software development process). One implication of this was that the coordination of the teams’ work to a large extent took place with the aid of whiteboards in the team rooms, the historical data being wiped out on a daily basis. The computerized tools contained less of the historical project management information, and no collaboration tools in the teams were clear candidates for attempts at informing the development of the project timeline.

A question that should be addressed based on this change of our study is: what does it take for the approach of investigating historical data to be viable in a reflection workshop? The duration of the workshop is one issue: probably, in most cases the workshop needs to be longer than 90 minutes. Also, should the approach be based on data in existing collaboration tools, based on current tool usage, or should tools and/or daily tool use be changed with the purpose of also supporting reflection by providing easy access to relevant data? If so, could the timeline representation serve as the ‘backbone’ of this design? Research has shown that information about users’ activities can be gathered for the purpose of supporting many different aspects of work (e.g., (Aranda and Venolia 2009; Minneman et al. 1995; Omoronyia et al. 2009)). The gathering of relevant information may involve users’ tagging of information that they see as important, an approach previously suggested to improve the utility of project wikis for retrospective reflection (Krogstie 2009). On the other hand, by imposing such changes, the simplicity of just utilizing existing tools in existing use, may be lost. Historical data to be used in reflection needs to be easy to access and navigate (Krogstie and Divitini 2010). In a real life case in which teams use different sets of collaboration tools, it is (unsurprisingly) not sufficient to ask the teams to bring a tool which stores data about their project management.

Even without the use of historical data in collaboration tools, the workshop may need to be longer than 90 minutes for the team to get the most out of the timelines and experience curves. Our findings indicate that most teams in their later meetings returned to the issues addressed in the workshops (see Figure 4),

but we do not know how thoroughly this was done. An answer to Question 3 by one student illustrates the challenge: *“Our insights in the workshop were really things that the team already was aware of, but then again the workshop went a bit fast and it was hard to elaborate.”*

#### 4.3 What may be good approaches to get the most out of the second round of workshops, in particular to understand the role of the timeline and experience curve representations

In WS1, the identification of project challenges was achieved through the development of a number of representations of the project process, individual and shared. This is diagrammatically shown in Figure 8, in which the grey arrows inside the middle circle indicate transformations of representations in the retrospective reflection workshop. These transformations can be considered from a distributed cognition perspective (Hutchins 1995), or they can be seen as indicating how one representation serves to mediate (Vygotsky 1978) the work of developing the next. The insights on how this unfolds in the actual workshops, and the possible generalization of these findings into patterns of use of the representations, have to draw on detailed analysis of the available data.

The second workshop in each team (WS2) will involve largely the same use of representations, but the representations will be generated for the entire project process and not just the first half, and from the point of view of having finished the process (but not yet received an evaluation of the result). Also, it is lessons learned and not project challenges/process improvements that will be in focus.

The connection between the process and outcomes of WS1 and those of WS2 (diagrammatically illustrated in Figure 9) will be investigated in the study. We hope that the representations created in WS2 can tell us something about the usefulness of WS1. The perceived impact of WS1 on the project process may be discussed in context of the timeline in WS2. It will be interesting to see the extent to which the challenges identified in WS1 are revisited in the lessons learned in WS2. Are there many lessons learned addressing issues that were present in the first half of the projects but that were *not* explicitly addressed in WS1? Did the work with the timeline and experience curves and challenges in WS1 point to issues that turned out to be profound to the project result and/or experience, viewed from the endpoint of the project process?

