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Peer-instruction and drawing as student activating teaching in SAU24

Barbara Lykke Lind

Department of Neuroscience
University of Copenhagen

In this project report I present my experience with introducing student activities in my sau24 teaching. I describe some methods to activate students and explain how a few of these were applied to four classes taught in the neurophysiology course on the faculty of health in the fall 2017. The feedback from the students is then presented in an evaluation of the approach with regards to participation, learning, which activities the student preferred and how well they were implemented.

Background

Sau24 is an abbreviation for studenter aktiverende undervisning (student activating teaching) followed by the maximal number of students in each class. Though the purpose of this class is to activate the students, I previously did not do much to achieve this. I would give a lecture-style presentation supported by powerpoint slides, punctuated by some relatively simple questions and followed by questions on a sheet of paper in the last 20 minutes of the class. This manner of teaching was suggested to me by my co-teachers and it did not seem to disappoint the students. I now know that much more should and could be done to activate them.

The neurophysiology course is a big course in which the sau24 on the action potential is taught up to 14 times, by several different teachers, in 2x45 min classes. Since sau24 is meant to review the topics presented to the students in the lectures and in the laboratory exercises the curriculum should be familiar to the students. That presents me as a teacher with a

quite uniform mass of students, though obviously some are further in learning and better prepared than others. I know from a few interviews that the students find the topic challenging. When teaching a sau24 it is my job to provide the students with an opportunity to go through the curriculum once more, so they may realize what they do not yet understand and ask questions accordingly. The purpose is to reach a deeper level of learning (Biggs & Tang, 2007), which gives better long-term retention of the learned subject (Prince 2004).

Active participation should increase learning in the students (l. Rienecker & Ingerslev, 2015). The first challenge was to decide on the appropriate methods to enhance the level of student activity. An often-proposed method in active learning is problem based learning (Prince 2004). I considered that this could be done through some real-life problems or old exam question which are likely to motivate the student participation. I then decided against it because I realized that I within my curriculum had the possibility to organize a jigsaw like discussion between the students. In such a discussion each student brings a certain theoretical perspective in to the group work doing peer-instructions (Chalmers & Fuller, 1996). To have time enough for this I had to skip introducing the subject through a complex problem. I also discarded implementation of a flipped classroom (Jensen, 2018), because its essence is preparation based teaching. Since each class is assigned to a specific team of students they could in theory be contacted with some material or information before the class. In practice the students may choose not to attend the classes assigned to them but instead go to another class. I could thus not be sure that the students in the class room had all received the instructions for preparation. To implement such a method, all sau24 teachers on this topic would have to coordinate their teaching. Finally, I considered to introduce some form of didactic game. Since it is effective in activating students and improve their learning, it would have been inspiring to do (Christiansen & Olsen, 2006), but I feared that introducing a playful approach would not go well with the high level of seriousness I had so far perceived in the students. I suspected they would be nervous they were wasting their time.

A few of my colleagues have been teaching sau24s in a very open format, letting the students define the topics of the class depending on where they felt they needed more knowledge. I decided not to follow such a student-driven approach, but instead to guide the discussions they would have. A guided discussion could be considered the intermediate between lecture-style and student-driven teaching, because the content of the teach-

ing is inflexible, while the students are in dialogue with the teacher and each other. This I did because I did not only want participation from the students with the best understanding of the curriculum and their own abilities. These students are likely to participate in any kind of teaching and I suspect were the ones answering my questions in my previous lecture-style classes. Now my goal was to ensure that all students were active and increased their learning during the class. Since practice by doing and teaching others gives the longest retention of knowledge (Magennis & Farrell, 2005) and fits the curriculum of the sau24 well, I decided that these methods should be used to activate the student.

Implementation of drawing and peer-instructions as student activating initiatives

To ensure active learning in as many students as possible two different activities were introduced. Group work, with and without peer-instruction and working with the tasks by drawing the solution. The teaching plan is shown in Appendix 1. From the start the students were each given several pages of blank paper. They were told that answers were to be given by hand-drawn illustrations such as diagrams or dependency curves. This was done to make the students transform their theoretical knowledge in to a diagram. To do so they had to work with their knowledge in a shift in register of semiotic representations which ensures a better quality in their learning (Duval, 2006). While considering a way to represent a solution to the task the students had to construct their own knowledge (Stewart, 2012). The reproduction of knowledge in a physical format is part of a cognitivist approach because the data was externalized in the creation of diagrams, different cognitive learning styles were respected, and the students were invited to discuss with each other during the process. This approach has been shown to give a better retention of knowledge (Stewart, 2012). Additionally, some students learn better through movement than through more classical learning activities (Murphy, Gray, Straja, & Bogert, 2004). To acquaint the students with making illustrations they were given a task and told to draw an illustration in groups of three. To work together on this the students had to discuss and evaluate the solutions given by other group-members while the answer was put on paper. Such interaction in a collaborative learning has been shown to give better learning than individual learning (Prince, 2004). By asking the groups to work on an illustration together meant that not all students

