

# Lecture Design Patterns: Laying the Foundation

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Lectures as method of instruction are conversely discussed in the literature, but despite all critics are lectures still widely used in academic institutions. The efficiency of these lectures is highly dependent on their design. Patterns can help with the design process, but even though quite a lot of educational design patterns have already been published, not many of them address the design of good lectures. All published lecture-relevant patterns focus on some specific aspects of lecture design, but what is missing are the underlying higher level aspects: the basics needed for laying the foundation of good lectures.

In this paper we propose five fundamental lecture design patterns that address these higher level aspects: SUITABLE CONTENT SELECTION, SUITABLE DELIVERY FORM SELECTION, REGULAR ATTENTION RECUPERATION, LECTURE STRUCTURING, and IMAGINATION STIMULATION.

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## 1. INTRODUCTION

Higher education makes use of a variety of instruction methods in order to cater for the different learning styles of students. Educators (and policy makers) in higher education are well aware that active learning, problem-based teaching methods and other inductive methods are effective means to ensure students actively work on and learn about the topic at hand. Although a significant amount of lip service is being paid to active learning, in practice many courses do not take active learning considerations into account.

Lectures are often seen as an activity where students are passive and the teacher is the only active person. With that in mind, it is surprising that lectures are still widely used. In many cases students choose not to attend a lecture, as they do not experience attending the lecture as something of value for their learning. But there also exist lectures which are always crowded and that lead to student and teacher satisfaction afterwards. In these lectures the students seem to see something of value, otherwise they would not attend (the obvious exception being when attendance is required). The question is: what is the difference between successful and less successful lectures? Why are some teachers more successful than others and what are these teachers doing differently? What is the difference between an inspiring lecture and a boring or narcoleptic lecture?

One good way of capturing these differences are educational design patterns. Educational design patterns help with looking at the parts of the lecture design that work well and help with describing them in an extensive format. A lot of educational design patterns have already been published (e.g. in [Larson et al. 2008; Köppe 2011; Schmolitzky

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2007; Anthony 1996; Pedagogical Patterns Editorial Board 2012]), and some of them cover aspects of the design of good lectures. In another paper [Köppe 2013] we collected existing patterns applicable for lecture design and identified categories for these patterns. These categories can be used for supporting pattern selection and also help with structuring the available patterns.

Although many educational design patterns have been published, many of these patterns were not originally (specifically) intended for lectures or are very specific regarding a specific aspect of lectures (e.g. the lecture content). Most patterns share some higher level aspects regarding lecture design. We believe that these aspects are actually elementary educational design patterns, and many of the available patterns relate to them. These relations can be diverse: in some cases the elementary design pattern forms the basis for many of the already described more specific educational design patterns. In other cases some available patterns act as a kind of pre-condition to an elementary design pattern. In addition there are descriptions of patterns that help to implement the elementary design pattern or that support its effectiveness. In this paper, these relations are summarized for each elementary design pattern.

The elementary design patterns we have identified are intended as help for educators who are designing and using lectures as educational method. The patterns have not yet been documented, or at least not specifically for lectures. Defining these patterns will help in different ways: they will serve as starting points for designing good lectures and they help with structuring the existing patterns by providing relations between them. They will also provide a common language for educators to discuss their lecture design with peers in order to improve them.

## 2. DEFINITION OF LECTURE

When discussing lecture design, one issue that pops up is that there is no unambiguous definition of what a lecture actually is. Baumgartner describes a lecture as something where learners take part in the presentation of a speaker (the teacher), where the learners have the role of listeners and/or observers and the teacher presents information — orally and in part supported by media — with the goal that the learners acquire new knowledge [Baumgartner 2011]. Summarized: the students listen and watch and the teacher explains. This is also the picture many educators have of lectures, and if implemented that way — as a one-way stream of information — there is a high chance of failure with this instruction methods. However, Baumgartner arguments that a lecture is more than this and describes it as a work form with the same properties as “Frontalunterricht”. This is best translated as “teacher-centered teaching”, whose main property is that the teacher is in front of a class and the center of attention. In the paper we adopt the same meaning for the term lecture.

“Frontalunterricht” sees the teacher more in the role of a learning facilitator, and not only a content presenter. “Frontalunterricht” also offers more possibilities of interacting with the students and it helps with realizing different functions of education: motivating, transferring knowledge, structuring content, making connections, etc. However, lectures as instruction method are less well suited for teaching students *skills*, as this usually requires the students to execute and practice the skills which is not possible during a classical lecture.

## 3. THE PATTERNS

In this paper we propose five patterns which we consider the most fundamental ones for lecture design. They were extracted from the common aspects of already described patterns that can be used for lecture design, which are inventoried in [Köppe 2013]. Additionally, these patterns are also implicitly mentioned in publications regarding successful lectures, like [Gunderman 2013]. However, there probably are other basic patterns for lecture design. These have to be explored in future work.

The five proposed patterns are:

- SUITABLE CONTENT SELECTION - Ensure that mainly content is selected and delivered that fits lectures as form of content delivery for the learning goals.
- SUITABLE DELIVERY FORM SELECTION - Explore different delivery forms and select the valuable ones for your lecture design so that the students are engaged and that the delivery forms fit the content.

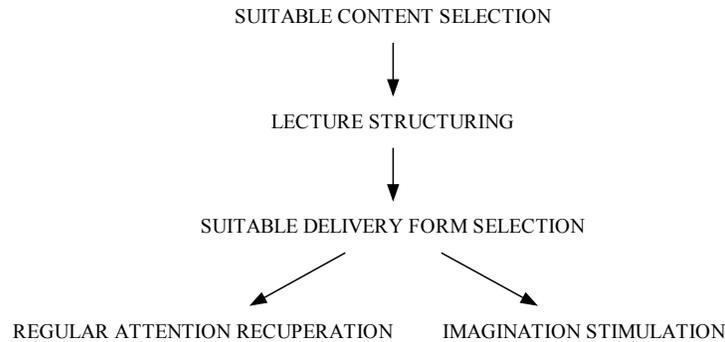


Fig. 1. Refinement relations

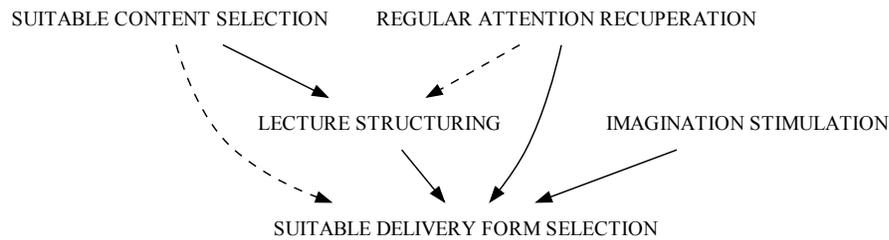


Fig. 2. Influence relations (solid arrows represent main influences; dashed arrows represent secondary influences)

- REGULAR ATTENTION RECUPERATION - Add activities to a lecture and vary in delivery forms to allow students to recuperate their attention.
- LECTURE STRUCTURING - Investigate and design the optimal flow of the contents and delivery forms of a lecture.
- IMAGINATION STIMULATION - Add activities to a lecture and use delivery forms and contents that stimulate the students' imagination.

