International Journal for the Scholarship of Teaching and Learning

Volume 11 | Number 2 Article 6

July 2017

Working as Partners: Course Development by a Student–Teacher Team

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Recommended Citation

Bengtson, Charlotta; Ahlkvist, Mikaela; Ekeroth, William; Nilsen-Moe, Astrid; Proos Vedin, Nathalie; Rodiuchkina, Katerina; Ye, Sofie; and Lundberg, Marcus (2017) "Working as Partners: Course Development by a Student–Teacher Team," *International Journal for the Scholarship of Teaching and Learning*: Vol. 11: No. 2, Article 6.
Available at: https://doi.org/10.20429/ijsotl.2017.110206

Working as Partners: Course Development by a Student–Teacher Team

Abstract
A first-year undergraduate course at Uppsala University has been redesigned in a process exploring different levels of student participation. In the first part of the project, the student voice was heard through interviews focusing on the role of the course in the degree program. In the second part, a student-teacher team was formed to develop course curriculum and teaching material in partnership. Among the implemented changes were new seminars focusing on conceptual understanding, redesign of all lectures to include active student participation, and a change of the course literature. The redesigned course significantly increased student satisfaction compared to previous years. Important success factors were involvement of the student organization to promote the project, institutional support, early selection of concrete development tasks, and allowing team members to choose what they wanted to develop according to their own expertise.

Keywords
Student engagement, Course curriculum, Student voice, Students as partners

Cover Page Footnote
We thank Maja Elmgren for continuous support and helpful comments on the manuscript, and Felix Ho for auditing a project meeting and gathering reflections from project members. We would also like to thank Johan Wickström, Ulrike Schnaas, Susanna Barrineau and Alexis Bergström for helpful discussions. Financial support was obtained from a TUFF pedagogical development grant from the Disciplinary Domain of Science and Technology, Uppsala University.

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(Received 15 September 2016; Accepted 1 March 2017)

A first-year undergraduate course at Uppsala University has been redesigned in a process exploring different levels of student participation. In the first part of the project, the student voice was heard through interviews focusing on the role of the course in the degree program. In the second part, a student-teacher team was formed to develop course curriculum and teaching material in partnership. Among the implemented changes were new seminars focusing on conceptual understanding, redesign of all lectures to include active student participation, and a change of the course literature. The redesigned course significantly increased student satisfaction compared to previous years. Important success factors were involvement of the student organization to promote the project, institutional support, early selection of concrete development tasks, and allowing team members to choose what they wanted to develop according to their own expertise.

INTRODUCTION

The present contribution describes a project where an undergraduate science course at Uppsala University was redesigned by a team of students and teachers. In the process we have explored student participation at different levels, from hearing the student voice to giving students the power to define course curriculum and design learning material. This reflective account is co-authored by the students and teachers involved in the project, and aims to describe the challenges, the effects on the participants, and the practical results. The focus is on student-teacher relationships, which should be of relevance for faculty who wants to partner with students in similar projects, independent of academic discipline.

Important inspirations for this project have been calls for active student participation in higher education (Gärdebo and Wiggberg, 2012, Bovill, 2013). The term 'student participation' has many different meanings, from widening participation in university education to students becoming co-creators of their own learning (Healey et al., 2014). Two of the most common forms of participation are connected to the student voice; student representation on university committees and feedback in the form of end-of-course questionnaires. It is "rarer for institutions to go beyond the student voice and engage students as partners in designing the curriculum and giving pedagogic advice" (Healey et al., 2014). Still, ideas of students as partners and co-creators of their own learning have been subject to increasing interest in recent years (Mihans et al., 2008, McCulloch, 2009, Barnes et al., 2010, Dunne et al., 2011).

Both students and teachers can benefit from partnership (Bovill et al., 2011a, Cook-Sather, 2011, Carey, 2013). Students experience an increase in motivation and confidence, take greater responsibility for learning, and improve academic performance (Bovill et al., 2011a). They also better understand the different roles of the academic community (Delpish et al., 2010). Teachers benefit from seeing the learning process from students' perspectives (Mihans et al., 2008, Cook-Sather, 2014) and the potential changes in teaching practices can improve both learning and student–teacher relationships (Bovill et al., 2011b).