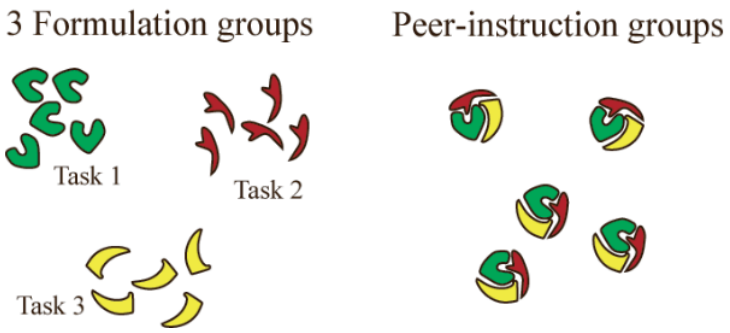

Fig. 12.1

would get to use their hands. This was of course suboptimal, but I did not expect all students to be equally prepared to use this methods from the beginning. By letting them work together on the task they would be able to gain confidence from each other, before I later would ask them to use the format independently in the peer-instructions. After they had work on the task, one of the drawn illustrations was then projected on to the whiteboard and presented by the students in the group to the class. This presentation was given in a dialogue with me to consolidate the learning of the subject. This structure of task-groupwork-evaluation of drawings was repeated once more.

I then went on to the peer-instruction activity which was done using the jigsaw method (Chalmers & Fuller, 1996). A diagram of how this method was used is shown in figure 12.1. First the students were asked to send one member to join each of three formulation groups. Each of these three large groups were told to prepare a short teaching session on the function of one or two membrane proteins. These proteins are responsible for three different mechanisms crucial for the development of an action potential. The proteins are well known to the students from the lectures and the report they write after the exercise on the action potential. The students should thus all have been well prepared for making such a small presentation. To be sure that the three formulation groups remembered all aspects of their protein functions I went to each of them and validated their considerations. After a short break the students were told to meet with the other two persons from their original groups and commence on the peer-instruction sessions. I chose to create the peer-instruction sessions because of the benefits from teaching others (Wood, 2004) and because I knew that it would be very difficult for a student not to participate under these circumstances. In the groups of three they each had the full attention of the two others for a

few minutes, as they taught their part. In practice the sessions became very interactive teachings experiences because the functions of the membrane proteins are complementary in the regulation and formation of an action potential. Each of the students held a piece of the puzzle and to draw the complete illustration all membrane proteins had to be taken in to consideration. When the peer-instructions were done I quickly summarized what I believed would be the key points from the guided discussions in the groups.

Documentation

After the 2x45 minutes class I asked the students to fill in a short assessments scheme and hand it back to me before leaving the room. Through this I got feedback on how much they participated in the class, how much they felt the teaching had helped them to better understand the subject, what activities they thought were the most effective, how they liked the activities introduced to the sau24 and what they missed in the teaching. The questions are shown in Appendix 2 and 3.

Feedback from the students

The student activating initiatives ensured a high level of student participation

The main feedback I received from the assessment handouts was with regards to participation in the class. When I taught sau24 in the previous semesters I experienced that approximately 20-25 % of the students participated by asking and answering questions in interaction with me. The introduction of student activating initiatives forced a majority of students to be active. One wrote that they were more active than ordinarily in sau24 *"vi var mere aktive end normalt i sau"*. More than fifty percent stated they had been very active in the class (Table 12.1) and that they had participated both by interacting with me, drawings illustrations and/or in the peer teaching sessions.