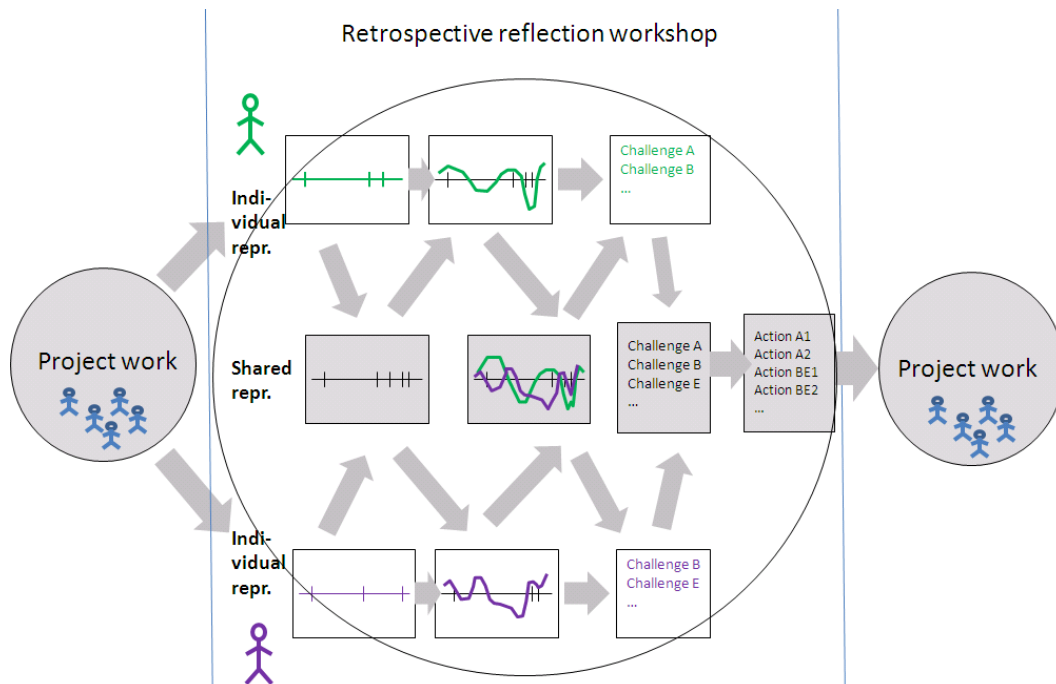


Figure 8: Transformation of representations involved in the first workshop (WS1)

Finally, comparison between the curves drawn in the two workshops, interpreted in light of other data from the workshops, can be used to investigate the research question of whether and how teams over time change their conception of early events in the project.

## 5 Conclusion

This paper presented preliminary results from an ongoing study on the use of certain techniques for retrospective reflection on project work. Whereas some of the original research questions for the study had to be abandoned, other research questions have been expanded based on the opportunities offered by the case.

The early results show that the timeline and experience curve technique is promising as an aid for students to identifying challenges to their project process. Further analysis of the data from the first workshop as well as a comparison of results from the first and second workshops will further inform insights about how these techniques inform process improvement and the identification of lessons learned.

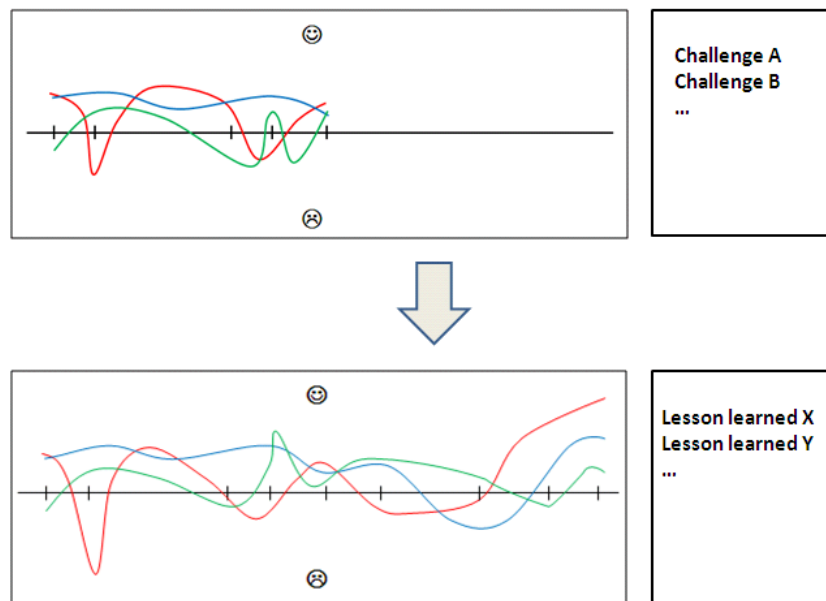


Figure 9: Representations created in WS1 and WS2: What are the relationships between them?

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