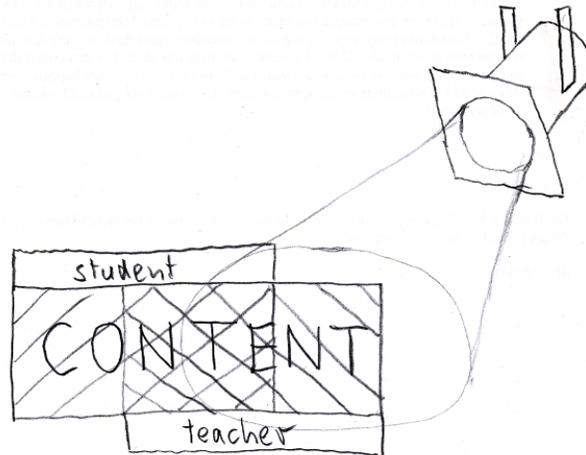
These patterns are related in different ways. Figure 1 shows the refinement relations between these patterns. These refinements also imply the partial order of application of the patterns. This process is iterative, and some pattern applications need to be adjusted based on the influence other pattern applications have on them.

Figure 2 shows which patterns are of influence on which other patterns. This influence means that the results of one pattern application are used during the application of another pattern. Solid arrows indicate direct influences — necessary for the pattern application — and the dotted arrows are mediated influences — affecting, but not determining the pattern application. All relations between patterns are described in more detail in the patterns themselves.

### Pattern Format

The patterns use a version of the Alexandrian pattern format, as described in [Alexander et al. 1977]. The first part of each pattern is a short description of the context, followed by three diamonds. In the second part, the problem (in bold) and the forces are described, followed by another three diamonds. The forces are given short names (in italics) with the intention to make them more easy to identify and remember. The third part offers the solution (again in bold), a discussion of possible implementations, the consequences of the pattern application and a summary of already related patterns (a complete overview of all already described and related patterns can be found in Appendix A; summarized versions of all related patterns can be found in [Köppe 2013]). In the final part we describe an example of the pattern implementation in *italics*.

### 3.1 SUITABLE CONTENT SELECTION



The learning objectives of a course and the content to be covered have been described and you want to — or have to — use lectures as one of the teaching activities.



**Lectures often do not fit the capabilities and interests of students, they are either boring or overwhelming. In both cases students won't remember much after the lecture, therefore it was of no value for them.**

There are three forces that act as follows:

*Information overkill.* Many lecturers think that they have to give all information during their lectures, trying to not miss even the smallest details. This is often the result of the systems approach to teaching: Dividing the complete subject to-be-learned into smaller sub-parts and presenting these piece by piece. However, this approach fails to appreciate that students are able to study detailed pieces of information themselves, if they have been guided through the theory.

*Information underkill.* Presenting content the students already know or taking too much time for presenting a small amount of content leads to bored students.

*Content duplication.* When students know that they can grasp the same content from another source — like the course syllabus or the accompanying book — they are likely to pay less attention to the teacher presenting this same content.



**Therefore: Group the overall content of the course according to following criteria: can be adopted by the students themselves, needs to or could best be presented by a lecturer, or can be accomplished both ways. Select for your lectures mainly the content that needs to or could best be presented by a lecturer and optionally broaden it with content that the students could also, but not mainly, adopt by themselves.**

The first step that needs to be done is to identify the content and to determine whether it is suitable for self-study of the students or if it should be presented by a teacher.

The following checklist helps with identifying the content suitable for self-study:

—A good text book covering the content is available.

—The content belongs to factual knowledge [Anderson and Krathwohl 2001] the students are required to know. However, the students should be pointed to that content in lectures and the reason why they should learn it can/should be communicated in a lecture.

If no text book is available, then you could consider writing a MANUSCRIPT [Fricke and Völter 2000] yourself. To stimulate the acquisition of this knowledge one could apply EXPLORE FOR YOURSELF [Pedagogical Patterns Editorial Board 2012] and have students study a topic on their own and present their findings afterwards.

The following checklist helps with identifying the content not suitable for self-study and therefore could be best covered in a lecture:

- The content covers interrelationships of elements of the conceptual knowledge the students are required to know.
- There are critical parts of the content, like decision points in a process or substantial ideas that form the background of the larger content. These critical parts should be included in the lecture content.
- General feedback on the students' performance. The feedback, even if on single student performances, should always be relevant to the whole class, otherwise it should be given directly to the student outside of the lecture.
- Textbooks often only cover the technical or domain-specific aspects. But the content of a course often has much wider implications in society, economy, or organizations. Especially this WIDER PERSPECTIVE [Pedagogical Patterns Editorial Board 2012] is good content for a lecture.

Examples serve different goals in lectures and are therefore important: they can provide orientation, help with making abstract concepts concrete, or help with showing dependencies between different concepts. Even though the material given to the students for self-study — books, manuscripts, tutorials on websites, etc. — also often contains examples, there is a chance that these examples are somewhat artificial or that they don't match much with what the students need in future assignments or exams and are therefore not very relevant for them. It is therefore important to include examples as lecture content that serve the above mentioned goals. Patterns that help hereby (among others) are ACQUAINTANCE EXAMPLES [Anthony 1996] or RELEVANT EXAMPLES [Fricke and Völter 2000]. The content also forms the basis for LECTURE STRUCTURING.

It is important to relate the new knowledge to already existing knowledge of the students, as described in many existing patterns (e.g. LINKING OLD TO NEW or EXPAND THE KNOWN WORLD, both [Pedagogical Patterns Editorial Board 2012]). However, many textbooks only provide the new knowledge to be covered in a course, and therefore fail to fulfill this important function. This is not surprising as the authors of these textbooks often do not know about the background of the students and their existing knowledge.

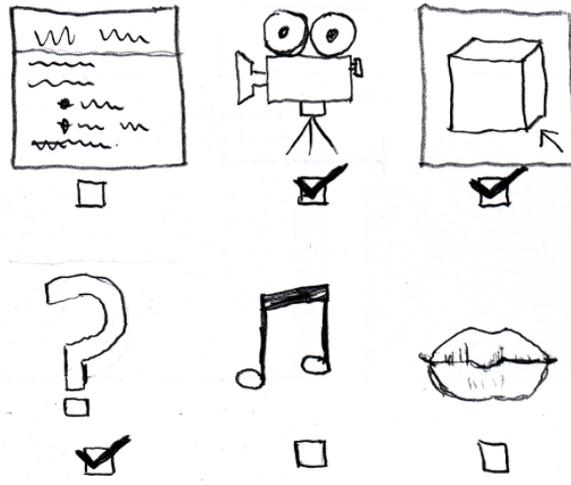
Providing this relation as teacher is therefore suitable for teacher-assisted learning. This means that the lecture content should include some old knowledge, which is related to the new one, and the relations or links between them.

Presenting critical parts in a lecture could be based on EXPOSE THE PROCESS [Pedagogical Patterns Editorial Board 2012], which describes that not only solutions to exercises or examples should be shown, but also the process of getting there (with an emphasis on the critical decision points).

*The main topic of a lecture was performance improvements of a relational database, with the focus on the subtopics searching, joining and indexing. To understand this topic, some reactivation of existing knowledge was required: tables, primary keys, foreign keys, normalization and normal forms, and select-queries including joins between different database tables. This existing knowledge was also explicitly made part of the lecture content, but only at the level of knowing and not at the level of applying. It was also chosen to provide an overview of all the subtopics and making the relations between the existing knowledge and the new topic obvious. For this an analogy as ongoing example was chosen which covered all relevant aspects: a record collection.*

*It was chosen to not include certain content, as this can be acquired or reactivated by the students at the moment when they need to apply it. Examples of this content were: all specific normal forms; how to create tables, primary keys, foreign keys, or other database objects; how to use joins in select queries; etc.*

### 3.2 SUITABLE DELIVERY FORM SELECTION



You have the SUITABLE CONTENT SELECTION for your lectures and are now at the moment of deciding the activities you want to use for presenting this content.