Those who wrote that they only participated somewhat mostly report that they participated in the peer-instructions. This show how effective the peer-instruction activity was in activating students. In summation a total of 88.75% (32.5% + 56.25%) of the students were activated, which is a

Table 12.1

	Participated	Increased comprehension
Not at all or very little	11.25 %	7.5 %
Somewhat	32.5 %	26.25 %
A lot	56.25 %	61.25 %

big improvement since my previous teaching. Even though the learning activities to a high degree forced participation, more than 10 % wrote that they hardly participated at all. One student wrote that he/she needed more time to find the right answer. *"Jeg har brug for længere tid til at komme frem til et evt. korrekt svar"*. Another that he/she is shy. A third that he did not take the class with his regular team and thus were keeping a low profile. These obstacles for participation reflects the personality of the students (Entwistle, 2009) and the importance of a familiar learning atmosphere and may be hard to overcome. Other students do not reveal why they did not participate in the class, but they would probably not have been more active during a regular lecture-format class. When asked in what way todays class had assisted their comprehension of the subject almost all students choose to estimate how much they had improved their comprehension (Table 12.1). Looking at these numbers the activities appear more successful than when the level of participation is evaluated. Still it cannot be satisfactory that any students felt they had learned almost nothing even if it is few. Around half of these students remark that they are now more confused than before. I suspect this could be because the request to explain the subject to others may have revealed that they had not jet understood sufficiently to be able do so. Hopefully this will probe them to spend more time on this part of the curriculum before the exam. One of the students who remark that nothing was learned in the class explained that everything had been described previously in the lectures. This student then admits that he/she did get to practice the communication of the subject. *" Man fik ikke større forståelse da forelæsningen før havde gennemgået alt. Men man blev bedre til at formidle det"*. This effort in communicating the subject has likely given a deeper learning in the student, at least by repetition and probably also by prompting reflection (Biggs & Tang, 2007), even if the student does not acknowledge this effect. It is worth noting that the learning appears strongly associated to the level of participation in the class (Figure 12.2). A clear majority of the students with a high level of participation also felt they learned a lot. In

Table 12.2

	Peer-instructions	Making drawings
Learned most from	27.5 %	15 %
Liked best	66.25 %	31.25 %

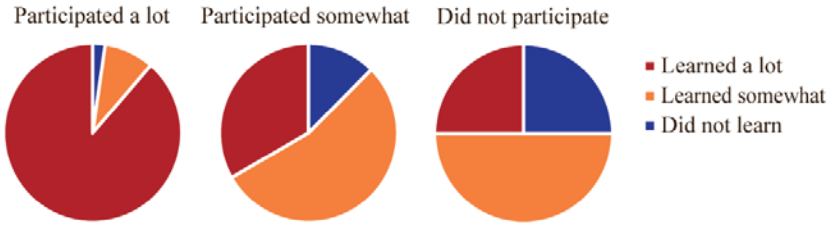

Fig. 12.2

addition, the largest proportion of students who felt they did not learn was among those who did not participate. This relationship reflects what is already known and emphasize how important it is to engage as many students as possible in an active participation in the learning.

The two student activities were not equally popular among the students

A few students objected to the use of student activities. One student gave a long defense in favor of theoretical blackboard teaching, with the main argument that it suits them better because it is the teaching format they are used to. That students may be critical of the introduction of activities is described before (l. Rienecker & Ingerslev, 2015). Other studies have found that student often appreciate interactive classroom learning (Scott, 2005). In line with this the peer-instruction activity was popular and perceived as effective (Table 12.2). Only very few were dissatisfied and then mainly because they found that too much time was spent on it. One student wrote that he/she spend a lot of time being in doubt, but luckily also felt that the confusion was dispersed in the final consolidation; *"Jeg savnede måske lidt at få det rigtige svar -der var meget tid med tvivl. Men det lykkedes til sidst i plenum"*.

The use of drawing as a tool was mainly appreciated by the students with a high level of participation. They were also among those who felt they learned the most (Figure 12.3). One such student wrote that it was

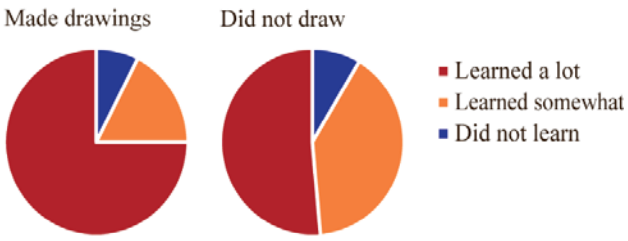

Fig. 12.3

very effective to draw, because one would then better remember the subject; "Det var vildt godt at tegne, fordi så husker man bedre". This is in accordance with the theory, so why then was this activity not as widely appreciated as the peer-instructions? The students belong to a digitized generation and some did seem uncomfortable in using pencil and paper, but most were willing in this regard. Was the activity then too difficult? This could explain why only the best students felt they benefitted from it. Some of the illustrations I received from the students to summarize in plenum were quite rudimentary, but this is not necessary problematic. In my opinion, half the learning was made as the pencils hovered over the sheets and the students considered or debated what to draw. The most likely explanation is that this activity needed a better introduction. A more precise description of what I excepted from these drawings could have guided the students to address the task more boldly. An excess of uncertainty can hinder the students in performing the learning activity (Stewart, 2012) and a few comments from the students reveals that they did not understand the task in the beginning of the class. This I will work to improve in the next sau24 teaching.