Several models exist to describe student-teacher partnerships (Bovill et al., 2016). Healey et al. describes four domains where students can engage in partnership: "learning, teaching, and assessment; subject-based research and inquiry; scholarship of teaching and learning; and curriculum design and pedagogic consultancy" (Healey et al., 2014). The current process covers the last two domains. It involves students in a scholarship of teaching and learning project by evaluating current practices and using research findings to propose changes in learning activities. The framework is a partnership in the domain of curriculum design and pedagogical consultancy, with curriculum meaning "structure and content of a unit (subject)" (Fraser and Bosanquet, 2006). Within that domain, some projects engage students as consultants during courses to advise on teaching approaches (Cox and Sorenson, 1999, Bovill et al., 2011b, Jensen and Bagnall, 2015, Curran and Millard, 2016). Other projects focus on teams of students, faculty, and academic development staff designing, or redesigning, courses together (Mihans et al., 2008, Delpish et al., 2010, Bovill, 2013).

When realized correctly, development partnerships give students the formal power they have in committees, but with the same direct connection to the learning experience they have when delivering course feedback. Examples of students designing course material or collaborating in course design are available from several disciplines, for example, educational science (Mihans et al., 2008), engineering (Alpay and Gulati, 2010), mathematics (Croft et al., 2013, Loch and Lamborn, 2016), law (Hess, 2008), nursing (Haraldseid et al., 2016), and natural science (Woolmer et al., 2016). From these examples, we extracted four common themes that are expanded in more detail below: inclusion and selection, institutional support, student-teacher relationships, and practical results.

Inclusion and selection: Although not all students want to participate in partnership activities, everyone must be given equal opportunity to participate (Barnes et al., 2010). It is important to set clear selection rules and consider the effects on those left out (Bovill, 2014). To attract students requires that the purpose of the project, as well as the expectations on the participants are clearly explained (Felten et al., 2013). At Elon University and University College Dublin student partners were selected through an open application process (Bovill et al., 2011b). Both projects reported that many students were interested, and that they were motivated by a desire to improve the curriculum of their discipline.

https://doi.org/10.20429/ijsotl.2017.110206

Practical aspects can also influence who will be able to participate. Meetings after classroom hours risk excluding students with other commitments, such as part-time jobs or family. Financial compensation is also a factor. Many projects pay salaries to stress the student's new roles as university employees (Cook-Sather, 2014). Salary can also make the projects attractive alternatives to other part-time work.

Institutional support: In many cases, co-creation initiatives are supported by institutional programs or by academic development staff (Bovill, 2014, Bergmark and Westman, 2016). One example is McMaster University where a program has been designed to support meaningful staff–student partnerships (Marquis et al., 2016). Another example is the 'course design team' (CDT) program at Elon University where academic developers actively participate in the teams (Delpish et al., 2010). Also projects that do not directly involve academic developers need support. An important task of the university is to offer inspiration for teachers and to facilitate the exchange of ideas between faculty members. The institution also has to recognize the time commitment for the development process. Even though the student-teacher team can be a time-efficient process, these projects typically implement larger changes than standard revisions of a course and therefore require significant efforts by the teachers (Woolmer et al., 2016). Finally, in projects where students are paid for their involvement, funding has to be made available.

Student-teacher relationships: A key component of any partnership is the student-teacher relationship. The inherent differences in knowledge and experience within the group offer both possibilities and challenges. These differences are what make partnership productive, because it brings complementary ideas and experiences together. Students are still in the process of knowledge formation, but this allows them to reflect on how the process can best be guided. However, the teacher is the disciplinary expert and ultimately responsible for the outcome of the course. This unequal power balance can constrain students from expressing themselves and affect how engagement truly captures the student perspective (Robinson, 2012).

To reach a productive partnership, students must have power and ability to make significant changes (Bovill et al., 2016). Power balance is most directly reflected in the composition of working groups. One way to improve the balance is to let the students be in majority. A recommended group size is to include one or two faculty, between two and six undergraduate students, and one academic developer (Mihans et al., 2008).

Co-creation does not remove the need for teachers' expertise, but the role of the teacher changes to facilitate the work by the students (Breen and Littlejohn, 2000, Bovill, 2014). This change can be confusing for students that are not used to directly influencing the direction of a course. In many cases, they can initially be "eager to produce the right answer, what they thought [the teacher] wanted them to plan" (Cook-Sather et al., 2014). It is therefore important that students at an early phase understand the philosophy behind the project. In the initial CDT process at Elon University, they describe a seminal moment in selecting course literature when students realized they really had the power to implement significant changes. After that they became more self-confident and engaged, while teachers agreed to let go of their control. In many cases when there were disagreements in the group, the students' suggestions won out in the end (Mihans et al., 2008).

A challenge in co-creation is how to reconcile the increase in student power with the absolute responsibility of the teacher for the outcome of the course. In practice, teachers will keep the power to reject any proposed changes. This should be made clear at the outset of the process, but does not necessarily change the group dynamics as long as there is a real intention to share power and to listen to arguments (Mihans et al., 2008). The teacher's responsibility is to appropriately frame the co-creation process and support the students so that the desired quality can be reached together.

Practical results: The practical results of the student-staff teams have been viewed as highly positive. As described by Bovill, in cases where "students were offered new responsibility for co-creating curricula in the examples studied, tutors reported them taking this responsibility seriously" (Bovill, 2014). The main concern, at least in the early phases of some projects, have been the quality of the student material. The lecturer has the overall responsibility and should review the resources that are produced (Croft et al., 2013). With adequate control, the new material is often of high quality (Croft et al., 2013, Loch and Lamborn, 2016, Haraldseid et al., 2016). Projects with complete redesign report higher student satisfaction and performance at least as good as in previous editions of the course (Mihans et al., 2008).

During the project, some questions of general interest were raised. In the student-teacher relationship, how can an appropriate balance between independence and mentoring be achieved, especially in a subject where authority is rarely questioned? When it comes to the practical results, are there any major differences between student-led and teacher-led development? In order to address these, and other questions, we report a case study mainly relying on self-reported data, but also using input from students taking the course. In the analysis and discussion, we use ideas and themes from earlier literature to contrast our experiences and reach conclusions on how student-teacher teams improve learning experiences at the university.

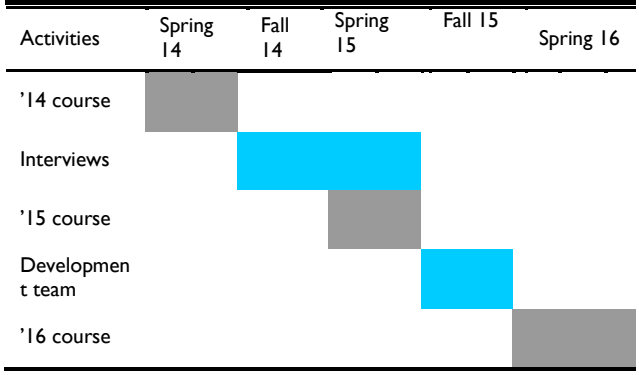
LOCAL ENVIRONMENT AND PROJECT DESIGN

At Uppsala University, the Bachelor of Chemistry program provides students with comprehensive knowledge in chemistry for work or future studies. Among the overall learning goals of the program are to "use theories and models to explain chemical systems" and to "independently, and in collaboration, plan, execute and evaluate projects". Basic physics is provided in an elective five-credit (European Credit Transfer System) course, 'Physics for Chemists', which covers the most important concepts, from a chemist's point of view, within classical mechanics, electromagnetic field theory and wave motion physics. It is fully integrated into the program scheduling during the second semester of the first year, and provides the necessary background knowledge for second-year courses in 'Thermodynamics', 'Physical Chemistry' and 'Quantum Mechanics'. However, it

is not a formal pre-requisite for any course as similar material can be covered by other elective courses.

In 2014, the number of students taking the course decreased significantly, at least partly because senior students conveyed that it was difficult and of limited use. This lead to an effort to redesign the course to fulfill its purpose: to provide students with knowledge in physics that could support future chemistry studies. The project started in fall 2014 and ended during the 2016 spring semester, see Table 1.

Table 1. Schedule for the project.



The first step was to hear the student voice. Students who have taken the course can give a unique perspective of how it connects to the rest of the chemistry education. Therefore, six students were invited to in-depth interviews during the 2014/15 academic year. Two of the students had already graduated from the Bachelor program, while the other four were still attending, one third-year student, two second-year students and one first-year student. They all were, or had been, active in the chemistry student organization Intresseföreningen Uppsala Akademiska Kemister. The interviews lasted 1-2 hours and were documented with memos that were sent out to the students for approval.

The interviews made it clear that significant changes were desirable. The underlying philosophy for these changes was that science students that take an active and participatory role in their education enhance their learning processes and outcomes (Freeman et al., 2014). The first change was a teacher-led development focusing on active student participation in the problem solving sessions, partly inspired by a previous peer-to-peer-teaching project (Lundberg, 2013, Bengtson and Lundberg, 2015). These changes were implemented in the course given during spring 2015, see Table 1.

After discussions with academic development staff, and getting inspiration from calls to use students as resources (Hald, 2011, Barrineau et al., 2016), ideas for a second part of the project were formed that involved student participation also in the design of the course. This student-teacher partnership received a grant from a pedagogical development fund. The money was used to pay students and teachers and to cover the costs of meetings.

An open call to participate was sent out to all students in the degree program by e-mail in June 2015. Rather surprisingly, considering the ease with which other projects had attracted participants, only two applications were received. A meeting with these two students revealed that they were neither sure of the expectations on the students, nor the desired outcome. They then organized a second recruiting effort in classrooms and social media in September 2015, which lead a total of six students joining the group. Three had graduated from the Bachelor program, one was in the third year, and two in the second year. Two of them had been involved in the interview part of the project. Together with two teachers, the development team consisted of eight members.

The group met a total of seven times, each time for one hour during lunch. The structure was proposed by the teachers and approved by the other members. In addition to the common meetings, working groups with two to four members, some of them without teachers, were formed. These subgroups met separately to develop specific areas, with meeting frequency and duration decided individually. The common meetings were used to report progress from the working groups, to discuss results, and if necessary, vote on proposed changes. The total time spent by students varied from 12 to 45 hours, with an average of 20 hours. The course redesigned by the student-teacher team was given in spring 2016, see Table 1.

RESULTS

Interviews

The topics of the interviews were selected based on previous course evaluations. One point was to review important experimental techniques in chemistry and their requirements for physics knowledge. One subject area was considered less important, and after a discussion with other teachers, this area was removed from the 2016 study plan to make it less disparate. Another common sentiment was that it is "better to focus on conceptual knowledge rather than quickly visiting many different areas of physics", although here the interviews did not provide detailed advice. The students also highlighted that a key problem is that "there can be large difference in prior physics knowledge between students", depending on the amount of physics they have previously taken at high school and university. One suggestion was to offer seminars at the beginning of the course to decrease potential differences in prior knowledge. Another issue was the course literature, which was seen as too extensive and not properly integrated in the course. The development team later addressed all these issues.

Despite the fact that only changes in the design of the problem solving sessions could be implemented for the spring 2015 edition, an early positive effect was a return to the normal class size following the 2014 dip, see Figure 1. A possible reason for this change was that students were aware of the process, which could have led to more positive attitude, prior to any major changes in course content.

Student-teacher team

The first meeting of the development team was held in fall 2015. Prior to that meeting, members were given access to previous course evaluations and notes from the interviews. Due to time constraints related to the university scheduling process for the next semester, the goal of the first meeting was to design a complete schedule for the 2016 edition of

the course. The major changes in the schedule were the replacement of three teacher-led lectures by group seminars.

The goal of the second meeting was to prioritize development areas. All members were invited to bring forward suggestions, based either on course evaluations, interviews or their own experience. These suggestions were then ranked by a voting procedure, with highest priority given to the following areas: seminars, examination, student activity, and problem solving, see Figure 2.

Figure 1. Number of registered students and students with a pass grade. The written exam is offered three times per year, and the data shows the outcome of the first of these three opportunities.

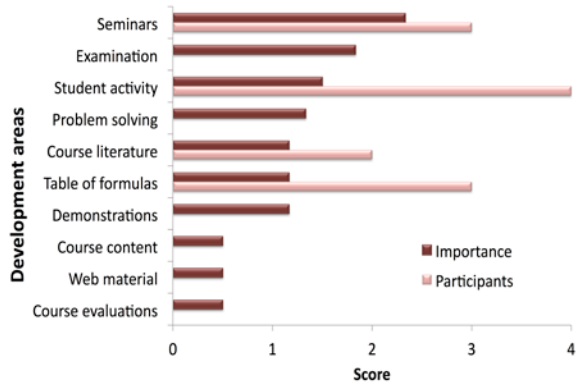


Figure 2. Importance and number of participants in each development area. The seven project members could participate in more than one group, giving a total of twelve participants. Each project member voted for their three most important areas, giving scores from three to one. To facilitate plotting the results, the sum of the importance scores was normalized to equal the number of participants.

All members were then allowed to choose an area, or areas, that they would like to develop further. Interestingly, there were significant differences between importance and group participation, see Figure 2. Two important areas, examination and problem solving, were left unstaffed. The group thought that personal preferences were most likely to lead to efficient development, so these areas will have to be addressed in another forum. In the end, four working groups were formed: seminars, student activity, course literature and a new table of formulas. The concrete results of these groups are discussed below.

Seminars: The team had decided to introduce three seminars, one for each subject area of the course. Two students designed the seminars, based on conceptual questions from the physics didactics literature (Hewitt, 2015). They created elaborate contexts in the form of quests that required solutions to the embedded physics problems. Teacher involvement was limited to advising on solutions and to comment on late drafts. The seminars took advantage of a classroom designed to promote peer-to-peer discussions, which none of the teachers had previously used. One of the students from the project also worked as a teaching assistant during the course.

Student activity: Several people wanted more active student participation during the lectures, but exactly how was a topic of discussion. Based on experiences from a course at another department, one of the students promoted the use of interactive response devices, so-called clickers. After agreeing on the use of clickers, the three students in the sub-group went through every lecture, highlighting unclear areas, suggesting modifications in content, and pointing out suitable topics for clicker questions. The students also contacted other teachers to collect examples and designed their own questions. In the end, all lectures were modified according to the groups' suggestions and included several clicker questions.

Course literature and table of formulas: The literature subgroup suggesting a total of seven different alternatives. All alternatives were presented with an extensive list of advantages and drawbacks, as judged by the working group. After some time to familiarize with these alternatives, all members voted for their preferred choice in a closed procedure. Six of the seven voters had the same top choice, a condensed primer complemented by an open-source digital textbook derived from the OpenStax project (Pitt, 2015). As the course literature has to be decided long before the course is given, the new literature could not be used in the 2016 edition, but will be introduced the next time the course is given. Another subgroup designed a comprehensive collection of formulas to be used instead of the extensive handbook previously required. The collection only required minor edits and reformatting by the teacher. The project will thus lead to the replacement of all reading material.

Reflections from the project group

After the project student partners were invited to send in their reflections. Five out of six students submitted their comments, which were sent to an academic developer to protect anonymity. Teachers wrote continuous reflections in the form of weekly summaries. The reflections have been summarized, translated and organized thematically. This section is purely based on self-reporting, but no student comments have been changed or added during manuscript preparation.

Student-teacher relationships: Some comments connect to the themes of shared power and students as important players in education (Barnes et al., 2010, Bovill et al., 2011b, Dunne et al., 2011). One student point out that: "teachers forget that we are adults that should be super-

engaged in our education and not just be content that it is ok. It can always be better in some way" (student A). Another comment was that it "felt good that we as students could come in and directly develop the aspects of the course we did not like without any middle-men … because for once our voices really mattered, it felt like our opinions really counted even though we are just students "(student B). "We worked as colleagues where everyone's voice had equal weight and we discussed things together and made decisions together" (student B). This is contrasted against "writing a course evaluation [that] only becomes a one-way conversation, primarily because you never get the teachers comment on the criticism" (student D).

One of the most important questions was how to balance students' freedom with appropriate guidance by teachers. The fuzzy definition of the project was an issue already in the recruiting process, and it remained so at the start of the project. It was "difficult to know what kind of changes that were possible, and […] what Teachers A and B would be comfortable doing" (student A). Another student remarks that in "the beginning of the project everyone was a little careful when it came to discussing and having opinions" and it seemed that teachers "did not want to interfere to avoid influencing us [but] in general I think that we would have appreciated more help sometimes" (student E). This agrees with the teacher reflections that they "had rather clear ideas of what we wanted, but in the beginning we stayed mostly in the background for fear of silencing the discussion of the students' ideas" (teacher B).

On the positive side, students "felt like we could make concrete differences and that all proposals and opinions were taken seriously" (student E). Another student wrote: "I expected us just to develop the lectures and Teacher A and B would decide most of the things. It was not at all like that. We developed a lot of things, not just the lectures, but also the course literature, the table of formulas and seminars" (student B). These sentiments are echoed in other comments. "As students we came with most of the suggestions and then we decided what would fit best. It was a good structure […] Teachers were open for suggestions, listened and took in our opinions and ideas to get a perspective about how students think" (student C).

Some reflections also consider the effects on themselves as participants. "I have learned a lot about how you think as a lecturer" (student D) and "I have at least started to think what can be improved in other courses by working like this" (student A). These reflections align well with observations that student participants gain better understanding of the different roles of the academic community (Delpish et al., 2010, Healey et al., 2014).

Practical results: The opinions about the material matches the literature; initial uncertainty replaced by confidence (Croft et al., 2013, Bovill, 2014). "It is really impressive to see how much we managed to produce in such a short time" (student E). "The changes that were made to the course felt very good" (student C). "I think that this kind of effort should be as frequent as possible" (student A) and "I hope that more courses do this" (student B).

The division into subgroups was viewed favorably. "Very satisfying to see how everyone has been working with their part, and that we have all chosen to take inspiration from so many different places, courses, and people" (student D). Other students wrote that "smaller groups with different parts of the course […] was the best way as we were able to cover more areas" (student C), and "exciting to see how all the sub-groups presented finished documents and similar material on things that we in the common group had only discussed in very general terms" (student E).

A possible improvement was that although members were given a lot of power to decide "it would have been good if the group had discussed more about what they were thinking before the voting began" (student E). The shortage of discussions can partly be attributed to another major concern, the short time available for discussion in the full project group. "In case this kind of project would be repeated, it would be good to have more time" (student D). Similar opinions are that "I think that we should have had one or a couple of meetings that were a little longer" (student A), and that it "easily got stressful at the end of the short hour" (Student E).

Post-course evaluation and exam results

All changes proposed by the team were implemented in the 2016 edition of the course, with the exception of the course literature. There was also a change in the design of an experimental lab unrelated to the project. The post-course evaluation was filled in by 12 out of 22 registered students (55%). It consisted of several open-ended and multi-choice questions, the latter using a grade of 1 to 5, a high value being positive or showing that students agree with a given statement. Compared to the previous year the most striking change was for the statement "This is a good course", where the grade increased from 3.3 to 4.5, see Figure 3a. A t-value test shows statistically significant increases in student satisfaction compared to previous years, while no such differences could be detected when comparing the previous editions with each other, see Figure 3b.

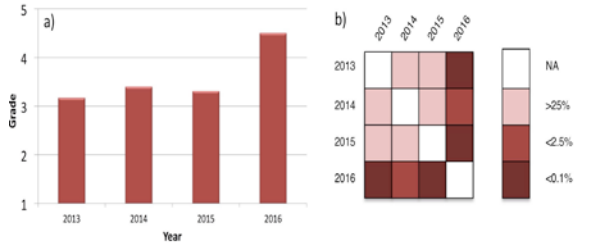


Figure 3. a) Level of agreement to the statement that "This is a good course" on a scale from 1 to 5, with 5 corresponding to the answer "I completely agree". **b)** T-value test showing the probability that two courses have an equal grade.

To analyze reasons for this change in overall satisfaction, we looked at questions with significant differences in student response. The area that had improved the most turned out to be communication between teachers and students (from 3.5 to 4.8). Other important changes were a more appropriate level of difficulty (from 3.7 to 3.2, with 3 being the target), and workload (from 3.7 to 3.3). None of these areas were explicitly targeted in the

development process, but seem to have benefited from the student-centered perspective.

In the open-ended question about the best aspects of the course, a student pointed to the "activity and discussion during the [course]". The learning activities are also judged separately by how students experience their importance for learning. The most valuable learning activities were problem-solving sessions and lessons (4.8 and 4.5), similar to the ranking from previous years. These activities already incorporated ideas of student activity and had not changed from previous editions of the course. The grade for the lectures, which had been targeted in the development process, improved only slightly (from 3.9 to 4.0). However, the use of clickers received positive free-text responses. One student wrote that "clickers during the lectures forced you to really participate and think about what had been said". The newly developed seminars received a grade of 3.4, with large differences in opinion between students. One student wrote that to "sit in a group and discuss conceptual problems [during seminars] has been very valuable".

As discussed above, examination was considered an important area to improve, but as no one developed that area, a similar written exam was used as in previous years. There were no significant differences in the results of the written examination with a pass grade on the first attempt of 63% (14/ 22), the same as the average of the two previous years (19/30 or 63%), see Figure 1.

DISCUSSION

In the discussion we revisit the four themes identified in the introduction; inclusion and selection, institutional support, student-teacher relationships, and practical results. The ideas from literature are now complemented with, or contrasted against, the results of the current project.

Inclusion and selection: An early challenge of the project was to attract students. This was initially surprising considering the "overwhelming" response in similar projects (Mihans et al., 2008). The central problem was communication. After the e-mail invitation, students were still not sure how they were supposed to contribute. On the one hand, this is related to the idea of student-driven development where teachers did not want to specify the desired outcome. On the other hand, it is hard to get students to sign up for a project without well-defined goals, except to make a better course. Other projects solved this by meeting with students to explain the philosophy of the project, before asking for applications. This turned out to be a successful strategy also in our case. A satisfactory number of applications were received after the project was promoted by students and teachers in the classrooms. As previously observed, mainly students already engaged in their education signed up (Felten et al., 2013).

Underestimating the challenges in recruiting led to a delay in the start of the project, from September 2015 to late October and a consequent shortening of the time frame. The lack of time was one of the main complaints raised by the project members. An important lesson is thus to start recruiting at a very early stage, explaining the idea to a few students, and listen to their advice on how to promote and advertise the project. This and other suggestions are gathered in Table 2.

Table 2. Observations and suggestions for student-teacher development teams.

Area	Observations and suggestions
Inclusion and selection	Explain the project in a personal meeting with students. Ensure student involvement in the recruitment process.
Institutional support	Contact academic development staff to get early inspiration. Apply for financial resources to pay students.
Student-teacher relationship	Start with student voice and gradually increase partnership. Clarify the project philosophy and framework to students by referring to literature. Give equal power in voting but make sure only acceptable options are on the ballot. Take at least one early decision so students understand they have real power.
Practical results	Let group members freely choose areas to develop. Allow time for discussions to learn from each other and improve decisions.

Institutional support: The present project received valuable support and inspiration from academic development staff. Financial support made it possible to give the students salary for their work and sent a message that their knowledge and opinions are valuable. The chemistry student organization's help to communicate the ideas of the project were important for the formation of the development team.

Student-teacher relationships: Similar to the process described by Woolmer et al., there were two distinct phases, first listening to the student voice and then involving them as partners in the development of the curriculum and teaching resources (Woolmer et al., 2016). The first phase gave valuable insights that were used by the student-teacher team to quickly decide on important areas to develop. However, as discussed by others, interviews and discussion groups naturally center on complaints and that students rarely gets the chance to explore possible solutions (Mihans et al., 2008, Carey, 2013). It is therefore interesting that only after the second phase, partnership, did students feel that "for once our voices really mattered … [and] our opinions really counted".

A difficult part of the process was to find a balance between defining the project and giving students enough power and freedom. The students appreciated being treated at an "equal level" but also wished to have more guidance. Unfamiliarity with the process made them feel insecure if their ideas were possible to implement and would be accepted by the teachers, as discussed by Bovill and Bulley (Bovill and Bulley, 2011). In hindsight, we believe it is possible to explain the philosophy of the project, for example by referring to similar projects in the literature, without defining a rigid frame for the course in question.

As teachers cannot abdicate the responsibility for the outcome of the course they can veto any changes. Although this should be made clear at the outset of the process, the important point is the intention to share power and to listen to arguments (Mihans et al., 2008). In the present project, several factors contributed to overcoming the differences in power and disciplinary knowledge. Initially, recruiting

students with different educational experiences gave a more gradual difference in expertise, and provided a wider range of opinions. Then, it was beneficial to decide on schedule and development areas early to show students they had real power. Finally, working in sub groups made it possible for the teacher to ensure that only good proposals reach the stage where the entire group has to decide. This is a less intrusive use of power than to veto a final decision of the group. Teacher's feedback on the material only strengthens the working relationship within the group.

The process could have been improved by allowing for more time for discussions, and thus learning from the different perspectives of teachers and students, and reaching a better understanding for the reasons of individual choices. Teachers should also have more clearly communicated the process for taking and implementing decisions.

Although the project focused on changing course curriculum, participants also reported that it had changed their experience of learning by making them think more like teachers. They got a realistic insight into the efforts that go into designing a course, and can use that insight to spot opportunities for improvement in other courses. This change in attitude should be useful for both the students involved and the rest of the program.

Practical results: Allowing all partners to freely choose areas to develop, based on their own expertise and experience, resulted in high levels of motivation and excellent results. These choices were based on what made members feel comfortable and in control. Some difficult but arguably crucial areas, like examination, were therefore left out. One solution is that the teachers attack these problems separately. The students' hesitation to work with difficult areas can also be fixed by dividing these areas into smaller more manageable parts where expectations are clearer.

With the present approach, changes are mainly limited to approaches students have experienced in other courses. Projects are more likely to be fruitful in environments that already employ a variety of different pedagogical approaches. Here, it led to profitable transfer of knowledge from faculty already using interactive methods, by way of the students. The same transfer can of course occur also directly between teachers, but the students know all courses and can promote ideas that could work in the specific context of each course.

The final results of the partnership were the revision of all lectures, three new seminars, a new table of formulas, and a change of course literature. Some students felt that it was initially difficult to judge the quality requirements, but in the end the major problem was to find time to reach the standard they had set themselves. All the student-produced material was introduced into the course with only minor edits. This was not due to teachers being hesitant to change, but rather due to the high quality of the material, which reflects similar experiences from other projects (Woolmer et al., 2016).

Based on the course evaluation, the project did lead to a higher degree of student satisfaction compared to previous years. This coincides with outcomes from Elon University (Mihans et al., 2008). Whether this changed because of the new learning activities, or because they appreciated that their peers had been involved, cannot be distinguished. Teachers did not experience that the team tried to lower the degree of difficulty; they only tried to raise the quality of learning. The end result was an improvement in how the students experienced the level of difficulty.

The exam results were comparable to previous years. A major part of the revision was to introduce more student activation, which has been shown to improve the results for students in science (Freeman et al., 2014). The small sample size and potential differences in difficulty level between individual exams prevent any major conclusions to be drawn, but with examination as one of the priority areas that still needs to be addressed, student performance will continue to be evaluated.

An interesting question is how different the practical results would have been with a teacher-dominated process. As discussed previously by Hudd, the students did not demand a complete overhaul of the course (Hudd, 2003). The project reduced the amount of lectures and replaced them with seminars, but kept the same general structure. The reason could be that the schedule had to be set very early, while students were not yet clear to which extent the course could be changed. However, it turned out to be a level of change that most project members were happy with.

The time investment was relatively high, but the same effort in a teacher-dominated process would have given less extensive changes (Woolmer et al., 2016). Seminars could potentially have been introduced, as they had been suggested from the interviews, but they would have been less imaginative than the student-designed versions. The detailed examination of each lecture gave new perspectives and lead to considerable changes. The introduction of clickers required significant effort from the teacher, and this would probably not have been completed without the help and motivation from the students. The textbooks that were adopted by the project had not previously been considered by the teachers. A teacher-favored activity that did not get any interest from the group was to gather and organize the large amount of online learning material available in basic physics. However, as described by Brooman, the team did not escalate the amount of material and instead favored more discussions to achieve better basic understanding.(Brooman et al., 2015)

CONCLUSIONS

The outcome of the student-teacher partnership was positively received, both by project members, students and colleagues. It resulted in significant changes in the course curriculum, produced high-quality learning material and led to higher levels of student satisfaction. The major challenge was to attract students to a project to which they were unfamiliar, and where the expected outcome was not well defined. This was resolved by help from the student organization in explaining the philosophy of the project in the classrooms, but the delayed start of the project resulted in a condensed schedule. An important lesson is thus to start recruiting at a very early stage, explaining the idea to a few students, and listen to their advice on how to promote and advertise the project. We believe it is possible to explain the philosophy of the project, for example by referring to similar projects in the literature, without defining a rigid frame for the course in question. The most critical factors for success were to decide early on prioritized areas and let all team members choose what they wanted to develop

according to their own expertise and experiences. This led to profitable transfer of knowledge from faculty already using interactive methods, by way of the students. The same transfer can of course occur also directly between teachers, but the students know all courses and can promote ideas that could work in the specific context of each course. Other important factors were the support from academic developers, as well as financial support from a pedagogic development grant. The overall process was initially time consuming, but provided new perspectives and led to more extensive changes than a teacher-only project. As team members we found this to be an inspiring approach that will hopefully be used in the development of other courses at the university.

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