**Lectures in which the content is presented in a flow of speech of the lecturer are a challenge for the students' span of attention. It is also of no value if a lot of information is presented in a way that the students find hard to understand or in a way that does not help them grasping the content.**

*Volatile information.* One does not learn by listening only, learning is much more complex and includes many different activities. Putting all content into a lecturer-led oral presentation, independent of the issue or learning goal, is unlikely to lead to durable knowledge acquisition.

*Delivery form limitation.* Limiting the delivery forms to the usual ones only — slides with text and occasional diagrams — increases the chance that not all students are supported well in their learning according to their learning styles.

*One size does not fit all.* It is hard to find a set of delivery forms that is ideal for teaching to a group of students with heterogeneous learning styles.



**Therefore: Choose delivery forms that explicitly take the content, the students' learning styles, and the general possibilities of lectures into account. Choose them by matching them with the content to be presented and check if they support the educational goals.**

During a lecture, lecturers are not restricted to just orally presenting information. Instead, lectures can be supported by visual displays (slides), photos, videos, music, peer discussions, small exercises, Twitter back-channel discussions, and interactive classroom response systems, amongst others. These alternative delivery forms actively engage students with the content (while at the same time respecting the constraints of the lecture theatre). Insights of Howard Gardner

[Gardner 1983] have learned educators that intelligence is not limited to linguistic intelligence, but that intelligence also includes logical-mathematical, spatial, bodily-kinaesthetic, musical, naturalistic, existential, interpersonal and intrapersonal intelligence. By alternating the form of delivery, more students will be able to easily comprehend the content.

Presentation of content does not need to be restricted to the presentation of the bare facts itself. The purpose of education is not only the transfer of facts, but also setting of goals, activating prior knowledge, structuring the content, giving opportunities to practice with the content, motivating students and managing the learning process. Oral presentations are not the most suitable form for each of these educational goals.

Therefore lectures need to identify which of these different purposes of education can successfully be matched to the content and delivery form of your lecture so that all functions are supported. Sometimes this means that parts from the lecture will need to be excluded that were intended to support educational goals which are better supported by activities other than lectures.

Slides that only contain (lots of) text are not the most ideal delivery form. Students should be exposed to a variety of different delivery forms, which might be supported by the different media you can use, like blackboard, smartboard, slides, films, overhead projector etc. This addresses different senses and also partially supports different learning styles (see DIFFERENT APPROACHES [Pedagogical Patterns Editorial Board 2012]). It is also good to CHANGE MEDIA [Fricke and Völter 2000] regularly so that an optimal mix of delivery forms is reached, which also supports to REGULAR ATTENTION RECUPERATION. Another criterion might also be that specific delivery forms help to EXPAND THE KNOWN WORLD [Pedagogical Patterns Editorial Board 2012] of the students. However, the first step is to select these delivery forms.

The pattern WORK FORMS [Fricke and Völter 2000] is intended for seminars and makes a distinction between presentation style and other work forms where the students are actively involved. In a lecture it is much harder — but possible — to actively involve the students in many different ways. However, the presentation style consists of different forms itself and these forms should be identified and used in an alternating way during a lecture. These forms are also part of a BALANCED CURRICULUM [Olson 2008] and should be included in the SEMINAR PLAN [Fricke and Völter 2000]. The suitable delivery forms are highly dependent on the possibilities regarding the specific circumstances of the lectures to be given, so one should CHECK PREREQUISITES [Fricke and Völter 2000] to make sure that all chosen delivery forms can be used in the lecture.

Few patterns address the issue of engaging students actively in the lecture. Questions asked by the teacher are one such way, as described in CAREFULLY CRAFTED QUESTIONS and SIMPLE ANSWER [Larson et al. 2008]. If the group is not too large, then SIMULATION GAMES [Anthony 1996] or TRY IT YOURSELF [Pedagogical Patterns Editorial Board 2012] are a good way. One can also MAKE IT THEIR PROBLEM [Schmolitzky 2007].

It is more interesting if something happens at the front of the lecture hall instead of only static text and pictures being shown. Demonstrations of tools might help to make some concepts more concrete when you SHOW IT RUNNING or SHOW PROGRAMMING [Schmolitzky 2007]. This also can be used to EXPOSE THE PROCESS [Pedagogical Patterns Editorial Board 2012], which offers the possibility to actively engage students by having them telling you what to do.

*The main topic of a lecture was performance improvements of a relational database. The specific content selected for the lecture was the existing knowledge on basic RDBMS and the new topics: how database searches work, how database joins work and how this knowledge can be combined to optimize the performance of database queries. It was chosen to use a record collection as example.*

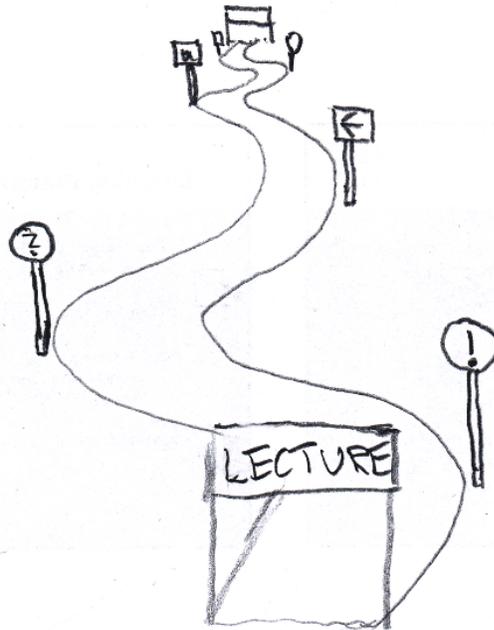
*In order to improve the engagement of the students one of the delivery forms selected for the lecture were photo's of a record collection and piles of records. Right before the beginning of the lecture there was also some music played which the students heard when they entered the room and they saw a picture of a record collection projected on the wall.*

*As part of the content was existing knowledge, it was chosen to reactivate this knowledge by asking questions. As the answers to the questions might be easily overheard and also to make this existing knowledge more explicit and visible to the students, the whiteboard was chosen for collecting the students' answers. This also to make the relations between*

*the answers visually explicit by grouping elements that belong together and making relations explicit through drawing arrows.*

*In order to make some of the improvements more concrete to the students, it was also chosen to use a programming demonstration as delivery form. This allowed to make some of the introduced concepts immediately concrete, but also offered interactivity possibilities by providing a way of answering students' questions regarding some performance issues by demonstrating the effects directly.*

### 3.3 REGULAR ATTENTION RECUPERATION



You have the **SUITABLE CONTENT SELECTION** and are now starting to identify the elements and structure of the specific lectures. You also (partially) have the **SUITABLE DELIVERY FORM SELECTION**.



**Students often find it hard to follow your lecture over a longer period. They fade away in their thoughts or start to do other things. Everything you tell or do at such moments is very likely to be fruitless.**

*Monotonous Voice.* Whatever someone is saying, if it's done with a monotonous voice it is hard for listeners to not fall asleep.

*Attention Span.* People have difficulties with paying attention for longer periods.

*Text Slides.* Many teachers tend to put as much information as possible on the slides, resulting in large amounts of text. Even if people are interested, it is nearly impossible to read the slides and at the same time listen to the teacher.

*Student Passivity.* Students who are not intrinsically motivated to make use of the lecture for their learning are likely to be passive during the lecture. This often results in inattention and being busy with non-lecture activities like surfing the internet or text messaging with their peers.