The student activities must be implemented in alignment with the course structure

The students' main complaint in all four classes was that too little time was spent on traditional teaching with the teacher at the catheter. These situations were of course reduced by the time spend on the active learning activities. Exactly what format of catheter teaching they requested depended on their level of preparation (Figure 12.3). The more days it had been since the class had taken the exercise related to the topic of the sau24 the more likely that the students had written the report on this exercise. Writing this report would be the optimal preparation to participate in the activities. In the two classes less prepared for the sau24 around half of the students re-

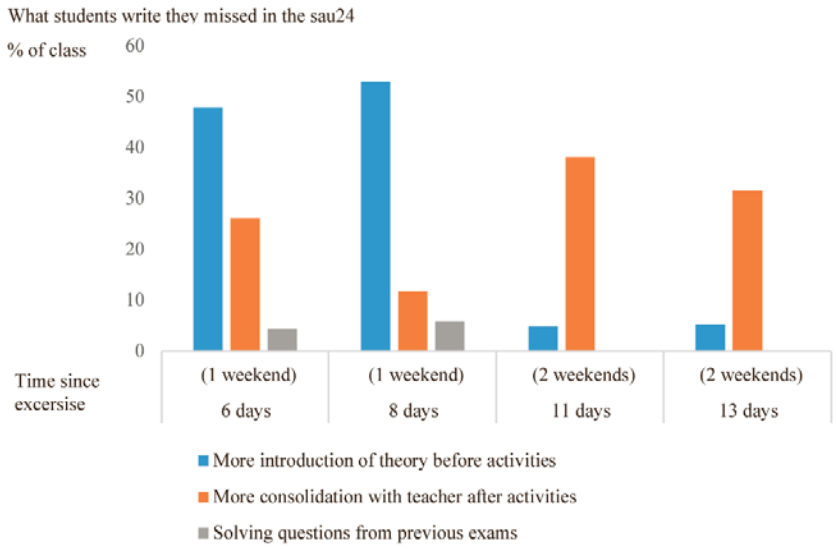

Fig. 12.4

quest more theory in an introduction from the teacher before the tasks. One of them point out that not all what they had heard at lectures was understood "Ja, vi har hørt det meste til forelæsningerne, men det betyder ikke altid at man forstår det til fulde". Meanwhile, in the two classes where most had written the report, 30-40% of the students remarked that they could have used more time consolidating with the teacher after each task. That the students ask for a better introduction and more consolidation of their learning between the activities is a relevant critique, as these steps are important to ensure an appropriate learning (Hunt, Chalmers, & Macdonald, 2012). It is thus central to Disregarding these differences in the students learning level will reduce the success of the active learning approaches. Because of the size of the course it is not possible to ensure a similar alignment of the sau24 classes to the other course activities. Thus, it is up to the teacher to get some information on how far each class has come in learning the subject. An estimation can be gained from the time since the laboratory exercises, as in figure 12.4. A much faster and more accurate approach would be to simply ask the class. Before commencing on the teaching, the proportion of students that has already written the report can be assessed from raised hands. The teacher must then be flexible in how much time is spent introducing the theory before the activities. This is in accordance with good teaching practice, as a teacher is always supposed to know the level of the students learning and adjust the level of the teaching accordingly (Hunt

et al., 2012). Fortunately, even though they differed in what they required more of, all four classes appear similar with regards to student participation and learning.

Evaluation of the level of difficulty.

