Pair Teaching – an eXtreme Teaching Practice

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Abstract—**In previous papers, we have presented eXtreme Teaching (XT) as a framework for continuous improvement of teaching and learning. In those papers we have also sketched a number of XT practices within the framework, but have not been able to give them any real in-depth treatment. In this paper, we focus on one single XT practice – Pair Teaching – and cover it in more detail.**

First, we give a short overview of the XT framework. Next, we present the background and motivation for introducing the practice of Pair Teaching and relate the practice to pedagogical theories. Then, we discuss and compare experience from practicing Pair Teaching – both our own and those of others. We relate this experience to the specific context in which Pair Teaching techniques have been used. Finally, we draw our conclusions.

I. THE XT FRAMEWORK

TEACHING is often looked at as a solitaire activity. We want to change that view and look at it as a social activity that is done in pairs, which could be part of a larger team.

eXtreme Teaching (XT) is a framework that allows teachers to focus on experimenting with and improving their teaching techniques without compromising quality. The XT framework, see Figure 1, encourages a scientific approach to teaching, it is based on four fundamental values: Feedback, Communication, Respect, and Courage, it is highly iterative, and it contains a number of specific practices. The goal of all this is to help achieve better student learning.
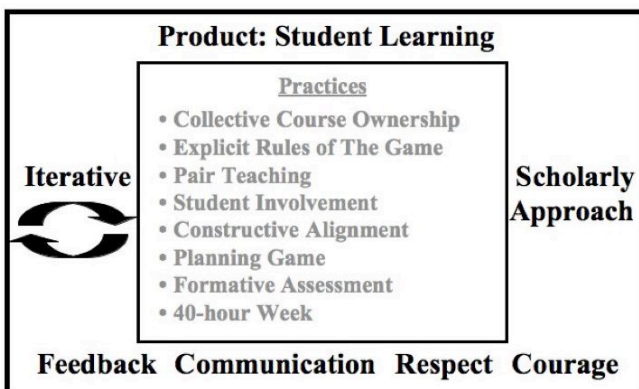

Figure 1. The XT framework.

From the description above, it might seem that XT just fell out of the sky ready to use – but this is not the case. It is the current result of years of work trying to find something that could guide us to a more systematic and consistent

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approach to teaching and continuously remind us of what it is that we should do. The three major sources of inspiration for XT are:

1. Scholarship of Teaching and Learning [5]. Scholarship is the core of all academic work – be it research, service as well as teaching.
2. eXtreme Programming [4]. eXtreme Programming (XP) is based on a number of underlying values, which we have found universal also to the teaching situation.
3. Kolb's Learning Cycle [7]. Kolb is normally used to describe the students' learning process, but we use it to describe the teachers' learning, which simply means it is the teachers who are iterative in their "experiental learning" of the teaching profession.

Our first tentative description of XT can be found in [1]. A better and more covering description, including the practices, is given in [2]. Finally, the framework itself is described in a more detailed way in [3]. In this paper, we will focus specifically on one of the practices – Pair Teaching.

II. THEORY AND BACKGROUND FOR PAIR TEACHING

The very start for the practice of Pair Teaching (PT) was in part our own experience from teaching in pairs and in part influenced by the corresponding practice of Pair Programming in XP. Both authors had early on in their teaching careers an intuitive understanding of their need to pair up with other people. However, the actual term Pair Teaching wasn't explicitly coined – and used in a more systematic way – until the idea of XT came around.

In this section, we will use the XT framework to analyse how PT could and should be carried out.

A. Scholarly approach

Doing research is a scholarly activity. You define your research problem, perform some experiment or work, reflect upon the outcomes and relate them to theory, and finally you discuss and publish your results and conclusions. Doing the same in the teaching situation is known by the term Scholarship of Teaching and Learning (SoTL) [5].

To claim that PT in itself makes the involved faculty reach all levels of SoTL is to exaggerate, but PT definitely stands for a scholarly approach to teaching. PT increases the dialogue between the involved faculty members, which is a first step and corner stone to SoTL. Sometimes is it not possible to get all faculty interested in SoTL, but a smaller step like PT might be possible. PT means that you at least have to formulate and put your thought to peer review from your partner. If you combine PT with rotating pairs then you are one step closer to scholarship.

B. Values

The XT framework is also built on the values of Communication, Feedback, Courage and Respect. We will now look at how PT can support those values.

