

# EXPERIENCES WITH ONLINE RESPONSE TECHNOLOGIES IN EDUCATION OF ENGINEERS

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**Abstract:** This article reports experiences achieved during the development of open, online Student Response Services (SRS), and the emerging extension of these SRS into assessment services carried out on modern mobile devices. The evaluation results obtained from engineering classes in Norway that have used the online SRS, show very good results. The online SRS is flexible, intuitive, easy and fast to use. They may be used together with any kind of software. It is also reported how teachers are going to use a forthcoming and extended version of the SRS, as a tool for verification or elaborative feedback immediately after completion of tests and exams. This may be done for single students or groups of students. The development of the SRS and the forthcoming assessment system is co-funded by the EU-Commission through the Lifelong Learning Programme.

## 1 INTRODUCTION TO MOBILE RESPONSE TECHNOLOGY

Mobile learning is dramatically shaping the nature of teaching, learning, and social interaction. Assessment methods, however, is still frequently often done by use of traditional evaluation methods, though students and teachers may integrate mobile technology and learning both in and out of the classroom, due to portability of mobile devices and their ability to connect to Internet almost anywhere. They are ideal as a store of reference materials, learning experiences, and general-use tools for fieldwork.

Mobile technology provides a new active collaborative learning approach, which let students set the in-class terms for discussion in order to get a clearer view of their instant knowledge and perception. The new mobile technology based online Student Response Services (SRS) (EduMecca, 2010) are flexible, intuitive, easy and fast to use. The SRS may be used together with any kind of software systems, and for in-class, laboratory and distance training purposes. Use of SRS easily display complex interrelationships between opinions in class, including most relevant or marginal choices, or what is most difficult to understand. It interconnects the teacher and student in a new way

that by highlighting learning impact, which it is impossible to do so quickly by using traditional methods. The tools were during 2009 and 2010 tested and validated in training of staff from higher education and industry in several European countries, e.g. Norway, UK, Sweden, Hungary, Romania, Slovenia and Slovakia. The evaluations show excellent feedback from students and teachers.

This paper reports experiences obtained and discusses recent developments that bring mobile learning to the next level by using open web-based solutions for cheap Smartphone's in education, keeping in mind the pedagogical challenges in the new mobile learning environment. Mobile devices can be used almost anywhere, they are perfect platforms for situated and context based learning activities, where real life is used to provide stimuli and activity for learning. They are constructed for use in vocational education and training, and in higher education courses. This is achieved through easy and flexible integration with interactive touch screen blackboards by utilizing Flash in combination with AIR and FLEX technology. The European Commission cofounded the R&D during 2008-10 as a pilot project under the KA3-ICT program (EduMecca, 2010).

At the end, the article outlines new, emerging mobile learning assessment solutions (Done-it, 2011) that are based up on latest mobile technology.

This will extend the usability of the SRS by construction an assessment solution for mobile devices.

## 2 ONLINE RESPONSE TECHNOLOGY SOLUTIONS

The new SRS is based up on XML-based standards and web authoring facilities for the contents available on web pages, by providing XML-based universal notation and interface including visualization of scientific and engineering drawings and graphs. The search facilities retrieve the postulates of the instructor through a service-oriented architecture that integrates semantic web into the system for retrieval of information from the knowledge base system. Closed solutions like for instance iTunes are avoided by using open web-based solutions.

The decision process solution system is open and flexible in order to achieve maximum interoperability. The easiest teacher lead SRS knowledge cycle includes, based up on results from Norway:

1. Teacher starts the SRS for mobile devices when he/she is ready to teach, and the students enter the 3 digit session code just before the lecturing starts. The session codes allocates the class to one lecture room, whereby several neighboring classrooms may use the same WI-FI network in parallell.
2. Teacher present new material from the curriculum
3. Students are presented a conceptual quiz and asked to discuss with each other for 2-3 minutes
4. The teacher starts a voting session by using a a web interface on the digital blackboard
5. Student casts individual votes using the handheld units.
6. The vote is closed and results are presented on the blackboard (immediately or when the teacher decides)
7. The teacher comments on the various alternatives and highlight the correct one, explaining thoroughly why it's the correct one and why the others are incorrect.
8. Go back to point 3 and repeat.

