Continuous development of the postgraduate course GEOV360 – Advanced Clastic Sedimentology: Years 2017 to 2021

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1. Summary

This is a report in the course *UPED620 – Basic module in university pedagogics*, where I describe the changes I have done to the course GEOV360 – Advanced Clastic Sedimentology over the last five years. These changes include restructuring of the teaching to include much more student active learning, redefined course goals, an assessment strategy that is strongly aligned with the course goals, and a comprehensive student evaluation program. The goal of these changes has been to improve student learning and knowledge retention of the geological skills taught in the course, and to give the students experience in data interpretation, handling uncertainty, teamwork and giving presentations. The purpose of this report is to share insights with other educators who may be able to benefit from my experiences.

2. Course overview:

I teach the course *GEOV360 Advanced Clastic Sedimentology* and have done so since 2017. This is an intensive course running from 09:15-16:00, five days a week, for three weeks. The **curriculum** is a textbook (Facies Models IV, James & Dalrymple, 2010) and a set of ten review- and research articles which are *recommended reading*. The two first weeks of **teaching** consist of 1–3-hour segments of student-active learning. In the third week of the course, the students do longer and more independent exercises on real data based on the skills they have acquired through the course, and they present their solutions at the end of the course. Finally, we have plenary discussions about the different solutions. There is **formative assessment** throughout the course, based on how students collaborate, work and present. The **summative assessment** is a 4-hour written exam given c. 3 months after the course which results in a A-F grade.

The course has about 20 very motivated **students**, mainly first year master students but also some PhD candidates and a small number of advanced BSc students. About 25% of the students are from foreign universities, the rest are Norwegian.

The **learning outcomes** are that students can

1. recognize deposits of different sedimentary environments (beaches, rivers, floodplains, submarine fans, avalanche fans);
2. know how these environments are controlled by different environmental, climatic and tectonic factors;
3. know which geohazards occur in these different environments and how these hazards can be mitigated ; and
4. know how deposits from these environments can act as reservoirs for groundwater, hydrocarbons and CO_2 storage.

This will prepare students to do work and research within the field of sedimentary geology. **General skills** that are developed in this course are presentation skills, collaboration skills, discussion skills, and three-dimensional problem solving.

3. Story of me and my course

I have taught this course since 2017. When I was doing my postdoc in 2017, I was asked to teach the course for *one time only*. The exact same thing happened in 2018, I was asked to teach the course again, *just once*. These two years, I inherited the course structure, course slides and exercise material from a previous lecturer. Because I originally believed I would only teach the course once, I did not change the course much from its original form during the first two years. At this time, the course was very theoretical and strongly based on lectures for the first two weeks. The practical exercises were concentrated in the third and last week. Thus, I got experience in teaching this course in a lecture-heavy way.

Those two years, the course covered a lot of important material. The students were exhausted at the end of every day, and so was I, but most of the students were exceptionally motivated and told me they learned a lot from the course. Some students seemed to zone out, and the course evaluations revealed that most of the students liked the course, and a smaller number of students thought the course was too heavy and graded it negatively.

Since I started my current position in 2018, I have changed this course a lot. Because it is an intensive course, I have much flexibility to experiment with different forms of teaching and I have included large amounts of practical exercises, student active learning, and problem-based learning. I wanted the students to spend less time listening to me, and more time working on problems themselves and getting feedback on their solutions. The students can read themselves, but they cannot asses their work as well as an expert can.

4. Goals of this report

The goals of this report are to outline the changes I have done to the course, to explain the reasoning for doing so, and present how I work on developing the course continuously. Finally, I summarize these findings and present the way forward for the course. Specifically, the goals of the report are threefold:

1: Present changes to the course goals, curriculum, and assessment strategies,

2: Present the changes to the teaching methods in the course, and

3: Present the changes to the course evaluation, and how the evaluations are used to develop the course further.

5. Changes to course goals and curriculum

The **course goals** when I took over the course were to bring students to the research front of understanding clastic sedimentology. Although this is still an implicit goal for the course, the focus of the course has been rephrased to highlight the applications of the material presented. Based on conversations with students, it is clearly motivating for students to have the

applications of the course clearly stated, and it also helps students who are trying to find courses that fit within their course program. The new course goals are to:

1. recognize deposits of different sedimentary environments (beaches, rivers, floodplains, submarine fans, avalanche fans)
2. understand how these environments are controlled by different environmental, climatic and tectonic factors
3. understand which geohazards occur in these different environments and how they can be predicted and mitigated
4. to understand how deposits from these environments can act as reservoirs for groundwater, hydrocarbons, and CO2 storage.

Currently, **the curriculum** for this course is the course slides supported by a textbook (*Facies Models IV, James & Dalrymple, 2010)*), a course compendium consisting of a set of exercises and suggestions for how to practical geological work, and a set of 10 *research and review articles* which are *suggested reading*. The textbook is structured around a set of chapters which are written as long review papers by various authors. The textbook and compendium were the curriculum when I took over the course, and these two elements work very well. However, during the early years I taught the course the students would often request more focused papers, and this led me to state a list of ten papers which are recommended reading for the different lecture days. In the future, I plan to revise this list of recommended papers, as a large amount of the current papers are written by male authors. The students would benefit from seeing a greater diversity of authors on the papers they read.

6. Changes to the teaching techniques

The teaching techniques are what have changed the most since I took over the course. From being completely based on lectures for the first two weeks, the course has now changed into something which is inspired by problem based-learning (e.g., Hmelo-Siver 2003; Hung et al 2008), or BOPPPS (Pattison & Day, 2006), where most of the teaching follows this format:

I start each segment of the course by presenting a new concept and telling the students why this concept is important and what real-world implications and uses it has. I then I present context, concepts, and techniques for 15-60 minutes Students then work together in groups to solve an exercise based on these concepts for 3-180 minutes. These exercises are often quite difficult and extensive, and the students are encouraged to discuss their work and the problems they encounter with me or other instructors, because when the students struggle with problems, or make observations they cannot explain, they are especially receptive to learn new things. One group that worked well or had an interesting solution to the problem is then chosen “at random” to present their solution to the entire class. I give them feedback on their presentation, their work, and their collaboration, but I do not grade their presentation (more about this later in Section 7). The segment ends with me presenting my solution to highlight what would be regarded as a high-quality solution in this field, and we discuss this solution and other solutions.

The third and final week of the course follows the same procedure, but the exercises done in this final week are much more extensive and take 0.5-2 whole days to finish. The groups work

independently on their assignment and present their observations and interpretations to the other groups at the end of each segment.

Doing all these exercises take a large amount of time and we end up *covering much less material* than we did when the course was taught with a much greater amount of time spent on lectures. I do believe the course was quite *overloaded* when I took over, and I believe the students retain much more knowledge now than they did in the original form of the course (see Biggs 1999). I also believe that what the students I encounter at this level need, is to learn how to *apply* what they learn, and how what they learn *fits into a larger context*.

7. Changes to assessment strategy

The **assessment strategy** for the course is on the surface similar to how the course was before I took over: The **summative evaluation** is only a 4-hour written exam at the end of the semester. However, the exercises in this exam have been tailored very carefully to better test the goals that are stated for the course, and to better match the activities the students do in the course. This has led to a greater degree of constructive alignment (Biggs, 1996) in the course (a concept and way of thinking that I did not know about before this course, but which inspired me). A clear constructive alignment between course goals, course activities and assessment strategies also make it easier for students to use learning strategies (e.g. McGuire, 2015). At the start of lectures and at the end of teaching (before preparations for the written exam) in the course, I spend some minutes to tell the students about learning techniques and how they can learn more about them.

With the much larger amount of student-active learning in place in the course now, there is a much greater opportunity for **formative assessment** in the course. As the students have several exercises that they present every day, they get feedback on their cooperation, their answers, their presentations, and the way they communicate their science. As noted above in part 6 of this document, I have chosen not to grade these contributions because 1) the level of motivation and effort is already extremely high and I do not think introducing grades would make the students try harder, 2) because the students can discuss their work with me at any time, introducing grades would probably make the students less independent and afraid to try things on their own, and 3) because it would punish students for trying new things and failing.

Some of the students complain that there is a significant delay between the end of the course in mid-March and the written exam in early June. They say that they would prefer to do the exam just after the course. I tell them that this delay is intentional, because it gives them 3 months to read, prepare and revise what they learnt before the exam, and that this waiting period makes them better geologists. The students usually agree with this reasoning.

8. Changes to course evaluation strategy

At the Department of Earth Science, we have a common anonymous evaluation form for all the courses we teach at the department, and we ask the students to anonymously fill in this form at the end of every course. This evaluation form has more than 40 questions, and significant parts of these questions are not relevant to any particular course. This leads to low

student response numbers, and because I cannot ask questions that I want to know myself, I have limited use of these evaluations. I do understand that having a common evaluation system for all courses is useful for the administration, so I strongly encourage the students to answer this survey as well.

However, because of the limitations of the official student evaluations, I also run my own, "personal" course evaluations. I use the online platform www.freesuggestionbox.com, where students can submit answers anonymously, and I ask the students to use free text to answer the following questions:

1) Do you think it is a good idea to teach this course as an intensive course? Why, or why not?
2) What works well in this course? Why?
3) What does not work well in this course? Why?
4) What would you change in this course?
5) What has been the best part of the course?
6) What has been the worst part about the course?
7) How were the exercises we had during the lecture days 1A-2E?
8) How was the exercise part (3A) at the end?
9) How was the logging exercise (3B)?
10) How did it work when we changed to online teaching? (*this year we all spent 1 week in quarantine as there was a COVID-case in the class)*
11) Do you have any other suggestions for this course?
12) Were there any pointless exercises? Which ones?

I strongly encourage the students to answer this survey. I tell them that it is very important for me and for the future students that they do answer, and that I will study their responses thoroughly to improve the course. This way I can get answers to the things I am unsure about in the course, and I can then use this information to improve the course. The most useful information to me is when students felt that a concept was poorly explained that they couldn't understand something, that we spent too much time on concepts that they did not learn from, or that a concept seemed irrelevant. I usually get a response from about 75% of the students this way. Most students choose to answer the questions I asked, and about a third rather give choose to give me a free-text answer which is often useful as well. As an example, in 2021 the student feedback showed that the part of the course that which deals with landslides (rock avalanches, snow avalanches, debris flows) needs improvement. For next year, I will therefore spend more time on this section, make sure I lay out the basics in a more accessible way, and have exercises that makes the students work on the basic processes and recognition criteria for different types of landslides.

9. Conclusions and way forward for GEOV360 Advanced clastic sedimentology

Teaching the course GEOV360 is an intense but rewarding experience. I am satisfied with the course, but if I had time I would completely restructure it and redo the slide pack that I use. There are too many slides, and some parts of the course are weaker than other parts. I currently do not have time to do this, but I change the course every year to reflect what I consider to be the front of the field, what applications are most relevant in the news (recent floods, tsunamis, landslides, developments in CO_2 storage, climate change-related events), and to include exercises and concepts shared on blogs and Twitter by other people who teach similar courses worldwide.

The course evaluations show that the students on average are more satisfied with this course now than when I taught it in its original form: The first two years the grades were mainly A's and B's with a few C's and D's too. During the last two years the course has gotten only A's and B's. I am not sure if this actually reflects changes in the course, or if it just reflects changes in the students that take the course, but it is encouraging that the students are generally happy with the course. That the lower grades have disappeared might indicate that students with "*less internal motivation*" get more out of the course than they did before, and I hope this is the case. I believe the free-text evaluations give a more nuanced and useful picture of how the students experience the course and how it can be improved, and that a combination of clear, targeted questions and numerical grades is ideal. The text answers give good indications on which parts of the course work well and which work less well, and the numerical grades makes it possible to crudely compare the student experience from year to year and from course to course.

In the short term, I plan to include more information and exercises on landslides. If I can find time for it, I will also take the students to the field and look at currently active sedimentary processes, perhaps recent landslides near Bergen? I will most likely take out some of the content on the physics of sediment transport to make space for things I currently consider more useful. I will also revise the curriculum to include newer papers, and try to achieve gender balance between first-authors in the articles on the reading list. This is important to make more of female role models visible for the students. I would also like to create an exercise that the students answer an individual exercise with a text, perhaps something about a research article they could choose themselves. I believe the students would benefit from writing more texts that they will get concrete feedback on.

In the long term, I would like to replace the textbook we use with recent review articles, and I would like to strongly reduce the number of slides that I use, and I want the students to read more and perhaps also do more of the teaching in the course.

10: References

Biggs, J., 1999. What the student does: Teaching for enhanced learning. Higher education research & development, 18(1), pp.57-75.

Biggs, J., 1996. Enhancing teaching through constructive alignment. Higher education, 32(3), pp.347-364.

Hung, W., Jonassen, D.H. and Liu, R., 2008. Problem-based learning. Handbook of research on educational communications and technology, 3(1), pp.485-506.

Hmelo-Silver, C.E., 2004. Problem-based learning: What and how do students learn?. Educational psychology review, 16(3), pp.235-266.

James, NP & Dalrymple, RW. 2010. Facies Models 4. Geological Association of Canada. 586 pp.

McGuire, S.Y., 2015. Teach students how to learn: Strategies you can incorporate into any course to improve student metacognition, study skills, and motivation. Stylus Publishing, LLC.

Pattison, P. and Day, R.W.C., 2006. Instructional Skills Workshop (ISW) handbook for participants. In Vancouver, Canada: The Instructional Skills Workshop International Advisory Committee. https://www.algonquincollege.com/profres/files/2013/11/Instructional-Skills-Workshop-ISW-Handbook-for-Participants1.pdf