Communication serves to move around information between the different people involved in a teaching activity (e.g. a course). This includes both people presently involved with the activity and people who have been involved in the past or will be involved in the future. Information could be knowledge, experience or ideas, and we want to keep down the communication costs, barriers and overhead. Pairing makes communication easier, because your partner can see what is going on and you can use verbal communication. Even between "generations" it is possible to avoid the more heavyweight written communication to transfer information if you manage to pair up with past or future participants. If more than two people are involved in an activity, then we can facilitate the spreading of information by rotating pairs within the team.

Practising PT can also give a person *Courage* to try out something new. If you pair up during the design of the activity you want to test, you have someone with whom to discuss and debug your ideas. Pairing up during the actual execution of your experiment, it is nice to know that you are not alone if you get stuck or otherwise run into troubles. It might even give you the courage to try out something new on the fly.

If PT has to work, we need to *Respect* our partner. People have different ways of thinking and through pairing up we will also get a better understanding of the reasoning for their way of doing things.

Feedback is what we get from the students and is not directly supported by PT. However, a partner can notice reactions that we don't see because we are too immersed in the activity. The feedback that we get from our partner during discussions and brainstorms, we will categorise as communication.

C. Iterative

The iterative nature of the XT framework is inspired by Kolb's Learning Cycle. According to that, students learn by doing and must go through the stages of Experiencing, Reflection, Conceptualization and Experimentation before they are ready for another learning cycle.

We, as teachers, are also trying to learn and to improve our skills and should take the same ride through the experiental circles as the students. This will help us to become better teachers and to obtain better student learning in the topic(s) that we teach.

Teachers who teach have no problems in getting occasions for *Experiencing*. You immerse yourself in the task and gain a lot of experience. However, when you later have to reflect, you will need "data" on what happened. This data is not always so easy to collect while you are busy with your teaching, so a partner could observe and later help you to remember.

In the *Reflection* you step back and review your experience in the light of what you noticed. A partner can help us in pointing out observations that we might have missed or considered less important. Thus we can get a more complete picture.

Conceptualization involves interpreting the events that have happened and understanding the relationship between them. This is difficult for inexperienced students, but even experienced teachers can need a helping hand. This is very much a brainstorm activity that can be stimulated by having to explicitly explain the events and by getting input from another person. During this phase you also decide what to change and what actions should be taken. Again this planning is very much a brainstorm activity but also a creative and constructive activity, in which a more senior and experienced person can provide knowledge that help you see things in a different way.

You are now ready for active *Experimentation* – alone or preferably with a partner.

Practising PT, you will have a partner who can help and support you during some or all of the four stages. Your partner can also help you make sure you actually go through all of the steps of the learning cycle – and keep on doing it.

D. General remarks

The Pair Programming practice of eXtreme Programming has the concept of a driver, who does the work and takes care of the details, and a navigator, who observes, comments, asks questions, makes suggestions and in general takes care of the great picture. It also recommends that you switch often between the roles of driver and navigator within a pair. We suggest that the same should apply to the practice of Pair Teaching.

A quick search on the phrase "pair teaching" using Google and Yahoo gives about 300 hits from each. The vast majority of which has absolutely nothing to do with our context of teaching in pairs (some of the hits deals with teaching pairs). We conclude that Pair Teaching might not be a well-known and well-defined concept. Searching instead on "team|group|collaborative teaching" gives the impression that these are the "buzz-words" to use. However, by insisting on the use of *Pair*, we want to stress the difference between two people solving a task and a group of people building a product (student learning) and for which they might make use of PT or collaborative teaching.

The cost-effectiveness of Pair Programming is, in part, due to the fact that two activities (*writing* the code and *reviewing* the code) are carried out in parallel. This is not the case in PT as there is no tradition for explicit review in teaching, so we will have to rely more on the benefits mentioned in II.A-C and III.A-D to justify the added costs of being two people. Furthermore, two people will also be able to take care of larger groups than one person.

III. CASE STUDIES

In this section, we will present some examples of how PT could be carried out – and we will discuss the case studies and the experience that we can draw from them.

PT can be used for course planning, lecture planning, exam construction, exam marking, exercises, labs and even lectures.

A. Teaching a course together

Several years ago one of us started a collaboration with a colleague concerning two similar courses. This has over the years developed to something that can be described as

permanent PT. We now have one common course given two times each year. With common we mean one course code, both are officially course responsible (collective course ownership), and the final examination is common for all students. However, the different course editions differ slightly in teaching methods. All major activities concerning the course are done together except for the lectures. However, we even consider the lectures to fit in the term PT since they are planned in pairs and a switch of lecturer with very short notice would cause no problem. There are especially two things we would like to stress. First, the quality assurance aspect since if someone has an idea it must first be made explicit to make the other person understand it, then it is directly peer reviewed. This immediate peer review has stopped many "not so well thought out" ideas during the years. Second, PT also leads to a bonus back up flexibility – most things can be carried out alone even if planned to be carried out in pairs; if someone gets ill, has to attend a conference, or for other reasons cannot be present.

B. Developing a new course

Some years ago one of us had to develop a new course that was rather unique – with no previous courses to "steal" from. Person A was the more senior in this case, whereas Person B had experience from giving a smaller PhD course on the subject. They brainstormed the course outcome and learning goals together – during this B was mostly the driver whereas A was the navigator (though they were switching roles quite often). They discussed structure and contents of the lectures together, prepared them alone and reviewed them together – during this A was the driver for most of the lectures, whereas B most often had the role of navigator (mostly roles remained fixed for one lecture with the "owner" of the lecture being the driver). They also supervised each other's lectures so they could provide feedback and get information about what had been said and done. This made it much easier to refer to each other's lectures and create a sense of a red thread through the course. Exercises and computer labs were developed sitting together with frequent switching between being driver and navigator. The driver would be the "creator" of an assignment and the navigator would try to carry it out.

C. Student Pair Teaching

Our department uses eXtreme Programming in a course on Software Engineering, where the students work in teams that are guided by coaches [6].

The coaches are older students who have taken the course the previous year and who are now following a coaching course. They coach (teach) in pairs, mainly because they are not experienced and need the support of a partner with whom then can brainstorm ideas before trying them out. However, also when they carry out their ideas, they benefit from the fact that one can be the driver of the activity, while the other as navigator maintains the overview and can step in if needed – and that they can and do switch roles. Finally, they get flexibility in presence if one of them has to attend a lecture and can draw on the broader set of competences of two people.

The team follows XP and as part of that also the practice of Pair Programming. At the start of the course there is a great variation in the skills of the students, however, as the course goes on this variation becomes smaller. The stronger students get better, but the weaker even more so because they pair up. The strong student learns from teaching and the weak from being taught. Often the stronger act as driver, which may be good for the short-term productivity of the team, however, the best learning for both occurs when the stronger acts as navigator – which also gives the best long-term productivity. Sometimes we even see a coach pair up with a student to transfer his skills – most often as navigator.

D. Passing on a course

This case study is an example of where PT was *not* used, but could have been very helpful. A teacher was taking over a course in which he had comprehension of the topic and could apply it, but was no expert.

The previous teacher was no longer available, so the new one had to work quite hard on his own to get into the material that was left behind – especially for the parts where he had only a knowledge level. He had to guess at the motivation for slides, exercises and labs and in some cases even had to leave out some things because he did not have a clue about what it served for. During the course he also experienced that some parts were quite difficult for the students to master whereas others were easy – experience that the previous teacher must have made too and maybe even had had ideas about how to modify.

IV. CONCLUSIONS

Teaching should not be a solitaire activity, but something that is done in pairs. Done the right way, Pair Teaching can bring many benefits that outweigh the additional costs.

Some of these benefits are immediate and explicit – like having someone to brainstorm with, someone who can help you "debug" your ideas, the possibility to handle larger groups of students and the ability to step in for each other in case of absence. However, most benefits are more long-term or "hidden" – like communicating information, assuring quality aspects, educating colleagues, and most important of them all it guides the faculty towards SoTL. It is important to put an explicit value also to these benefits when you judge if Pair Teaching is cost-effective or not.

REFERENCES

[1] Andersson, R., Bendix, L., *eXtreme Teaching*, in proceedings of 3:e Pedagogiska Inspirationskonferensen, LTH, Lund, May 31, 2005.
[2] Andersson, R., Bendix, L., *Towards a Set of eXtreme Teaching Practices*, in proceedings of the 5th International Conference on Computer Science Education, Koli, Finland, November 17-20, 2005.
[3] Andersson, R., Bendix, L., *eXtreme Teaching – a Framework for Continuous Improvement*, to appear in Journal of Computer Science Education, 2006.
[4] Beck, K.: *Extreme Programming Explained – Embrace Change*, second edition, Addison-Wesley, 2005.
[5] Boyer, E., L., *Scholarship Reconsidered. Priorities of the Professoriate*, The Carnegie Foundation, 1990.
[6] Hedin, G., Bendix, L., Magnusson, B., *Teaching eXtreme Programming to Large Groups of Students*, Journal of Systems and Software, January 2005.
[7] Kolb, D. A., *Experiential Learning: Experience as the Source of Learning*, Prentice-Hall, 1984.