A lesson consists often of 2 lectures, each lasting about 45 minutes. During each 45 minutes period the students are usually presented for at maximum of 2 conceptual questions. In order to start a polling

session (which usually lasts 30 seconds), a “ticking clock” is used to shift the students attention away from discussion and over to the voting session in progress.

Several trials of the SRS have been completed in Norway and Sweden. Four trials have been performed internal at Sør-Trøndelag University College (HiST), in Trondheim in 2010. In addition to the internal testing at HiST, the SRS have also been tested by external users both in Norway and Sweden. In connection with these, numerous surveys, in form of questionnaire and interviews, have been conducted. The surveys consist of a mixture of written questionnaire where informants read the questions and indicate their response on a form, and focus group interviews with end-users. A focus group interview constitutes a form, with a group interview where the conversation and discussion process is essential. Unlike more conventional forms of interviews, where those conducting the interviews take the role of interviewers, a focus group interviewer takes on the role of a discussion moderator, that is, a moderator who organizes discussion within the groups. One of the main advantages of focus group interviews is that, if properly managed, it can be extremely dynamic (Bergh 2007).

The interviews were analyzed using type of analysis called grounded theory, a method for the analysis of qualitative data that has wide acceptance in social science (Johannesen, Tufte & Kristoffersen 2004). Grounded theory is an appropriate direction for the analysis of topics such as personal experience, opinions, feelings and attitudes (Charmaz 2001). The aim of the current evaluation was to bring out the experiences, views and opinions expressed by our students in relation to the use of SRS in engineering education. Grounded theory was considered to be an appropriate too for achieving that goal. This method provides specific procedures for the analysis of data, where data is coded in the steps:

- Line- by- line coding
- Focused coding
- Categorization

## 3 EVALUATION RESULTS OBTAINED IN ENGINEERING EDUCATION IN NORWAY

The first testing of SRS for mobile devices was done over a period of 5 weeks in the autumn 2009 (Stav

2010) in civil engineering classes. The second testing of the SRS was done in the autumn 2009, in a preparatory class for engineering in the subject of physics and lasted over a period of 4 weeks. The evaluation was carried out at the end of the 4-week testing period, and consisted of two focus group interviews and a questionnaire. Six students participated in the interviews, with three students in each group. The interviews were analysed using the analytical approach called grounded theory. The questionnaire was conducted online, through Google docs, by using the "redirect" function in the response system. A total of 57 students participated (39 boys and 17 girls). The analysis resulted in three categories: *Feedback on own learning* (A), *Increased engagement* (B) and *Group discussion* (B). These categories are made up of and represent the students' main experiences in relation to the use of student response system in class.

### A. Feedback on Own Learning

*1. Immediate feedback on their learning:* Use of SRS provides students with valuable feedback on their learning and progression. To answer the quiz questions and receive immediate feedback was a way for students to test themselves on the fly. They got an immediate feedback on whether they had understood what the teacher had tried to convey, whereby they immediately tested their knowledge in practice. Two of the students had the following to say about the feedback that SRS gave them;

Per: *"You get a feedback on how well you have understood the topic. For if you have selected the correct alternative to a quiz, you get feedback that you've understood this subject. You get feedback that you are able to use the formulas and laws – yes, the material that the teacher has presented."*

Ole: *"Yes, you get a feedback on whether you have understood it. Yes, it's all about your own learning. You get to see if you've learned something."*

For students is feedback an important part of their learning. Feedback tells them how they are doing in their own learning process. The feedback activities these students get are usually related to various types of tests and assignments. It is rarely provided any kind of feedback activity during the actual teaching time. The only opportunities the students have to receive feedback are by raising their hand and either ask or answer questions from the teacher. Whether students will receive feedback during the lessons depends, in other words, on them self, and whether they take the initiative and actually reply to or ask questions. From the student side, it too often ends up with very little feedback, because

they find it very uncomfortable to raise their hand and talk loud over dozens other students. When asked whether the teacher included some feedback activities during their lessons, one of the students said; *"No, the teachers may ask, "do you understand?" and then they just look sheepishly at us and move on. None of us that dare to raise our hand and respond. In that sense, it's our own responsibility, but no, I certainly don't. Feedback activities are normally not included, which is a bit of a shame."*