Some students complain that they already knew the subject. A few others objects that the tasks were too easy. One even suggest to use problem based learning to make the tasks more difficult *"Det kunne godt have været lidt sværere, måske med cases?"*. Though repetition is an aim with the sau24 classes, it is possible that my level in teaching was slightly low compared to the prior learnings of the students (Hunt et al., 2012). Since my level is based on the powerpoint show given in the previous years it is a troubling thought. My previous teaching format would not have allowed for sufficient interaction for me to acknowledge if this was the case and adjust my level accordingly. The level of teaching may on the other hand have been appropriate when the input from other students is taken in to consideration. *"God detaljegrad"*; *" vi nåede det vigtigste"*; *"Til sidst i timen synes jeg at jeg havde fået en større forståelse, men jeg synes det er et svært emne"*. Most importantly since the majority of students wrote they had a better comprehension after the class (Table 12.1), the level in teaching cannot have been all wrong. It is an important aspect to consider because the learning level in a guided discussion is somewhat inflexible. In the future I can assign more time to random questions from the students, which will give me even more feedback on what part of the subject they find difficult and help me adjust my level of teaching.

Conclusion

The purpose of my teaching is to activate the students to review what they already know. It is evident that the activities I introduced induced participation and that the students felt that especially the peer-instructions enhanced their comprehension. This is important when the goal is to make the students learn better. I no longer find it acceptable to give a lecture-style power point presentation, even though studies show that students can rate passive teaching quite favorable (l. Rienecker & Ingerslev, 2015). My teaching experiment would have been more interesting if I had chosen to give lecture-style teaching in two of the four sau24 classes and compared

the evaluations from these students with the activated students. I considered to do so, but after having learned about the huge difference in the depth of learning that these two styles of teaching create (Biggs & Tang, 2007), I could not purposefully give what I knew to be bad teaching to half my students. Instead I tried to evaluate how well suited the chosen activities were. The student activating initiatives used in the fall semester of 2017 may not have been the optimal methods, nor perfectly implemented. Still it was better than the lecture-style teaching I used before. The feedback will now help me to further improve my use of student activities.

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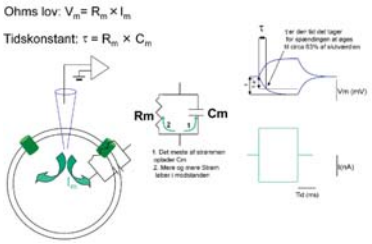
A

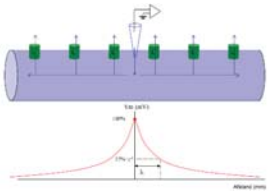
Appendix 1: Teaching plan

Introduction to the concept of drawing illustrations when working on the tasks.

First task: *Work in groups and drawing projected on whiteboard afterwards*
Illustrate the consequence of the law of Ohm on the membrane potential.
Possible solutions:



Second task: *Work in groups and drawing projected on whiteboard afterwards*
Illustrate the consequence of the length constant in the distribution of a potential.
Possible solutions:



Ask question: *Allow them to discuss with each other before consolidation in plenum.*
Which membrane proteins are crucial for the formation and development of and action potential?

Theory: Walk through the different phases of the voltage-sensitive Na^+ channel together with the students while drawing on the board.

Jigsaw peer-instructions: *Students form groups of three.*
Each of them join one of the three big formulation groups.

Tasks given the 3 formulation groups:

1. Illustrate the consequence of the function of the Na^+/K^+ ATPase and the K^+ leak channels.
2. Illustrate the consequence of the different phases of the voltage-sensitive Na^+ channel.
3. Illustrate the consequence of the function of voltage-sensitive K^+ channel.

Action step: *The three-student groups reform and each student is given 3 min to illustrate and explain what was debated his/hers formulation group.*

Some possible illustrations:

	Intracellulær koncentration	Ekstracellulær koncentration	Ligevægts potentiale
K^+	130 mM	4 mM	-90 mV
Na^+	10 mM	140 mM	+50mV
Cl^-	6 mM	104 mM	-75mV

Consolidation by teacher.

Final part on extracellular stimulations were done in a quick succession of simple questions and answers.

Appendix 2: Assessment scheme, Danish original

SAU24 undervisning, oktober 2017

1. Hvor meget deltog du i dagens undervisning? Bidrog du med et spørgsmål, en kommentar eller en tegning?
2. Hvordan hjalp dagens undervisning dig til større forståelse af aktionspotentialet?
3. Hvad synes du var bedst ved dagens undervisning?
4. Hvad savnede du i dagens undervisning?
5. Andre kommentarer:

Appendix 3: Assessment scheme, English translation

Assessment scheme to be handed to the students as a final thing in my classes and filled in immediately, to be handled back upon departure:

6. How much did you participate in todays class? Did you contribute with a question, a drawing, a comment?
7. In what way did todays class assist you in a better comprehension of the action potential?
8. What did you like best about today's teaching?
9. What did you miss in today's class?
10. Comments: