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For Free: Continuity and Change by Team Teaching

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For Free: Continuity and Change by Team Teaching

Team teaching is advocated in education to offer students multiple explanations to complex concepts and to improve teacher development. However, team teaching is typically associated with high staff cost due to the increased amount of teachers involved. The authors argue that team teaching can be conducted in a cheap way by including novice teaching assistants in the lectures and train them “on the job”. Additionally, novice assistants cause reflection on action and prevent a mechanization of the course. The authors use Brookfield’s four lenses to reflect on the application of team teaching in a Swedish undergraduate course on software modeling over three years, involving three teachers and collecting evaluation data from close to 400 students. The reflection shows that team teaching can be used as a cost-effective way to introduce novice teachers to a course, while at the same time receiving benefits from their participation in lectures and course development.

Keywords: Co-teaching; pair lecturing; team teaching; teacher training; course improvement

Introduction

There is a long tradition of including graduate students as teaching assistants in higher education (Shannon, Twale and Moore 1998, Park 2004). The introduction of graduate students can be explained both as a means to facilitate under-graduate teaching (Nyquist, Abbott, Wulff 1989) by increasing the number of instructors per student since they are more inexpensive than graduated faculty (Hoessler and Stockley 2016, Park 2002), but also to supply graduate students with economic support (Park 2004) and opportunities to mature as professionals (Marinkovich, Prostko and Stout 1998, Saroyan, Dagenais, and Zhou 2009).

Another trend in higher education is team teaching, which has been applied in various settings, such as interdisciplinary courses (Plank 2011) or for pair lecturing

(Andersson and Bendix 2006). In an inter-disciplinary context, teachers take turns to lecture on their aspect of the course subject, while pair lecturing emphasizes the lecture as a shared activity involving multiple lecturers at the same time. Benefits of team teaching include students getting more than one explanation to complex concepts, promoting teacher development through mutual reflection on action, and a more insightful bouncing of ideas during the planning of education (Burden, Haldal and Adawi 2012a, 2012b). However, regardless of the setup, team teaching is commonly associated with high costs (Plank 2011, Andersson and Bendix 2006, Buckley 1999, Henderson, Beach and Famiano 2009, McDaniel and Colarulli 1997, Higgins and Litzenberg 2015).

In order to lower these costs, the authors present an economically feasible way to employ team teaching by involving graduate teaching assistants during the lectures. Additionally to being cost effective, the authors argue that this model is suitable for introducing teaching assistants to a course and train them “on the job”. Furthermore, students and teachers benefit from this approach as it can lower the negative effect of the so-called “curse of knowledge” (Froyd and Layne 2008) and as it offers a cost-effective way for reflection-on-action (Schön, 1983) and course improvement. The continuous discussions and exchange between all involved teachers increases the course quality, as everybody is constantly synchronized and as weaknesses are uncovered during the discussions.

The authors use a model of three different roles in the given course: the role of Teaching Assistant (TA), the Lecturer, and the Examiner. TAs are the classical teaching assistants who help with group supervision or lab sessions. After becoming familiar and comfortable enough with the course contents, they advance in their role to become Lecturers. In this role, they are taking over a larger amount of responsibility, and help in

course administration and lecturing. In theory, they would be able to replace the Examiner in most parts of the course, the exceptions being where a faculty position is a formal requirement. The Examiner role is then the classical course responsible, who lectures and has the overall responsibility. The authors have applied this model for a number of years in an undergraduate course on software modeling. While originally introduced by accident, team teaching was found suitable for lecturing in the large, as it offers multiple explanations and a discussion to the complex topic of software modeling, and was consequently introduced for all lectures in the following year.

In this paper, the authors describe their experiences in more detail using Brookfield's four lenses (Brookfield 1995) and substantiate their claims using data from 346 course evaluation surveys collected over three course years. The following three research questions are answered:

- (1) RQ1: How can team teaching facilitate continuity and teacher introduction?
- (2) RQ2: What does team teaching imply for course improvement?
- (3) RQ3: What does the involvement of teaching assistants in team teaching imply for the costs of teaching?

Team Teaching

Team teaching can be carried out in many ways, where examples from literature include organizing cross-disciplinary courses where different teachers are responsible for the course content of their respective disciplines (Plank 2011, Buckley 1999); letting a team of faculty members be in charge of a set of courses to increase the alignment between course objectives (Garmston 1987, Showers and Joyce 1996); or by having two teachers co-lecture a single course (Burden, Heldal, and Adawi 2012a, Roth and Tobin 2002, Roth, Masciotra, and Boyce 1999). The latter is commonly referred to as co-teaching or pair lecturing. In this article, the authors use the term team teaching as the scope is not restricted to lecturing only, but covers all activities associated with a university course, e.g., lab sessions, assignments and project work.

Independent of how team teaching is conducted, a common benefit is how it promotes teacher training. For instance, Henderson, Beach and Famiano (2009) implement a set-up where one teacher is the master and the other is the novice. In their case the master models the own understanding of teaching while the novice explores and articulates how knowledge of teaching can be put into skills and practices with support from the master. The authors argue that the improved possibilities for reflection on the own practice together with peers are an important enabler for professional development. In this way, team teaching takes the form of a cognitive apprenticeship (Brown, Collins and Duguid 1989).

Shibley (2006) stresses the possibilities for mutual learning through team teaching for the involved teachers, as they learn new aspects of both the subject matter and themselves as teachers, 'Colleagues continue to learn from each other, about both content and teaching'. An important concept that is learned is the tacit knowledge that only is encountered and subsequently discussed when teaching happens in a concrete setting. This involves all aspects of teaching, from planning the course to carrying it out and evaluating the outcome. Buckley (1999) calls the transfer of tacit knowledge from more experienced to less experienced teachers as 'in-service training'. Roth et al. (Roth and Tobin 2002, Roth, Masciotra, and Boyce 1999) also mention the transfer of tacit knowledge as a key reason for introducing team teaching and so do Henderson, Beach and Famiano (2009). In relation to Brookfield's notion of reflective lenses (1995) the peer feedback is more rewarding when it comes from someone who has shared the same teaching experience (Henderson, Beach and Famiano 2009, Burden, Heldal, and Adawi 2012b). In a setting where one teacher is less experienced in teaching (Henderson, Beach and Famiano 2009) and/or with lesser experience of the course subject, the lecture becomes an immediate opportunity to learn for the novice but also for both

master and novice to reflect on his/her practice-in action (Burden, Heldal, and Adawi 2012b, Lynch et al. 2011). For this kind of relationship to be fruitful there has to be trust between the team teachers, since team teaching opens for student comparisons of teaching styles and subject knowledge (Burden, Heldal, and Adawi 2012a) as well as critique among the teachers in front of the students (Jessen-Marshall and Lescinsky 2011).

Finally, as mentioned in the introduction, the notion of increased teaching hours and subsequently the cost of teaching is a recurring drawback of applying team teaching (Buckley 1999, Plank 2011, Henderson, Beach and Famiano 2009, Andersson and Bendix 2006, McDaniel and Colarulli 1997, Higgins and Litzenberg 2015). There are different views as how to address the additional cost as well as voices that argue that the cost can be mitigated when the aim of team teaching is teacher training. Andersson and Bendix (2006) argue that the additional cost in terms of hours for team teaching is justified with the benefits of keeping tacit knowledge within the teaching team and ensures continued evolution in how the course evolves and therefore educational quality. Other counter measures range from Henderson, Beach and Famiano (2009), who budget for additional teaching hours when introducing new faculty members to the divisions' ambitions and subsequent teaching activities, to Burden, Heldal, and Adawi (2012a), who claim that team teaching can be done without additional costs when one of the teachers shifts hours from supervision preparation to lecture participation.

Research Method

For the presented study, the authors used a mixed-methods approach, collecting both quantitative and qualitative data. In this section, this approach is described, starting with a summary of the taught course. It is followed by an explanation of how teachers were introduced in the course over multiple years, and finishes with a description of the data

collection and analysis.

The Course

The course structure is shortly outlined here. More details are covered in (Burden, Heldal, and Adawi 2012a) and (Burden, Heldal, and Siljamäki 2011).

The taught course is a mandatory course in a Swedish computer science undergraduate program on the topic of Model-Driven Software Development. It lasted eight weeks in all three years, with three hours of lectures per week during the first seven weeks. The course is equivalent to 7.5 ECTS or 200 hours full-time studies. Students are assigned to groups of up to eight people, in which they work on a project that spans all eight weeks.

Model-Driven Software Development is an area within software engineering where software abstractions (as distinct from source code) are the key artifacts for implementing, analyzing, and describing software systems (Völter et al. 2013). Abstraction plays a major role in software modeling and there is usually not a single correct solution to a problem, but rather many different options. Therefore, team teaching is well suited for discussing the different options in a qualitative way live in the classroom.

When developing the course, constructive alignment played a significant role aligning the aims, activities, and assessment of the course elements (Biggs 1996). The students work in this course with more than 80% of the material discussed in the classroom during their project tasks.

The authors used a team teaching model consisting of three roles, the Teaching Assistant (TA), the Lecturer and the Examiner:

- Teaching Assistant (TA): TAs are PhD students who help with project supervision or lab sessions. They have a mixed level of experience in teaching and in the course matter, depending on the resources. They receive the same amount of hours as in a regular course, 180 hours in the presented case. Hence, no additional hours are required for the team teaching setting.
- Lecturer: After having gathered experience as a TA in previous instances of the course, the TA becomes a Lecturer. This implies that s/he has some experience in the subject matter, but considerably less than the Examiner. The Lecturer is still a PhD student and receives the same amount of hours as the TA.
- Examiner: The examiner is a senior faculty member, with experience in both education and the subject matter. S/he is the stable element in the course and the classical course responsible. Compared to a regular course, the examiner does not receive additional budget for team teaching.

The authors have applied this model for a number of years in the same course. In this paper, the experience from three years is considered - the academic years 2011/12, 2013/14, and 2014/15. In 2011/12, two authors were part of the course. The pair consisted of one Examiner (*RH* in the following), one Lecturer (*HB* in the following), and one TA, who left the course after this year. In 2013/14, the first author joined as a new TA (*GL* in the following) so that the team consisted of *RH* as Examiner, *HB* as Lecturer, and *GL* as TA. Finally, in 2014/15, *HB* left and *GL* took over the Lecturer role. Additionally, two new TAs joined. In this way, the three setups represent the origin, the overlap, and the transition for the authors' team teaching. Subsequently, the

transition from TA to Lecturer was passed by two different teachers (*HB* and *GL*) while applying team teaching. Over these three years the number of students taking the course increased from 88 in 2011/12, via 135 in 2013/14, to 164 in 2014/15. In 2012/13, the setup was the same as in year 2011/12, but no evaluation data was collected since there was no intervention to assess. Therefore, this year is omitted in the analysis.

In 2010/11, elements of team teaching were introduced by accident, as one of the TAs attended the first lecture in order to explain the course contents. The main teacher was seated in the front row and added clarifications and comments during the presentation. After the break, the roles were reversed as the TA commented and clarified the lecture given by the main teacher. Realizing that this could be a suitable way for lecturing in the large, the concept of team teaching was introduced for all lectures in 2011/12 as the TA now became a Lecturer.

Introducing New Teachers

The course has systematically evolved according to an Action Research methodology (Kember and Gow 1992). That is, iterative improvement has been applied over many course instances/years, through evaluations and reflection (Burden, Heldal, and Adawi 2012a). Using the terminology of Schön (1983), reflection occurred both in-action and on-action. The authors acknowledged the danger that having a single lecturer teaching the same course over several years can result in a mechanization of the course, similar to the *Einstellung effect* (Luchins 1942). By introducing a second teacher, existing contents are questioned and discussed. Keeping one teacher throughout the years gives the course a stable element and will ensure continuity. This stable teacher is the Examiner, the classical course responsible who is holding the lectures, examining the students, and who is ultimately the responsible. A PhD student is introduced as a Teaching Assistant (TA), helping only with group supervision. This TA then matures

during the first iteration and becomes more familiar throughout the course. In the next instance of the course, the TA changes role and becomes a Lecturer. That is, s/he is participating in the lecturing and is introduced to taking more responsibility for the course as a whole. Discussing the course contents and structure in an increasingly critical fashion with the Examiner then leads the Examiner to reflect on the course and ultimately to changes aimed at improving the course.

Data Collection and Analysis

In all three years, the authors distributed an evaluation survey among the students during the final project presentations. The survey covers the different aspects of the course, such as the lecture content, lecture style, projects, and tooling aspects. The students filled out the survey before receiving their grade, with a number of questions regarding the grading being left until after the grading. In 2011/12, 85 out of 88 students (97%) answered the survey. 2013/14 the response rate decreased to 82% (110 of 135 students), to rise again in 2014/15 when 151 out of 164 answered (92%). Among other questions, the surveys contained an evaluation of the team teaching efforts. This evaluation was restricted to the lecturing component of team teaching, as this was the only part in which students could directly assess the team teaching element. The students were asked to rate their agreement, on a five-point Likert scale, to the following statements:

- (1) I remember more after a lecture with team teaching than in traditional lectures.
- (2) I have to think more in lectures with team teaching than in traditional lectures.
- (3) Team teaching should be used in more courses.
- (4) Team teaching makes it more likely that I will attend the lecture compared to traditional lectures.
- (5) Team teaching lets the students' questions influence the content of the course more than in traditional lectures.
- (6) I was more active during the lectures than in traditional lectures.

Additionally, students rated their overall impression of the course on a five-point Likert

scale.

This evaluation data reflects Brookfield's student lens (Brookfield 1995). Additionally, the authors analyze their own reflections, which mainly represents the autobiographical lens (Brookfield 1995). However, as authors changed role and joined the course later on in the case of the first author, these reflections also contain an element of the peer lens (Brookfield 1995). The literature presented earlier forms the theoretical literature lens (Brookfield 1995).

Results and Discussion

In the following, the authors reflect on the team teaching efforts using the student, autobiographical, and peer lenses (Brookfield 1995), thus answering the three research questions. Additionally, findings are compared to the existing literature, which corresponds to the theoretical literature lens (Brookfield 1995).

Student Lens

The course itself received good overall feedback in all three years. The students' answers to the question how pleased they are with the course are depicted in Fig. 1 for all three years. Note that, in all three years, not a single student chose the most negative option 'Not Pleased at all'. The slightly more negative view during the second year can be explained with technical problems during the project part of the course. Due to this, the difference between the three years is also statistically significant (Kruskal-Wallis (Kruskal and Wallis 1952), $p < 0.01$).

[Figure 1 near here]

As depicted in Fig. 2, over 65 per cent of the students in all three years agree that they remember more after a lecture with team teaching than a traditional lecture.

Only 9 per cent in the first year, 14 per cent in the second year, and 6 per cent in the third year disagree with this statement. Statistically speaking, there is no significant difference between the three years with respect to this question (Kruskal-Wallis (Kruskal and Wallis 1952), $p \approx 0.93$).

[Figure 2 near here]

While a large number of participants are neutral, still 49, 50, and 52 per cent agree that they have to think more in lectures with team teaching, compared to traditional lectures. Consequently, 15 per cent or less disagree with this statement, as depicted in Fig. 3. Again, there are no significant differences throughout the years (Kruskal-Wallis (Kruskal and Wallis 1952), $p \approx 0.83$).

[Figure 3 near here]

When asked if team teaching should be used in more courses, the majority of all students during all three years agree. This is summarized in Fig. 4. Noticeable is the high amount of students that strongly agree with this proposal. Among the free-text comments of students who disagreed, there were numerous students stating that team teaching was well suited for the given topic, but might not apply to other courses. For example, one student stated “Great idea. Maybe not suitable for all courses.” hence addressing that the nature of the covered topic is an important factor for the suitability of team teaching. Another student stated that it “could have been better prepared for what each of you said - like when giving a speech as a group you need to try out the transitions”, hence advocating a structured use of team teaching in contrast to the authors’ approach with an emerging discussion. The Kruskal-Wallis test (Kruskal and Wallis 1952) for this question yields no significant differences ($p \approx 0.24$).

[Figure 4 near here]

According to the answers, for many students team teaching increases the chance that they will attend the lectures (see Fig. 5). However, the amount of strong disagreements during the first two years, 9 and 10 percent, shows that some students are irritated by team teaching. This is reflected in some of the free-text answers, where students stated that multiple lecturers confuse them and that they would prefer a clear direction from a single lecturer instead of the ensuing discussions. For instance, students stated that during lectures done in a team it is “sometimes a little hard to follow which one [teacher] has the final standpoint and the collective opinion” or that “some disagreements should have been solved before lecture”. These are interesting comments, as the teachers’ intention in all three years was to show the existence of different opinions and that there is usually no “final standpoint” or a “collective opinion”. In the future, this aspect clearly needs to be stressed more.

[Figure 5 near here]

Very high agreement, 70, 58, and 66 per cent in the three years, was achieved for the statement whether team teaching lets students influence the course content to a higher degree (Fig. 6). Thus, according to the students, team teaching could be a good means to reach a higher amount of involvement from student side. However, fewer students agreed to that they were more active during the lectures, compared to traditional ones (Fig. 7). This indicates that the possibility for influencing the course to a larger extent is not enough to activate some of the students.

[Figure 6 near here]

[Figure 7 near here]

Overall, it is interesting to see that the course evaluation changed significantly over the three years, see Fig. 1, but the evaluation of aspects related to team teaching did not.

Especially when keeping in mind that the second TA took over the Lecturer role after the second year. Hence, the introduction of new teachers by means of team teaching did not affect the student evaluations in a significant way. Relating this result back to RQ1, seen through the student lens, team teaching is a suitable way to introduce new teachers in a way that does not cause any interruptions or irritations. Judging course improvement, targeted by RQ2, based on different sets of students in each year is difficult, as they lack comparison to previous years. However, the free-text comments give a valid insight into major irritations or successes within the course. One such irritation was the software tool the students had to use in their project work during the first two years. The tool had obvious flaws, but had been used for such a long period that the course had adapted to it and required large changes to replace it. While the Examiner was not daring to take this step, the newly introduced Lecturer in the third year had enough motivation and energy to take over this responsibility and to make the change. Consequently, the complaints regarding tooling diminished in the third year. Some students had taken the course before or had talked to students of earlier years, and stated that this was indeed a positive change. Through the student lens, this indicates that the introduction of new teachers can cause momentum and necessary changes in the course.

Autobiographical and Peer Lenses

While the previous section contains the view on team teaching through the student lens (Brookfield 1995), this section presents the autobiographical lens, the authors' own reflections-on-action (Schön 1983). As multiple teachers were involved in the team teaching and reflected on each others' teaching performance, and as some of the authors joined in later course instances, this lens overlaps with the peer lens.

By involving teaching assistants, Burden, Heldal and Adawi (2012a) argue that no additional costs arise for using teaching assistants for lecturing. In this paper, the authors go one step further, arguing that it is important to distinguish between pair lecturing, purely targeted at the lectures, and team teaching, spanning all course activities. Additionally to the lectures, the involved teachers discuss the course content critically and share the responsibility for lectures, supervision, and examination within the team. This ensures a continuous critical assessment of the course contents, even if the course responsible stays the same over consecutive years. In this way the course aims, activities, and assessment strategies evolve over time as the teachers collaboratively seek constructive alignment of the course elements. In fact, this can be seen as a form of peer observation, where peers are invited to attend lectures for course assessment and improvement (Brookfield 1995, Lomas and Kinchin 2006).

In terms of costs, all Lecturers and TAs in the three years had a teaching budget comparable to a course of similar size in terms of students and necessary project supervision. When the role of the first author changed in the third year (2014/15), he had the same teaching budget as a Lecturer as he had the previous year, when he was a TA, and did not participate in lectures. This confirms the observation by Burden, Heldal and Adawi (2012a), that increased hours needed for lecturing are compensated through a decrease in preparations for project supervision. Hence, in relation to RQ3, the authors argue that involving teaching assistants in team teaching, both with respect to lecturing and to overall course administration, does not cause an increase in teaching costs as he was still paid as a graduate teaching assistant. Involving graduate students in team teaching therefore not only increases the number of instructors per student (Hoessler2016,Park2002), it also increases the teacher-student ratio in all course activities (planning, lecturing, evaluation etc.) without an increase in cost. Furthermore,

team teaching scales as the number of students rise. In our case the number of students increased with 86%, from 88 in 2011/12 to 164 in 2014/15, while the number of lecturing hours was constant. What did increase was the number of hours for supervision and assessment as there were more teams to manage and students to grade.

An additional observation in this context is that the authors opted to nearly completely remove presentation slides when introducing team teaching. Instead, the intention was to use the blackboard in order to support the dialog between the two teachers and the students. This dialog needs to be planned just like a regular lecture. However, the medium can differ. The authors opted to use a small script and a list of concepts that should be covered instead of traditional presentation slides.

Keeping in mind that including teaching assistants in team teaching does not increase the costs, it is indeed an effective means to introduce new teaching assistants to a course. Instead of spending teaching hours on self-study, team teaching can be used as ‘training-on-the-job’ (Buckley 1999, Shibley 2006), terminology reused by Gallego (2014) for graduate teaching assistants who take a faculty-like responsibility. These insights validate conclusions by Henderson, Beach and Famiano (2009), who report that team teaching offers an immediate opportunity to learn for novices included in team teaching. However, in contrast to their experiences, the authors did not include novice faculty members, but PhD students as teaching assistants. This is an interesting aspect, as the subject knowledge can be assumed to be less for PhD students. Clearly, training by participating in the lectures is only possible to a certain extent. If the newly introduced TA is lacking too much knowledge, additional self-study or training by the Examiner might be necessary in order to be able to advance to the Lecturer role. This resonates with Park’s account of graduate students’ teacher training in North America (Park, 2004). According to the experience gathered over the three course years, this

investment pays back once the TA advances to the Lecturer role. The Examiner then needs to spend less time on the course moments which the Lecturer took over. Additionally, as the Examiner and the Lecturer are constantly aligned through the common lectures and have previously taught the course together, there is less need for synchronization meetings.

While it might be challenging and might require additional training to involve inexperienced TAs in team teaching, it could also have a large positive impact on the students' learning. Originally introduced in the area of economics as “the curse of knowledge” (Camerer, Loewenstein and Weber 1989), it has been reported in several fields that humans who have a certain knowledge have difficulties to take the perspective of someone else who lacks this knowledge, e.g., difficulties to reason about false beliefs (Birch and Bloom 2007), to reason about mental states (Birch 2005), or to reason about novices in an educational setting (Froyd and Layne 2008). In the case of team teaching, the Lecturer and Examiner roles represent the experienced who have difficulties to reason about the students' learning, whereas the TA role, especially if inexperienced in the subject matter, can be an asset to the teacher team and help overcoming the curse of knowledge. From personal experience, the authors who took the TA role in team teaching recognize that it is often rather easy to assess when the audience has difficulties to follow or to understand a concept. Furthermore, novice TAs might have exactly the same questions as the student audience and, by asking these questions, encourage the audience to ask further questions or join the discussion. Therefore, it could be valuable to also involve TAs in the lectures, possibly in an observing role.

A related experience shared by the authors who took the TA role is that newly introduced teachers discovered in several cases that existing course contents were not

clear or implicitly assumed by the Examiner. From a psychological standpoint, this can be attributed to a mechanized state on the Examiner side (Luchins 1942), as he had taught the course for many years and, hence, had difficulties to see how the course contents and structure could be changed or improved. Here the efforts to constructively align the course elements benefited from applying a new lens by an informed peer.

Additionally to unclear or implicit course contents, new teachers also brought sufficient motivation and energy into the course to make larger changes, such as the previously mentioned change in tooling. Clearly, the Examiner needs to be willing to accommodate changes and to give the other teachers freedom and responsibility to make these changes. An interesting topic for future research would be to evaluate the aspect of teacher training by a formal study using external peer observations (Brookfield 1995, Lomas and Kinchin 2006). This would allow for less biased evaluations and give more insights regarding how the training can be understood and improved.

Finally, teaching is a profession that requires critical and continuous reflection (Brookfield, 1995). For the PhD students to evolve into full-fledged teachers it is important that they acquire self-awareness and reflect on their own teaching (Lee 2005), something that is not always easy to accommodate (Wulff et al. 2004). Team teaching can facilitate such an apprenticeship (Henderson, Beach and Famiano, 2009) but also supply the ingredients for the more experienced Examiner to analyze and improve the own practice throughout the teaching activities (Burden, Heldal and Adawi. 2012b). The same conclusion is made by Park (2004) who states that supervising a teaching assistant is complex and demanding, where success depends on the effective relationship between supervisor and supervised.

While team teaching using the three roles described in this paper has proven valuable in the case of the presented course, it is important to point out that it has

certain restrictions and requirements. First, in relation to RQ3, in order to actually achieve a low-cost team teaching setup, a certain level of continuity in the course is required. The course contents cannot change radically if the training is to be relevant in subsequent years. This means that if the technical content changes (by for instance introducing new tools) the domain knowledge should be left unchanged. Further, training the TA to become a Lecturer might be too high of an effort if s/he is only part of the course for a single year. In this case, the training time would not pay back as the TA never advances to the Lecturer role. Secondly, it is relevant to consider the student comments pointing out that team teaching might not be suited for all courses. This is certainly true for courses in which lecture contents are less debatable. Software modeling can be understood and performed in many different ways, which requires constant debate about the relevance of the produced models and their quality (France and Rumpe 2007). By participating in team teaching, TAs can acquire this skill in a better way than if studying literature, as they are directly exposed to the debate from the beginning. Finally, depending on the country in which a course runs, the notion of costs might be different. In Sweden and many other European countries, PhD students are typically required to perform a certain amount of teaching. Therefore, they are from the beginning considered as teaching assistants. In other settings, including PhD students might require additional resources not planned for in a regular course. In this case, the costs would increase but still be considerably lower compared to including additional faculty staff.

A second requirement in order for team teaching to be successful in a setup with teaching assistants included as lecturers is that there exists a great deal of mutual trust and respect between all involved teachers. The continuous critical assessment and discussion between the course responsible and the remaining teachers has potentially

negative side effects. There is an ongoing pressure on the course responsible as his/her way of teaching and the course contents are constantly being assessed and weaknesses might be exposed. While exposing weaknesses in a course would certainly improve it in the long term, the course responsible needs to be accept being challenged by his/her peers, even if they lack seniority in the topic or their held positions. This means that the course can only be improved substantially (RQ2), if the course responsible accepts this challenge.

In the context of the presented course, the relationships between Examiner, Lecturer and TA worked well as all involved knew each other well and due to the flat hierarchy in the Swedish university system and the Swedish society in general. In environments that have a much more authoritative power structure, the continuous critique from peers lower in hierarchy might not be acceptable to a course responsible. In such a context, a classical master-novice distinction as in cognitive apprenticeship (Brown, Collins and Duguid 1989) could be more appropriate. Prieto, Scheel and Meyers (2001) claim that many TAs still prefer a collegial style of supervision.

Furthermore, it might facilitate critical discussions and assessment across hierarchy levels if the involved TAs and Lecturers are not PhD students of or otherwise dependent on the Examiner. In the case of the presented course, one TA (HB) was the PhD student of the Examiner, while the other TA (GL) was not. While the authors did not observe any differences between these two settings and did not employ any additional mechanisms to allow for criticism, the settings should be investigated further in different contexts in order to determine the effect of the dependence on the course improvement. For example, the team teaching setup could be replicated in a country with a more authoritative power structure.

Conclusion

Team teaching can be applied in different course contexts. It offers benefits such as different explanations of the same concept by multiple teachers or teacher development through mutual reflection on action. However, it is often associated with high costs in the academic literature.

The authors have applied a team teaching model in which a new teaching assistant (TA) is introduced in the first year, only supporting project supervision. In the second year, this TA advances to the role of Lecturer, additionally participating in lecturing and taking over further responsibility within the course. The stable element is the Examiner, the classical teacher and course responsible over a number of consecutive years. This model explicitly includes other course moments, apart from lecturing, i.e., discussing the course contents, or organizing and supervising project work.

From personal reflection (autobiographical and peer lenses) among the three authors, all of who were involved in team teaching, and from 346 evaluation surveys collected over three years (student lens), this model has proven to be successful with respect to several aspects. First, newly introduced TAs can be trained during the course. Secondly, by granting the TAs and Lecturers an increased responsibility, unclear or unsuitable elements in the course can be discovered and improved, and a mechanization of the course is prevented. The motivation and energy that new teachers bring into the course can also encourage more substantial changes within the course, while the team ensures stability in terms of evolving the course elements. Thirdly, novice TAs counteract the “curse of knowledge” as they initially take the student perspective and can offer valuable insights to which parts of a lecture or a course are difficult to understand for the audience. Finally, there is no additional cost of applying this model

compared to a regular course with teaching assistant participation, as newly introduced teachers learn while lecturing and as synchronization meetings can be reduced.

While beneficial in the presented course, the applied team teaching model requires a high level of mutual trust and respect between the involved teachers. Especially in strongly hierarchical cultures, it might be difficult for the course responsible to receive continuous critical feedback by junior faculty members of PhD students and formal mechanisms might be required to allow for criticism.

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Figures

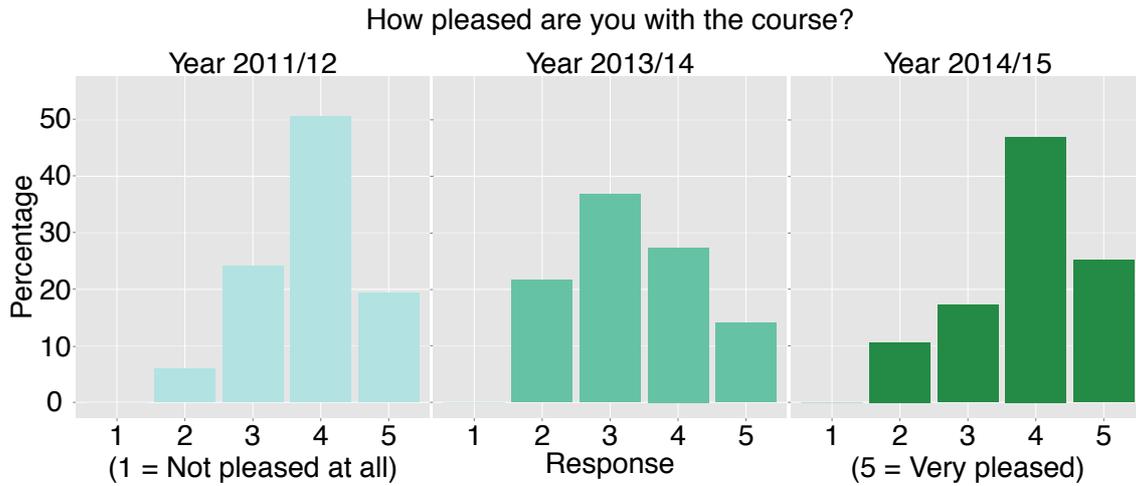


Figure 1: Overall Evaluation

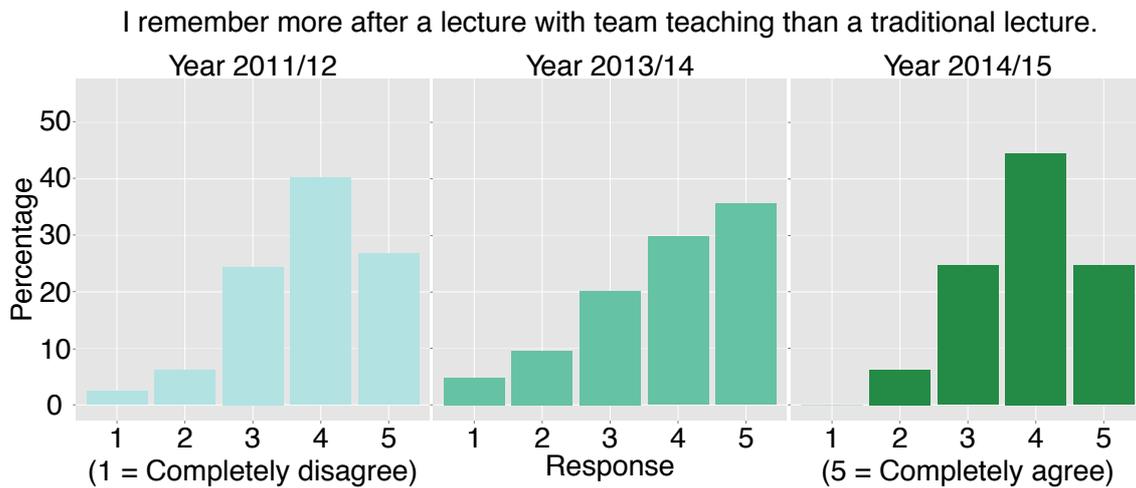


Figure 2: Remembering Lecture Content

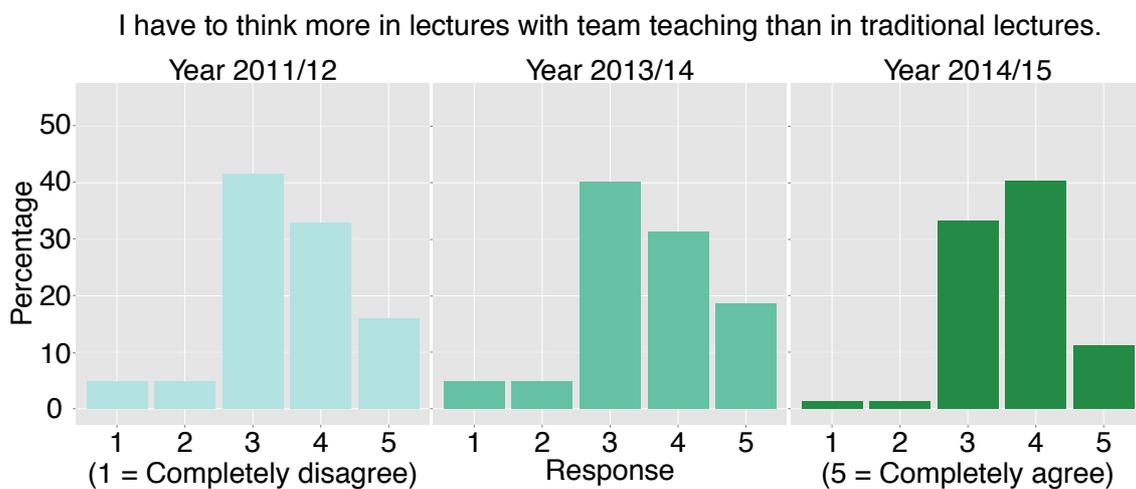


Figure 3: Increased Thinking

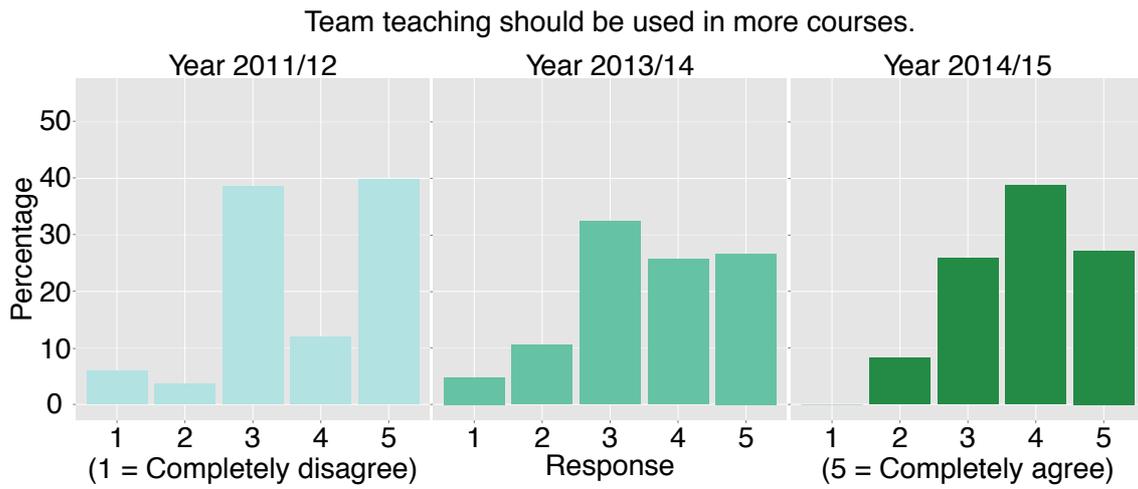


Figure 4: Using Team Teaching in More Courses

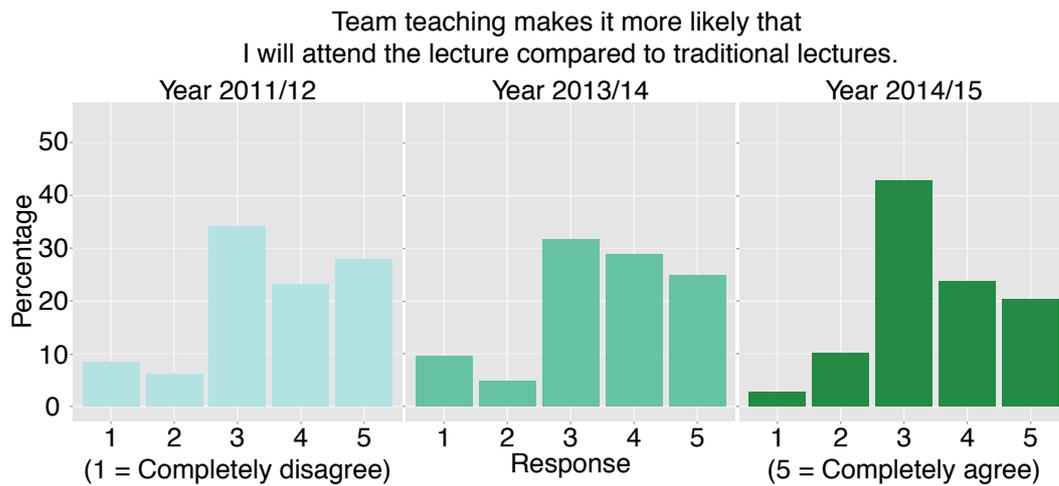


Figure 5: Lecture Attendance

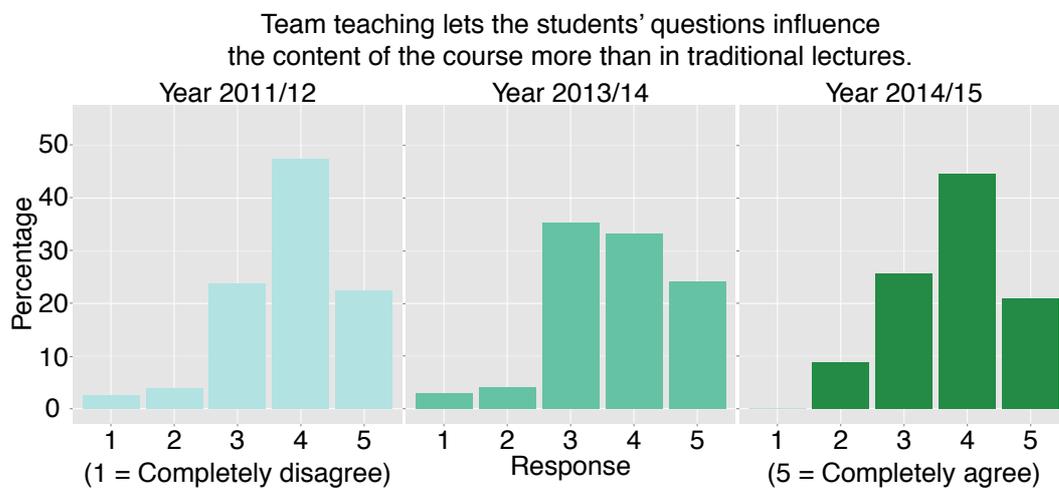


Figure 6: Influence on Course Content

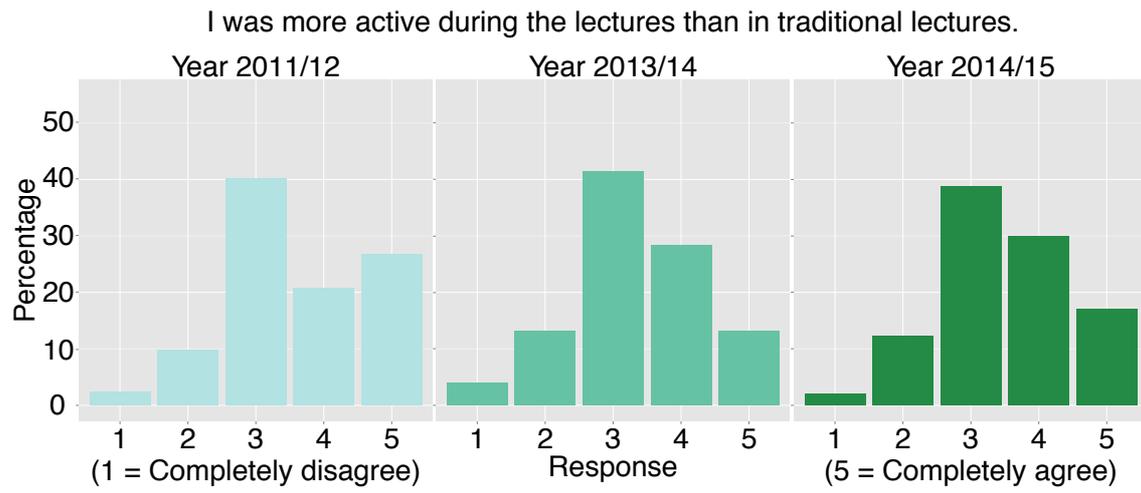


Figure 7: Activeness during Lectures