Students desire something they call constructive feedback in their academic life. This is feedback that in addition to providing them with a pointing stick if they're on the right track or not, explain why something is right or possibly wrong. From the student side, this is feedback that gives them something concrete to work with; they get feedback on what they are possibly struggling with and what they need to focus at. Without such feedback students feel that they only have themselves to deal with, making it difficult for them to know where they stand in relation to their own learning and progression. One of the students said it quite clearly; *"Without constructive feedback, how can we really improve?"*

*2. Teacher's explanation afterwards: the key to students' understanding:* In relation to students' desire for more constructive feedback, SRS came in as a long awaited breath of teaching. Firstly, the system gave them an immediate feedback on their polling, in that they got to see if they had voted right or wrong, as well as the teacher went through each option after the vote and explained thoroughly why they were correct or incorrect. For students, the teacher's explanation was perceived as a constructive feedback, and was further highlighted as critically important in relation to their experience of learning. In short, it was here that the learning came into play. Through the teacher's explanation the students get an understanding of why the alternatives were correct or incorrect. One thing is to cast a vote that turns out to be right or wrong; another thing is to really understand why it is right or wrong. If they achieve such an understanding; they feel they have really learned some of the quiz questions. Especially the wrong options are highlighted as important to get a thorough explanation around. For students, this is all about giving those who have answered incorrectly a chance to understand why they answered incorrectly. One of the student groups explained it this way;

Emma: *"Those of us who got the answer wrong have to be given to chance to understand that we were wrong. Some part of the class usually got it wrong, and then it must be explained in such a way that we can understand where we went wrong."*

*Because we obviously don't know if an option is wrong – otherwise we wouldn't have voted for it! "*

Lise: *"Yes, I feel it gives me a chance to understand what the subject is really about."*

The second group had the following to say;

Per: *"There's a reason why people have answered incorrectly, it's because they have misunderstood something, and then they have to be explained why the answer was wrong."*

Ole: *"Yeah I think the explanation from the teacher is very important. I think it is necessary that he explains why he uses certain laws, or other parts of the curriculum, and that he shows us why it is right or wrong. "*

Jens: *"Spending some time to explain or discuss the different options and how to the right answer in this way is; well, I feel that the quiz becomes a bit useless if you don't do that - if you don't spend enough time on it and do it thoroughly. The quiz then becomes – maybe not useless, but the quiz has a much greater effect on learning if you get an explanation why the answers are right or wrong. "*

3. *For improvement – how to get a better feedback on the "actual understanding"?:* From the student side, there is little doubt that the use of SRS can provide them with valuable feedback on their learning, particularly if the teacher gives them a thorough explanation after the vote. At the same time, however, they leave no doubt that the SRS may have a much greater learning potential than was used in their teaching.

Traditional teaching where planned for the test group of students. They usually have two or three lessons after each other. During trials of the SRS they usually got the first quiz question a little off in the first teaching hours (often after about 20-25 minutes), the next question came either later in the same teaching hour or a bit out in the next one. The times they had three hours in a row, they had no quiz questions in the last hour. The teacher started the lesson by introducing a new part of the curriculum. Afterwards the students got a quiz questions based on what they had recently been presented. According to students, this was a straightforward way to implement SRS in teaching, as they due to the teacher's explanation after the vote felt that they learned something from it. In relation to test their understanding, however, this was no optimal solution. The quiz questions were introduced too early. Whether you test comprehension or not, is according to the students depending on the time the quiz question is being asked. It is also depends on the available time they have for learning before the question is asked. In other words, if a teacher wants to use SRS to test students' comprehension, students must first be given time to work with the curriculum

and acquire the academic requirements they need to answer the quiz question. If they get the quiz questions too early in the teaching hour it is not certain that students have got these prerequisites. Thus, instead of testing their understanding through the use of SRS, the teacher gives them an understanding through a thorough explanation after the voting.

Group 1:

Per: *"I would like to get a quiz at the end of the day too, in order to check if we've really understood it. After we've worked with the exercises for a period of time, and had time to process the material."*

Jens: *"Yes, I agree."*

Per: *"That would give a very good indication as to whether you've understood something or not. That would be a proper test!"*

Ole: *"Then we would have worked with it for a bit, and then we'll get to see if we've understood it."*

Group 2:

Emma: *"I somehow ... need time to understand it, in a way. Sometimes I think that the quiz questions seemed to come too early for me, in a way ... There were times when I just made a guess. I had somehow not received the scientific basis for properly discussing it. I felt that it was a bit unnecessary."*

Ingrid: *"Yes, we'd almost have to lie ahead, if we are to do it that way. The questions tend to be from the new subject area that we've just been through. So really, it might be best if he took us through the curriculum first, and included questions at the end of the class."*

Lise: *"Yes, to see that people had actually ... understood it."*

The students point out that in many ways it is up to the teacher how he/she wants to use the SRS. The teacher may use it to give the student an understanding, by giving them a quiz question followed by a thorough explanation, or he/she may just test their understanding. According to the students, we had in no way selected to use the SRS in an incorrect way. They just pointed out that to really test their understanding, they must first possess an understanding of the curriculum thought, and it is rarely in place after only 20 minutes. It comes usually after the material has decreased slightly, which usually happens when they have worked a bit with it through exercises. If we will test their understanding it is at this point they should get quiz questions.

## **B. Increased Engagement**

1. *Finally there's something else!:* Use of SRS is

a great way for the students to engage in the teaching process. By answering the questions they participate actively in the production of educational content, and their involvement increases. In contrast to ordinary classes, where students feel they have more than enough to listen and take notes, use of SRS introduces a break where they get time to think about, resonate around the educational material and process, and simultaneously test themselves. From the student side, it is impossible to maintain the concentration in one or several hours. It is simply too much information to absorb at once, whereby it is easy to lose the concentration and the motivation drops. Using the SRS, however, stop the regular teaching process in the class and the students may recover during a short time frame where something else happens! Students welcome a distraction introduced by SRS, instead of just sitting and receiving information. They become activated and motivation increases. One group of students discusses the increasing involvement in relation to the use of SRS in the following manner;

Per: *"You participate, yes, you are active in that you work with quiz questions and talk to other students. I was more engaged when using the system. But it has an effect on motivation as well. I think it's a bit exciting, a bit of fun, and it made classes more fun."*

Ole: *"It was like a small activity in the middle of the lecture, which restored my motivation when I started to doze off. I think, the lecture, well, there's too much information at once, you cannot keep up. So it's refreshing that you get to think for yourself, even if it's just for a short period, and get to answer questions."*

Jens: *"Yes, I felt that the class got a motivational boost, and became more active. It is definitely one thing that helps to maintain interest during classes! The tests are seen as a bonus, "soon a quiz will come and then I may test myself to see if I've understood it." I see nothing but positive aspects with SRS."*

Per: *"Me too. I'm normally not very active, so it was fun to join in and participate."*

Jens: *"Yes it was very, very positive, a real bonus."*

Ole: *"Yeah, well, you get a break from the usual lecture."*

2. *Anonymity: the magic key:* Although SRS offers students a much sought-after break from the ordinary teaching process in classes, it is according to the students the way the system allows them to participate that is the main reason behind the increase in their commitment. SRS offers students something that ordinary education is missing: a chance to participate anonymously. In contrast to ordinary classes, where students' participation

usually involves raising their hands with oral responds, they may use the SRS to answer questions without that answers are traced back to them. What they respond, and if they answer correctly, it is only they themselves that know. The students explain that anonymity is a crucial role in relation to their participation and usage of SRS. In short, anonymous responses made it sure that they participate. One of the students describes the role of anonymity in the following manner;

*"It ensures that everyone participates! Everyone may provide his or her vote and their "voice" will be heard (pause), that will never happen in a normal class. It [the anonymity] was the key factor, which convinced me to attend, no doubt."*

The most common option, and often the only one, where students may have the opportunity to participate actively in a lesson is by raising your hand to either answer or ask a question. From too many students point of view, this is not a particularly attractive opportunity. Far too many find it uncomfortable showing off by raising their hand and talk. They are afraid to make fools of themselves, either by asking a stupid question or answer incorrectly. They have all experienced to wonder of something but not asked any question, or to avoid answering questions from the teacher, especially if they are not sure about the correct answer. The fear of exposing themselves to the class prevents them simply from active participation in the class. Students define their own role in an ordinary teaching as a spectator, and not a participant! The usage of the SRS reduces the threshold for active participation significantly. By answering the quiz by using SRS, their anonymous participation was placed in safe limits. Everyone could answer without having any fear of dumb out towards fellow students. Use of SRS was a new way for students to solve tasks, which resulted in the response from the entire class, versus the usual few.

3. *Ultimately: learning at all:* From the student side, engagement and learning are flip sides of the same coin. One does not exist without the other! Commitment is a prerequisite for obtaining good learning. In addition it provides a better experience of learning. Being involved is described in this context as being mentally present. The student's concentration and attention are sharpened, and they find it easier to absorb information. The use of the SRS helped to initiate such processes among the students. By getting the opportunity to think for them selves, discuss with the person sitting next by, answer questions and receive responses, the students experienced increased engagement. They were activated and felt that the concentration, which often disappears during traditional teaching hours, were

awakened. Four of the students had this to say about both the commitment and learning, and SRS's role in relation to commitment;

*"As far as learning is concerned, unless I'm somehow engaged, I simply drop out and start thinking about other things. So for my learning, I need to be engaged during lessons to be able to absorb information."*

*"You learn a lot better when you are engaged. You are more "on the ball", because you get to conclude with different things – pulling different cords in a way – you think more actively about things, you work better with the material, and you learn better!"*

*"I think it was good, because you are a bit like, "aha, now we're going to run a quiz", and you get a bit excited like that. You never as much attention as when you get the quiz up on the board. So I think, for me there was more involvement. You were more into it!"*

*"Let me put it this way: at least I woke up"*

### C. Talk with the Person Sitting Next by

*1. Group Discussion: a good way to learn:* Before each vote using the SRS, the students were encouraged to consult the persons next by discuss the quiz question and its alternative in a few minutes. An encourage that no doubt was taken seriously by students. From their side, to collaborate with other students is an effective way to learn. Hearing others' perspectives, opinions and viewpoints are highlighted as important to get deeper into curriculum and achieve a better understanding. The discussions gave them, in other words a professional benefit. Students described the discussion as follows;

Group 1:

Per: *"I think I learned something from them, absolutely ..."*

Ole: *"It's always nice to get the opinion from the person sitting next to you"*

Jens: *"Yes, when you see the questions, you form an opinion that goes one way, and then along comes the person next to you with a different opinion. Thus, you get input from somebody who may think in a completely different way, and you just realize, "I never thought about that". Yes, you get a chance to discuss what the correct option is."*

Group 2:

Lise: *"It's very nice to be given the opportunity to speak with someone, especially since we're covering subject areas that are new to us. It's good to hear what others think, and together try to achieve a common understanding."*

Emma: *"Yeah I think it worked really well. We tried to reach an agreement on the correct answer."*

*So, if we disagreed there would be a very good discussion. You knew that both sides couldn't possibly be right, so you'd turn the material a bit upside down and discuss it. Very good."*

*2. Targeted discussion, they discuss not only to discuss:* The discussion with the person sitting next by was perceived as a valuable element in relation to the use of SRS. One reason for this is that the discussion had a clear goal, it should end in a vote that would give students feedback on their learning. They discussed, with other words, not only to discuss, they discussed to be better understand and to cast their vote. The goal was to find the correct answer that would further give them a positive feedback, and the discussion raised the chances of achieving that goal. The feedback students receive when using the SRS was thus a "carrot" that motivated them to participate actively in the discussion. According to the students this made the discussions focused and efficient. They only had a couple of minutes to try to discuss and try to find the correct answer, whereby they must use the time efficiently. One student group had the following comments about this;

Emma: *"The point of the discussions we had, was to figure out an exact answer. Otherwise, when we are discussing, I think the discussion very quickly loses focus, or at least becomes a rather "free-roaming" discussion."*

Lise: *"Yeah true, I think voting is very important! I don't think we would have bothered to discuss with the person sitting next to us if it would have been for nothing; if I didn't cast a vote afterwards."*

Emma: *"You motivation increases."*

Ingrid: *"You put more into the discussion, to find the right answer."*

Lise: *"Yeah, that sums it up nicely!"*

## 4 EXTERNAL TESTING OF SRS AT HIGH SCHOOL IN NORWAY

Four college teacher students tried out the SRS system in the spring of 2010, as part of a research project in their master studies. They had practice at a high school in Trondheim, where they should teach 3<sup>rd</sup>-year students. SRS was used as a regular part of their math classes for three weeks. Trials were completed with an evaluation, in the form of questionnaires and group interviews. Before the trials started, the college teacher students came to HiST where they received technological and methodological training in the use of SRS. They also

borrowed a PC pre-installed with the SRS-Control interface (SRS-Ci), a wireless router, 30 iPods and chargers for the iPods. They obtained the following experiences:

*Methodology:* A typical SRS session was conducted as follows: the students came to classes and picked up their iPod. The teacher started teaching as normal, using traditional teaching methods. During the course of the class, two multiple-choice sessions with using the SRS were conducted. The teacher, based on what students should have learned, or sometimes to test whether students were following the lecture, designed the assignments. The questions were read out loud by the teacher, and at the same time shown in writing (using, for example, PowerPoint, overhead projector or a normal whiteboard). The students were given a few minutes to discuss the assignment among themselves in small groups, before casting a vote. After the vote, the results were discussed in class. Both students and teachers participated in the discussion. All response options were discussed, both those that were correct and those that were incorrect.

*The teacher students' experiences in relation to the use of SRS:* Based on our experiences, we believe that the SRS can contribute as a positive tool in the assessment of learning. An important point in this context is that students become increasingly more active both the learning process, as well as the assessment of the teaching being given. Particularly in large classes, we believe that the SRS can act as a good tool to provide continuous feedback.

Communication with the students was an important aspect of using SRS in our classes. By communicating with the students to a greater extent than by traditional teaching, we believe we made an established a better report with them, which in turn helped to improve the learning environment of the class. Further on in our practise period we saw the importance of activating and motivating students during classes. By introducing the SRS in classes we noticed that students became more active and motivated, which also contributes to a more including and forgiving classroom culture. As future teachers, we therefore wish to stimulate the students to be orally active and, and to encourage students to participate in reflective discussions.

Our experience from the practice period is that many teachers find it scary and difficult to try new things in education. We experienced the same thing when we started the research project for developing an open SRS. It was actually a bit frightening to introduce a brand new technological system in classes, but after a short trial period we learnt that

we mastered it without major problems. The more comfortable we were on the system itself, the better our use of SRS in classes became. Our experience suggests that when a teacher is willing to take a leap of faith (technology-wise), it can improve the way we teach. We hope that in the future, we don't allow ourselves to be locked into a fixed pattern of teaching, but rather can challenge ourselves with new and exciting teaching methods.

*Student evaluation: results from interview and questionnaire:* Students experienced the SRS as a positive element in mathematics teaching. The training was more fun, it increased involvement and the students expressed that they had a more active role in classes. Student quotes:

"It was a positive experience to use the SRS. It turns the math into something positive."

"Using the SRS is fun, and when something is fun, it is easier to learn."

"Exciting new way to learn!"

"It's anonymous, so no one is afraid to answer incorrectly."

SRS was also seen as positive in relation to students' reflections on their own learning and learning process. In other words, SRS caused them to reflect more of their own learning. By answering questions during class, they got a feedback about their own learning process, and they could use this information to plan which parts of the curriculum they had to work harder with. Students emphasized the importance of getting a concrete response, which allows them to prepare and plan further learning. Student quotes:

Sturla: "SRS tells me where I stand in relation to the curriculum."

Robert: "You got like a concrete response as to what was right and what was wrong."

Sturla: "And then you find out what you need to practice harder."

After each vote, the students were encouraged to participate in a larger class discussion, where the various options and responses were discussed. The student perceived these discussions as very useful in relation to their own learning. The discussions gave them the opportunity to discuss with several fellow students and teacher. They received clarification about the different options while at the same time processing the subject material in a more active way. Student quotes:

"I learn more using the SRS is such a way that the answer options are reviewed and discusses in class after the vote."

"When you reviewed and discussed the various options - what was wrong, and why - we felt like we

*were absorbing knowledge in very much the same way that a sponge is absorbing water.”*

The SRS was perceived as an integral part of their mathematics classes. They did not feel that the use of SRS came at the expense of ordinary teaching. On the contrary: several of the students think that the system should be used as a regular part of their teaching in all subjects. Furthermore, the iPods were perceived as simple-to-use voting devices; the quiz questions were rated as satisfactory, and the teachers seemed comfortable with using SRS. As with previous evaluations, the teacher's explanation after the vote is once again highlighted as essential. So when a teacher initiates a larger class discussion after the vote, it's important that also the teacher contributes to the discussion. From the student side, it is important that the teacher involved and give his testimony about what is right and wrong, and why.

## 5 EMERGING NEW MOBILE ASSESSMENT SOLUTIONS

Today, students are unable to immediately verify their learning during tests/exams as feedback is published after several days or even weeks. This is in particular the case for learning skills in vocational education and training, and in higher education in Europe. Usually educational institutions don't have access to a high number of computer science labs where it is possible to run digital multiple-choice tests for all campus students. On the other hand, within a few years a lot of students will have access to cheap Smartphone's with high-resolution pressure sensitive screens.

An innovative mobile learning project (Done-It 2011) is currently developing a new evaluation model and mobile technology solution, where assessment and test results for a class are turned into an active, creative and collaborative learning process by the use of immediate feedback:

- Verification feedback led by a teacher: why is this particular answer correct and why are the others incorrect.
- An elaborate feedback discussion run by students: the answers are displayed but they don't know which are the (in)correct ones.
- An elaborative feedback discussion led by one student: the deviation from the correct answer without addressing why this is correct and the other ones are incorrect.

The mobile evaluation system for Smartphone's is going to extend the open SRS. It will give the teacher a new tool, allowing him/her to either give

verification or elaborative feedback to individual students or groups of students immediately after a test. This is a key factor helping students to improve their skills by the use of active collaborative supported learning. Students will, when they still remember the questions in the test, learn why the correct answer is correct and why the other ones are incorrect. Thus, mobile technology provides new evaluation and testing criteria for education and training.

The mobile student evaluation system has the potential to become a gateway to active learning for students that may be used for in-class laboratory experiments, but also for distance training purposes. Each student uses Smartphone's to answer and mark multiple-choice tests with a number of questions. An embedded automatic marking system is included. The training method includes using cases and/or experiments demonstrating what to do, how it works, and what the deviation will look like. The new open mobile technology based evaluation services are going to be designed such that they improve industrial certification processes. The system design has a strong pedagogical focus, such that the usage of the assessment services is merged into the instruction and training process. The system will collect the KEYS (the correct alternatives) and the DISTRACTIONS (the wrong answers). It is expected that the first prototype is ready for testing at the end of 2011.

## 6 CONCLUSIONS

The results obtained in undergraduate engineering programs in Norway and Sweden during testing the prototype solution for a new type of online Student Response Services (SRS) for next generation mobile handheld devices with pressure sensitive screens, e.g. like iPod Touch, iPhone and Smartphone's, is reported. The teacher collects and visualizes the responses from class at a the digital blackboard or the PC screen, by utilizing state of the art SRS decision process solutions consisting of a controll interface and mobile devices which the students may use for polling. Our results point out that the students appreciate attributes like feedback on learning. Furthermore, the students commonly appreciate increased involvement and more peer learning through group discussions. SRS rather than raising their hands let individual responses stay confidential. The open SRS has been tested and used in classes with from 7 to 208 students in Norway and Sweden. The experiences and feedback we have obtained is to a large extent independent of the size

of the group.

The students provide positive feedback with respect to increased engagement and motivation, which is accordance with results reported in the literature. Many students feel it become fun to attend the lectures. They also point out that the SRS has become an integrated part of the teaching practises, since it is intuitive, easy and fast to operate by the teacher. A majority of them feel it leads to improved understanding of the curriculum, though we haven't any indication if this is the case during the final examination process. Further research is required in order to detect if it is any differences in using SRS with respect to gender.

The new services may extend and replace existing response systems where universities and Vocational Educational Training institutions must buy dedicated and expensive hardware tools, so called "clickers" or electronic voting systems, in order to provide feedback from students during training sessions. The prototype of the open SRS services, which were finalized in December 2010, use the existing wireless network and may run on widely available mobile, wireless multi touch pressure sensitive hand held devices. It is also possible to use it in parallel on PC/MAC/laptop. They are constructed for easy integration and use on digital blackboards, as well as to the story telling provided by the teacher. The students use mobile devices like iPod Touch, iPhone or their mobile phone, to interact anonymously with the teacher through online questionnaires and voting sessions.

The use of SRS has significant benefits: Instructors get immediate feedback on how well the students are paying attention to a lecture, while students get instant feedback on their understanding of key concepts. The online SRS is designed to help teachers to enhance learning effects by:

- Breaking the monotony of a lecture and allow the students to actively take part in the lecture.
- Increasing teacher-student interaction.
- Give teacher and students "real-time" anonymous feedback on learning effect.
- Use modern, cheap and widely available mobile devices that start quickly in order to merge their usage into the teachers storytelling

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