**Therefore: Include delivery forms and activities in your lecture that help with regaining the attention of the students. Vary in the sorts of activities/delivery forms and involve the students actively in these attention refreshments.**

Attention span has long had the attention of pedagogical researchers. In 1976, Johnstone and Percival noted that the attention span of students dissipates in cycles of 10 to 15 minutes, after which the students let their attention lapse, after which they pick up their attention [Johnstone and Percival 1976]. A recent study by Bruce et al. from 2010 shows that the attention span cycle is closer to five minutes and decreases as a lecture progresses [Bunce et al. 2010]. This time-slot therefore gives a good indication of the maximum duration of a period after which students need an attention refreshment.

Bunce et al. [Bunce et al. 2010] also showed that “student-centered” learning and active-learning methods positively influence the attention span of students. In the study, the two most frequently used active-learning methods were questions and demonstrations. All students in the class answered questions, posed by the lecturer, using a clicker. Bunce et al. discovered that during the student-centered parts of the lecture, fewer attention lapses occurred, when compared to those reported during lecture parts. In addition, the researchers found that there were fewer lapses in attention during lecture parts that followed immediately upon a question or demonstration, when they compared this to the attention during lecture parts prior to the active-learning activities. This finding indicates that active-learning methods have dual benefits: engaging student attention during the parts when the lecturer uses these methods as well as “refreshing” the student’s attention immediately afterwards.

There are many ways of implementing this pattern and it can be combined with many other patterns in order to increase its benefits.

One of the most important aspects for keeping the students’ attention is to make use of DIGESTIBLE PACKETS [Pedagogical Patterns Editorial Board 2012]. These are typically shorter than the attention span. The different packets should comprise DIFFERENT APPROACHES [Pedagogical Patterns Editorial Board 2012] and make use of the SUITABLE DELIVERY FORM SELECTION. It also helps to CHANGE MEDIA [Fricke and Völter 2000] on a regular base.

Making use of some concrete representations of abstract concepts makes it easier for students to follow and therefore helps them to keep attentive (see COLORFUL ANALOGY [Anthony 1996] or CONSISTENT METAPHOR (AKA ANALOGY) [Pedagogical Patterns Editorial Board 2012]). If these analogies are covering multiple concepts, then they could be used multiple times during a lecture and be interwoven in a MODULE’S STORY [Anthony 1996] which also supports IMAGINATION STIMULATION.

Questions are a good way of engaging students actively during lectures. There are two distinguishable applications. The first is asking questions to the students, which encourages them to think about the answer and therefore requires their attention. Patterns that help with this application are CAREFULLY CRAFTED QUESTIONS and SIMPLE ANSWER [Larson et al. 2008]. Important hereby is an UNINTERRUPTED LISTENING [Larson et al. 2008] to show the students that their complete answers are valued and not taken over by the teacher. A PREGNANT PAUSE [Larson et al. 2008] helps if students do not immediately answer a question. The second way of using questions in lectures is to have students asking questions, which implicitly includes that they are actively thinking about the content and therefore attentive. This is difficult to plan in advance or to include in the planning. However, the students should be made aware of that you HONOR QUESTIONS [Pedagogical Patterns Editorial Board 2012].

A monotonous voice and sticking gesture-less to one place in front of the class does not help getting and keeping the attention of the students, so take care of the TEACHER’S LANGUAGE [Pedagogical Patterns Editorial Board 2012]. Show your TEACHER ENTHUSIASM [Olson 2008] and try to keep the MINIMUM DISTANCE [Larson et al. 2008] to the students if possible.

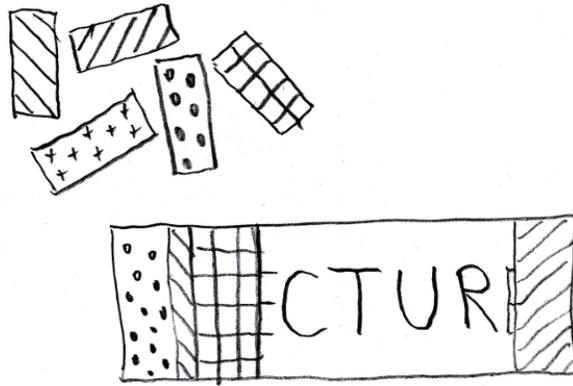
Students tend to be more attentive if something really happens during a lecture instead of only static content being presented. A couple of patterns help with including such a dynamic aspect, e.g. SHOW IT RUNNING [Schmolitzky 2007], SIMULATION GAMES [Anthony 1996], or MAKE THEM MAKE IT THEIR PROBLEM [Schmolitzky 2007].

The need for attention recuperation might become less if special attention is paid to interactivity during lectures. The interactivity patterns proposed in [Köppe and Schalken-Pinkster 2013] help hereby.

*For the lecture on database performance optimization, the suitable content was chosen together with accompanying delivery forms. The content was presented using varying delivery forms, whereby all parts were no longer than 15-20 minutes. In the beginning a photo of a record collection was used to reactivate existing knowledge about database design. This was achieved using questions, which requires the attention of the students. The answers of the students were written down on a whiteboard. Then some slides were used for introducing the concepts of basic performance measurement (as requirement for performance improvement). After this introduction a tool was used for making these concepts concrete. Here again questions — like “what do you think happens when I do this” — were used to actively involve the students and to gain their attention. After sufficient demonstration and explanation of this subtopic a new subtopic was introduced, again using the analogy of records. A photo with two piles of records was shown, and it was asked to the students how they would approach the task of finding all duplicates in these two piles. This led to a discussion — again actively involving the students — and the results were summarized on a whiteboard. This was followed by presentations about different strategies.*

*This way the whole lecture included changes in delivery forms, made reuse of collaboratively gathered knowledge (written down on the whiteboard), and involved the students in different ways. The combination of all these things helped to keep the attention of the students during the whole lecture.*

### 3.4 LECTURE STRUCTURING



You made the *SUITABLE CONTENT SELECTION* and now are looking for ways how to effectively include the content in the lecture to allow the students to comprehend the material.



**Students do not learn much in a lecture if all the content is completely presented, but in isolated and un-ordered pieces.**

*Learning Styles.* Different students have different learning styles. Just presenting the content without taking these differences into account is likely to fail.

*Completeness Compulsion.* Teachers tend to feel the urge of completing everything they consider important into the available time, even though the time is too short.

*Content Dependencies.* Some content is dependent on other content.



**Therefore: Structure the content of a lecture so that it optimally supports students' learning and that all dependencies of content parts are taken into account. Respect different learning styles explicitly and balanced by consciously using and mixing a variety of delivery forms. Focus especially on the beginning and the end of the lecture.**

The lecture structure should help students to see the relation between the points made and to relate the new information to existing knowledge. Some parts of the lecture content are especially suitable for the beginning of a lecture, e.g. reactivating existing knowledge, providing feedback on some exercises, or giving an overview of the lecture. Other parts are better included at the end of a lecture, e.g. a summary of the content or a presentation of assignments where the content of the lecture has to be used.

This pattern is a more concrete variation of *SEMINAR PLAN* [Fricke and Völter 2000]. If you have a plan, then you should also consider to *REFERENCE THE PLAN* [Fricke and Völter 2000] during the lecture. Sometimes some unexpected events might occur — students asking very specific or interesting questions —, then you should consider to *LET THE PLAN GO* [Fricke and Völter 2000] if that is better for students' learning.

Probably the most important thing regarding lecture structuring is the splitting of the lecture content into DIGESTIBLE PACKETS [Pedagogical Patterns Editorial Board 2012]. The goal of this splitting is to increase the learning effect of a lecture and to ensure an appropriate handling of attention loss.

The structure of the lecture in the middle should include enough variety of delivery forms and also be set up in smaller units. This will help to overcome the otherwise unavoidable attention loss. If there are dependencies in the parts of the content — for example if patterns like ABSTRACTION GRAVITY - FROM HIGH TO LOW [Pedagogical Patterns Editorial Board 2012], GENERAL CONCEPTS FIRST [Fricke and Völter 2000], SPIRAL [Pedagogical Patterns Editorial Board 2012], or SEPARATE SIMILAR CONTENT [Fricke and Völter 2000] are applied — then make sure that the structure reflects these dependencies.

Some delivery forms require time which is difficult to estimate, e.g. when using CAREFULLY CRAFTED QUESTIONS [Larson et al. 2008] or STUDENT DRIVEN LECTURE [Pedagogical Patterns Editorial Board 2012]. It can happen that these take much longer than expected, so there should be some BUFFERS [Fricke and Völter 2000] included in the lecture structure in order to being able to handle such situations. If there are long lectures then you might consider to include one or more BREAKS [Fricke and Völter 2000].

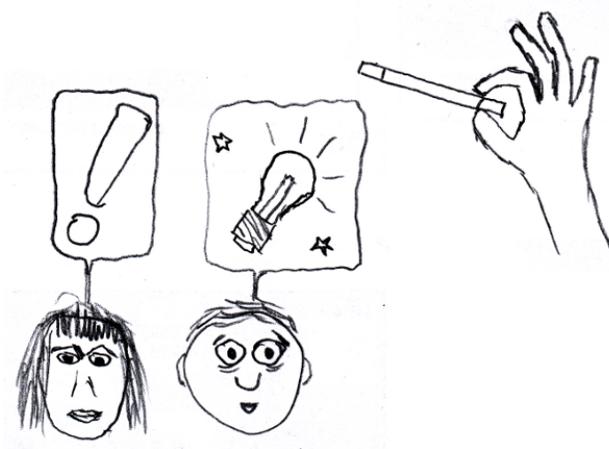
A good beginning of a lecture is to SET THE STAGE [Pedagogical Patterns Editorial Board 2012]. This also fulfills the educational function of providing an overview for the students. Other pattern for beginning lectures are described in [Köppe and Portier 2014].

If you use a MANUSCRIPT [Fricke and Völter 2000] or a textbook, then make sure that is easy to follow for the students where the additional content can be found. Provide pointers to book chapters or manuscript sections. It also could help to harmonize your LECTURE STRUCTURING so that it follows the book or MANUSCRIPT.

*For the lecture on database performance improvement the suitable content and the suitable delivery forms already were selected. The content also contained some existing knowledge to be reactivated, so we put this at the beginning of the lecture. We hereby used an analogy (a record collection) and different delivery forms (photo's, whiteboard, slides). This knowledge reactivation was followed by a presentation of new material. After that we used another photo and a couple of questions for actively involving the students in the lecture. We then again discussed some new concepts, making hereby use of the answers the students gave earlier, and demonstrated these concepts directly using a tool. At the end a summary was given of all discussed topics.*

*In this structure we explicitly decided on a start (reactivating knowledge), a mix of old and new topics, a change of media and delivery forms in order to keep the attention of the students, and a summary at the end.*

### 3.5 IMAGINATION STIMULATION



You have the **SUITABLE CONTENT SELECTION** and distributed the content during **LECTURE STRUCTURING**. You are thinking about how to increase **REGULAR ATTENTION RECUPERATION** and students' learning during the lecture in general.



**Being presented just pure facts and step-by-step instructions is boring for students. Providing the content in a well structured way does not support student learning by itself.**

*Curiosity Death.* Curiosity is a good motivator for learning. Not having the opportunity, or not being encouraged, to think about things in new ways kills this curiosity and therefore hinders learning.

*Unexpected Connections.* There might be some connections between contents of the lecture and the prior knowledge of the students where you as a teacher are not aware of.

*The Unknown Known.* Students often do not know that they already know something about certain concepts. Many concepts can also be found in analogies the students are familiar with, but the students don't know that these are related.

*Delivery Form Monotony.* It is hard to think of things in new ways if they only are presented using one delivery form.



**Therefore: Stimulate the imagination of the students while presenting the content. This can be done using storytelling, music, movies, thought-provoking pictures, or by exposing the students to some unfamiliar situations. By stimulating the imagination of the students, one triggers and keeps the attention of the ones listening and/or following the lecture.**

By stimulating imagination one activates different parts of the brain. Imagination helps with connecting existing knowledge to the newly presented knowledge. Imagination is also a good motivator, as it is a personal experience of a student and related to his or her own context. The content becomes a personal issue this way, which is of more relevance to the students and therefore more motivating to be learned.

A good way of stimulating imagination are thought-provoking questions. These should be CAREFULLY CRAFTED QUESTIONS [Larson et al. 2008], and should increase the effect of this questioning by making a sufficient PREGNANT PAUSE [Larson et al. 2008], which gives the students enough time to think about their answer.

Topics that are presented with a WIDER PERSPECTIVE [Pedagogical Patterns Editorial Board 2012] show the students how certain concepts relate to a bigger picture. Students can use this for thinking about other relations themselves. This can also be supported with LAY OF THE LAND [Pedagogical Patterns Editorial Board 2012].

The old knowledge of the students can be (re)used when looking for links with some new concepts. Leaving enough room for exploration of the new concepts when using the old knowledge as starting point requires the students' imagination. Patterns that help hereby are EXPAND THE KNOWN WORLD [Pedagogical Patterns Editorial Board 2012] or LINKING OLD TO NEW [Pedagogical Patterns Editorial Board 2012].

If some examples are used that are analogies of the concepts to be presented, then probably not all parts of the example are evenly analogous as others. This might also trigger the students' imagination, so take this into account when you select a COLORFUL ANALOGY [Anthony 1996] or a CONSISTENT METAPHOR [Pedagogical Patterns Editorial Board 2012].

Seeing something often triggers questions. You should present things sometimes in a way that makes the students think about what other ways of doing it could be possible. This is a sign of interest, and interest is a great learning motivator. Patterns that help here are SHOW IT RUNNING [Schmolitzky 2007], PHYSICAL ANALOGY [Pedagogical Patterns Editorial Board 2012], or SIMULATION GAMES [Anthony 1996].

*In a lecture on optimizing queries in a database the teacher chose to first show a picture of a record collection. He asked the students about some different searches like finding all records from one artist. He asked the students what other searches one could do, based on how they look for music on their own. The answers by the students included searches for all records from a certain label, all records from certain period, etc. These answers then were used to make the link to the topic of the lecture: how to optimize these searches.*

*After discussing some parts of the main topic the teacher came back to the MODULE'S STORY [Anthony 1996] by showing another picture with two piles of records, both pretended to be bought at a record fair. The question was how to find the identical records of both piles. This re-used the analogy of the record collection and the content of a RDBMS, and brought the students back from the theoretical content to more imaginative one. The answers to the question actually lead to different kinds of query joins.*

*After some concepts of performance measurement had been introduced and some ways of improving the performance, a tool was used to make these concepts concrete. We hereby often asked the students either what they would enter into the tool in order to reach certain goals. The answers were not presented upfront, so the students needed to imagine by themselves what possible answers could be. Additionally, we didn't just answer the questions but executed them in the tool and had the students observe and analyze the results shown on screen. This also stimulated their imagination, as they were not familiar with the concepts.*

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## Appendix A

In this appendix we present all patterns that are related to the five patterns proposed in this paper and how they are related.

### SUITABLE CONTENT SELECTION

Pattern Name and origin	Remarks
BALANCED CURRICULUM [Olson 2008]	Only presenting content in the lecture that is suitable for lectures and using books or manuscripts for the other content is part of a balanced curriculum.
CHECK PREREQUISITES [Fricke and Völter 2000]	Selecting suitable content certainly belongs to the prerequisites of a course.

Table I. : Generalized version or a variant of SUITABLE CONTENT SELECTION

Pattern Name and origin	Remarks
ACQUAINTANCE EXAMPLES [Anthony 1996]	Examples serve different goals in lectures and are therefore important: they can provide orientation, help with making abstract concepts concrete, or help with showing dependencies between different concepts.
COLORFUL ANALOGY [Anthony 1996]	see CONSISTENT METAPHOR.
CONSISTENT METAPHOR (AKA ANALOGY) [Pedagogical Patterns Editorial Board 2012]	Metaphors — or analogies — are helpful with explaining concepts from another point of view, but can also be easily used for repetition. They therefore also are suited for lectures.
EXPAND THE KNOWN WORLD [Pedagogical Patterns Editorial Board 2012]	New content can best be presented if it can be related to the existing knowledge of the students.
FEEDBACK [Pedagogical Patterns Editorial Board 2012], also [Fricke and Völter 2000]	(Formative) feedback can be used to discuss new or already covered content based on results of students' earlier work. It can therefore be used as a form of EXPAND THE KNOWN WORLD.
ITERATIVE COURSE DEVELOPMENT [Anthony 1996]	You should take your experience with earlier version of the course (and the chosen lecture content) into account.
LAY OF THE LAND [Pedagogical Patterns Editorial Board 2012]	As one possible good function of a lecture is to provide an overview over a topic, this overview could be explicitly content in a lecture. LAY OF THE LAND helps with doing so.
LINKING OLD TO NEW [Pedagogical Patterns Editorial Board 2012]	similar to EXPAND THE KNOWN WORLD.
MIX NEW AND OLD [Anthony 1996]	Including some old content in a lecture helps to make the relation between this old knowledge and the new knowledge.
MULTI PRONGED ATTACK [Pedagogical Patterns Editorial Board 2012]	Another pattern on how to look for examples that cover multiple aspects of the lecture topic. As providing connections between topics is one suitable goal for lectures, the content should also include such broader examples.
ONE CONCEPT AND SEVERAL IMPLEMENTATIONS [Pedagogical Patterns Editorial Board 2012]	A pattern about choosing examples in order to support learning of abstract concept. These examples, which cover different implementations of the concept, can be part of the lecture content (or partly in the lecture and partly in the MANUSCRIPT).
PHYSICAL ANALOGY [Pedagogical Patterns Editorial Board 2012]	See CONSISTENT METAPHOR.
PIECE OF MIND [Larson et al. 2008]	A pattern that helps to identify suitable content for the following lecture based on students' feedback.
PITFALL DIAGNOSIS AND PREVENTION [Anthony 1996]	When you know that some of the topics are difficult for the students, probably based on your own observation or diagnosis of earlier versions of the course or lecture, then these should be included in the lecture content. Make sure to SELECT SUITABLE DELIVERY FORM for presenting them.

Continued on next page

**Table II – continued from previous page**

Pattern Name and origin	Remarks
PROBLEM ORIENTATION [Fricke and Völter 2000]	This pattern supports orientation for the students, this is important and suitable content for lectures.
RELEVANT EXAMPLES [Fricke and Völter 2000]	The examples chosen as content for a lecture (actually in general) should ideally be of relevance for the students.
SOLUTION BEFORE ABSTRACTION [Pedagogical Patterns Editorial Board 2012]	Another pattern about choosing appropriate examples, these examples are part of the suitable content.
SUMMARY [Fricke and Völter 2000]	Summaries, including relations to other topics, are content that is well suited for a lecture.
WIDER PERSPECTIVE [Pedagogical Patterns Editorial Board 2012]	This also is content that is suitable for lectures.

Table II. : Helping with implementing SUITABLE CONTENT SELECTION

Pattern Name and origin	Remarks
CAREFULLY CRAFTED QUESTIONS [Larson et al. 2008]	Questions provide a good way of working on content together with the students in an interactive way. But asking too simple questions is boring for the students. At the same time, the questions should contribute to the desired learning of the students, and should therefore be carefully crafted.
MAKE THEM MAKE IT THEIR PROBLEM [Schmolitzky 2007]	This pattern describes a combination of self-study and teacher-assisted learning. The students prepare part of the lecture content and present it to the group. Ideally content that is both suited for self study and for teacher-assisted learning can be used here.
MANUSCRIPT [Fricke and Völter 2000]	Content for self-study or not suitable for lectures can better be put into a MANUSCRIPT. But it also can contain some content also covered in the lecture. It should be complementary to the lectures and the other way around.
MODULE'S STORY [Anthony 1996]	The selected content can form the basis for a MODULE'S STORY.
SEPARATE SIMILAR CONTENT [Fricke and Völter 2000]	The selected content is the input for this pattern.
SET THE STAGE [Pedagogical Patterns Editorial Board 2012]	The selected content is the input for this pattern.

Table III. : Follow-up patterns on SUITABLE CONTENT SELECTION, making use of its results.

## SUITABLE DELIVERY FORM SELECTION

Pattern Name and origin	Remarks
CHECK PREREQUISITES [Fricke and Völter 2000]	Selecting suitable delivery forms certainly belongs to the prerequisites of a course.
SEMINAR PLAN [Fricke and Völter 2000]	Selecting suitable delivery forms is part of a seminar plan.

Table IV. : Generalized version or a variant of SUITABLE DELIVERY FORM SELECTION

Pattern Name and origin	Remarks
ACTIVE STUDENT [Pedagogical Patterns Editorial Board 2012]	The different delivery forms should help with engaging the students actively during a lecture or motivating them to be active with the content after the lecture.
NEW PEDAGOGY FOR NEW PARADIGMS [Pedagogical Patterns Editorial Board 2012]	If this pattern is applied, then suitable delivery forms are needed to support the new pedagogy.

Table V. : SUITABLE DELIVERY FORM SELECTION helps to implement or improve the efficiency of these patterns

Pattern Name and origin	Remarks
CAREFULLY CRAFTED QUESTIONS [Larson et al. 2008]	Whether certain content will be delivered in a presentation or interactively acquired through question-focused education is a decision that has to be made in advance.
COMMENTED ACTION [Köppe and Nijsten 2012]	Although mainly intended for teaching in a foreign language, a commented action is also one of the available delivery forms for certain types of content.
DIFFERENT APPROACHES [Pedagogical Patterns Editorial Board 2012], also [Fricke and Völter 2000]	This pattern describes that <i>in general</i> different approaches should be used to respect different learning styles by addressing various sensory modalities. But one needs to know first which approaches — the delivery forms — are suitable for using it in lectures, and this depends on the content. So there is an interrelation between these two patterns.
EXPAND THE KNOWN WORLD [Pedagogical Patterns Editorial Board 2012]	The delivery forms that were used to present earlier topics can be used again when related content is about to be presented. This supports the students in making the connections between old and new knowledge even more.
EXPOSE THE PROCESS [Pedagogical Patterns Editorial Board 2012]	Demonstrations of how final results are reached are an important delivery form.
FEEDBACK [Pedagogical Patterns Editorial Board 2012], also [Fricke and Völter 2000]	Feedback can also be seen as delivery form, as it helps the students to relate the provided information to their own knowledge and hereby shows different aspects or approaches of a topic.
ITERATIVE COURSE DEVELOPMENT [Anthony 1996]	You should take your experience with earlier version of the course (and the chosen lecture content) into account.
LINKING OLD TO NEW [Pedagogical Patterns Editorial Board 2012]	similar to EXPAND THE KNOWN WORLD.
MAKE IT THEIR PROBLEM [Schmolitzky 2007]	Also a way of delivering the content and keeping the students active thereby.
MAKE THEM MAKE IT THEIR PROBLEM [Schmolitzky 2007]	This pattern involves the students even more by having them preparing a short presentation of a subtopic on their own. This is a very interactive delivery form. One issue is that you as a teacher do not have much control on the quality of the presentation and should therefore be prepared to add missing parts or to place the content in the correct context.
MIX NEW AND OLD [Anthony 1996]	This is also of impact on the delivery forms. Old delivery forms can be used for the old content, which might help students to remember it. But if old content is presented using another delivery form, then this also could have a positive effect on learning.
MODULE'S STORY [Anthony 1996]	Such a story is best implemented if different delivery forms are used that support the story's parts.
PITFALL DIAGNOSIS AND PREVENTION [Anthony 1996]	When you know that some of the topics are difficult for the students and you need to pay extra attention to them during a lecture, then also try to use different delivery forms for presenting them. This might support students with different learning styles.
SEE BEFORE HEAR [Pedagogical Patterns Editorial Board 2012]	This pattern explicitly addresses the question of different complementing delivery forms.
SHOW IT RUNNING [Schmolitzky 2007]	Presenting running software is also a valuable delivery form when teaching software and tools.
SHOW PROGRAMMING [Schmolitzky 2007]	If the topic of the lecture is programming, then showing the programming in a real environment, including running the program and examining error messages, is a valuable and suitable delivery form.

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**Table VI – continued from previous page**

Pattern Name and origin	Remarks
SIMPLE ANSWER [Larson et al. 2008]	Asking questions is surely a valuable delivery form for reactivating already covered knowledge.
SIMULATION GAMES [Anthony 1996]	Only applicable in small groups, but a valuable delivery form.
TAKE A RISK [Pedagogical Patterns Editorial Board 2012]	In some cases it could be interesting to try out unusual delivery forms, e.g. using social media, playing cards, children's books etc.
TRY IT YOURSELF [Pedagogical Patterns Editorial Board 2012]	Only applicable in small groups, but a valuable delivery form.
USE PARTICIPANTS' MEDIA [Fricke and Völter 2000]	This could be of influence on the selected delivery forms.

Table VI. : Patterns that help with implementing SUITABLE DELIVERY FORM SELECTION

Pattern Name and origin	Remarks
CHANGE MEDIA [Fricke and Völter 2000]	This pattern already suggests that there should be different media used for presenting the content. These media are part of the delivery form selection.
MANUSCRIPT [Fricke and Völter 2000]	The selected delivery forms in the lecture should be supported and/or complemented by the manuscript.
MULTI PRONGED ATTACK [Pedagogical Patterns Editorial Board 2012]	Coming back to the same example regularly to discuss other ideas or topics helps to regain the attention of the students.
ONE CONCEPT AND SEVERAL IMPLEMENTATIONS [Pedagogical Patterns Editorial Board 2012]	The several implementations of the concept also could be presented using different delivery forms.
PREPARE EQUIPMENT [Fricke and Völter 2000]	If you select different delivery forms, then you should make sure that you also can use in the environment where the lecture is given. If you e.g. use movies, then make sure that the computer can play them and that you have speakers that are loud enough for the whole group.

Table VII. : Follow-up patterns on SUITABLE DELIVERY FORM SELECTION, making use of its results.

## REGULAR ATTENTION RECUPERATION

Pattern Name and origin	Remarks
ACTIVE STUDENT [Pedagogical Patterns Editorial Board 2012]	Having the attention of the students and regaining it regularly means that they are actively involved participants in the lecture.

Table VIII. : REGULAR ATTENTION RECUPERATION helps to implement or improve the efficiency of these patterns

Pattern Name and origin	Remarks
CAREFULLY CRAFTED QUESTIONS [Larson et al. 2008]	Asking questions certainly triggers the attention of the students, so it should be included in regular intervals.
CHANGE MEDIA [Fricke and Völter 2000]	One of the goals of alternating between different media is to keep the attention of the students.

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Table IX – continued from previous page

Pattern Name and origin	Remarks
COLORFUL ANALOGY [Anthony 1996]	If an analogy is used for presenting the content, then it also can be used to go back to during the lecture. As the students are familiar with the analogy, it is easy for them to relate to it and therefore to pay attention.
CONSISTENT METAPHOR (AKA ANALOGY) [Pedagogical Patterns Editorial Board 2012]	see COLORFUL ANALOGY.
DIFFERENT APPROACHES [Pedagogical Patterns Editorial Board 2012], also [Fricke and Völter 2000]	Using different approaches is a good way of keeping or reactivating students' attention.
DIGESTIBLE PACKETS [Pedagogical Patterns Editorial Board 2012], also [Fricke and Völter 2000]	One of the reasons for attention loss is that the time that a topic is covered is too long. So one of the important aspects of regaining or keeping attention is to make subparts — the digestible packets — of the lecture fit into the attention span.
EXPAND THE KNOWN WORLD [Pedagogical Patterns Editorial Board 2012]	Something well known to the students can help to gain their attention, so this pattern can be used for this.
FEEDBACK [Pedagogical Patterns Editorial Board 2012], also [Fricke and Völter 2000]	Feedback that is relevant for the whole group (and not only for some people) makes it easy to gain attention, as the students can relate it to their own experience and knowledge. The feedback should be of value for the students. Only saying what most people did wrong in an exercise does not help the students, but showing a way how most students would successfully have finished the exercise and that can be applied by them the next time is certainly of value.
GENERAL CONCEPTS FIRST [Fricke and Völter 2000]	Teaching concepts at different levels and going back to more general concepts helps to gain the attention of the students, as they are likely familiar with the general concept and have less difficulties to follow the new content (without being too easy for them).
HONOR QUESTIONS [Pedagogical Patterns Editorial Board 2012], also [Fricke and Völter 2000]	Students who're asking questions are likely to have paid attention before. So if you stimulate and honor that students ask questions (because your answers are of value for them), they might be more attentive during the lecture.
LET THE PLAN GO [Fricke and Völter 2000]	If you have the attention of the students because of an interesting discussion or sidestep, then prefer to keep this attention instead of sticking to the lecture plan.
MAKE THEM MAKE IT THEIR PROBLEM [Schmolitzky 2007]	If students present a topic by themselves, then one effect can be that they get more attention from their peers as you would. But this is often not the case if the presentation is boring or there are a lot of these presentations. But switching between different presenters (students and you) helps with gaining attention.
MINIMUM DISTANCE [Larson et al. 2008]	Standing in front of the group at the same spot for a whole lecture makes it difficult to keep the attention, as mainly your aural senses are triggered. Moving around means changing the position in the class and the distance to the students. This triggers also the figurative senses and the body senses, which is likely to improve the attention.
MIX NEW AND OLD [Anthony 1996]	Going back to old knowledge makes it easier for students to follow, and therefore helps them to stay attentive.
MODULE'S STORY [Anthony 1996]	A good pattern for keeping the attention. At regular moments you come back to the main story of the lecture, and by doing this there is a high chance to keep the attention of the students.
ONE CONCEPT AND SEVERAL IMPLEMENTATIONS [Pedagogical Patterns Editorial Board 2012]	As all implementation examples might be presented as DIGESTIBLE PACKET, the change of example might regain or keep the attention of the students.
OPEN ENDED QUESTIONS [Larson et al. 2008]	Asking questions to students always encourages them to be active, and this requires their attention.
PHYSICAL ANALOGY [Pedagogical Patterns Editorial Board 2012]	See COLORFUL ANALOGY.

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**Table IX – continued from previous page**

Pattern Name and origin	Remarks
PREGNANT PAUSE [Larson et al. 2008]	One thing many lecturers do is to ask a question and after waiting a short time answer it themselves. If the students know that they actually are not required to answer then they likely won't pay much attention when questions are asked. This problem can be weakened with a PREGNANT PAUSE, which therefore also supports regaining or keeping the attention.
SEE BEFORE HEAR [Pedagogical Patterns Editorial Board 2012]	Looking at something requires more attention than just listening, so this pattern also can be used to regain attention.
SHOW IT RUNNING [Schmolitzky 2007]	This will help getting the attention of the students, as it is likely something they have to do themselves later on. It should be used at appropriate moments during the lecture.
SHOW PROGRAMMING [Schmolitzky 2007]	If things are happening at the projection — new code is created, a program is run, error messages pop up, etc. — then this will increase the attention of the students. This is even more when they are expected to execute some similar actions later on.
SIMPLE ANSWER [Larson et al. 2008]	see CAREFULLY CRAFTED QUESTIONS. Knowing simple answers also helps to build self-confidence in the students.
SIMULATION GAMES [Anthony 1996]	Nearly all kinds of interaction get the attention of the students, so simulation games are another way of doing it.
SUMMARY [Fricke and Völter 2000]	Summaries are usually given at the end of a lecture or at the end of a coherent part of the lecture. They are mostly important for students, as they help them to get an overview of the content and they might be relevant for exams. Because they are likely of value for the students, they might gain higher attention and therefore should be included.
TAKE A RISK [Pedagogical Patterns Editorial Board 2012]	Trying something out that is new for the students might help to get a higher attention.
TEACHER ENTHUSIASM [Olson 2008]	Experiencing someone who is enthusiastic about a topic and about teaching often triggers the attention of the students.
TEACHER'S LANGUAGE [Pedagogical Patterns Editorial Board 2012], also [Fricke and Völter 2000]	This is important for keeping the attention of the students. No one is able to listen to a monotonous voice over a longer period.
THINK..PAIR..SHARE [Larson et al. 2008]	An interactivity pattern, that helps with gaining the attention of the students.
TRY IT YOURSELF [Pedagogical Patterns Editorial Board 2012]	Another interactivity pattern, that helps with gaining the attention of the students.
UNINTERRUPTED LISTENING [Larson et al. 2008]	This is important for keeping the attention when using questions. If there is no room given to the students for giving their own answers, e.g. because the teacher mainly asks them by herself or interrupts the students when answering, then they will recognize that it's of no value for them to react on the teachers' questions and therefore won't pay attention anymore when questions are asked.

Table IX. : Patterns that help with implementing REGULAR ATTENTION RECUPERATION

## LECTURE STRUCTURING

Pattern Name and origin	Remarks
SEMINAR PLAN [Fricke and Völter 2000]	Defining the structure of the lectures is part of the SEMINAR PLAN.

Table X. : Patterns that are a more generalized version or a variant of LECTURE STRUCTURING

Pattern Name and origin	Remarks
CAREFULLY CRAFTED QUESTIONS [Larson et al. 2008]	If questions are used as delivery form, then the structure of the lecture should be adopted so that enough time is available (BUFFERS), but also that the answers to the questions can efficiently be used for acquiring new content, e.g. by writing them down on a whiteboard or summarizing them in already created slides.
DIFFERENT APPROACHES [Pedagogical Patterns Editorial Board 2012], also [Fricke and Völter 2000]	Similar to CHANGE MEDIA, the different approaches should be respected in the lecture structure.
EARLY BIRD [Pedagogical Patterns Editorial Board 2012]	A more high level pattern for structuring the content spanning multiple lectures.
EXPOSE THE PROCESS [Pedagogical Patterns Editorial Board 2012]	If it is chosen to also exposing the process as one delivery form, then there also should be some additional BUFFERS for having enough time.
FEEDBACK [Pedagogical Patterns Editorial Board 2012], also [Fricke and Völter 2000]	If feedback becomes part of a lecture, then this should be given as close as possible to the moment when they can make use the information. If the information, given in the feedback, is essential for the next topics which are covered in the lecture, then the feedback should be given in the beginning. If it is important for making another assignment after the lecture, then it preferably should be given at the end of the lecture.
HONOR QUESTIONS [Pedagogical Patterns Editorial Board 2012], also [Fricke and Völter 2000]	If you honor questions (which you should), then make sure that you have enough BUFFERS included for them in the lecture structuring.
LAY OF THE LAND [Pedagogical Patterns Editorial Board 2012]	It helps students to provide an overview of what they can expect in a course as whole (presented in the first lecture).
LINKING OLD TO NEW [Pedagogical Patterns Editorial Board 2012]	This requires first a repetition or remembering of the old knowledge, which is of influence on the lecture structure.
MAKE IT THEIR PROBLEM [Schmolitzky 2007]	If applied, it is of influence on the lecture structure and should therefore be taken into account when structuring the lecture.
MAKE THEM MAKE IT THEIR PROBLEM [Schmolitzky 2007]	This requires enough time and also probably some BUFFERS.
MANUSCRIPT [Fricke and Völter 2000]	The structure of the lectures and the structure of the manuscript are ideally complementing. So if you already have a manuscript, then this could be a good starting point for structuring a lecture (or the other way around).
MIX NEW AND OLD [Anthony 1996]	This should be reflected in the lecture structure.
MODULE'S STORY [Anthony 1996]	Such a story is one good way of structuring a lecture.
MULTI PRONGED ATTACK [Pedagogical Patterns Editorial Board 2012]	Making use of a multi-topic example as proposed in MULTI PRONGED ATTACK is of impact on the lecture structure. The example should be introduced early, and regularly referenced later on during the lecture.
NAME IS LAST [Fricke and Völter 2000]	Applying this pattern if of impact on the lecture structure.
NEW PEDAGOGY FOR NEW PARADIGMS [Pedagogical Patterns Editorial Board 2012]	Different pedagogies require different structures in lectures.
ONE CONCEPT AND SEVERAL IMPLEMENTATIONS [Pedagogical Patterns Editorial Board 2012]	Applying this pattern is of impact on the lecture structure.
OPEN ENDED QUESTIONS [Larson et al. 2008]	If open ended questions are used, make sure that you include enough BUFFERS in the lecture structure.
PIECE OF MIND [Larson et al. 2008]	This pattern should be applied at the end of a lecture.
PROBLEM ORIENTATION [Fricke and Völter 2000]	If this pattern is applied, then the lecture structure should reflect this.
SHOW PROGRAMMING [Schmolitzky 2007]	If this is used in a lecture, then the structure should include some BUFFERS so that unexpected questions or error messages can be handled.
SIMPLE ANSWER [Larson et al. 2008]	Questions can be used to vary from delivery forms and to keep the attention of the students. This should be explicitly included in the lecture structure.
SIMULATION GAMES [Anthony 1996]	If this delivery form is chosen, then the lecture structure should include enough time for this.

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**Table XI – continued from previous page**

Pattern Name and origin	Remarks
STUDENT DRIVEN LECTURE [Pedagogical Patterns Editorial Board 2012]	If this pattern is applied, then it should be in the beginning of a lecture.
SUMMARY [Fricke and Völter 2000]	Summaries are usually given at the end of a lecture which should be reflected in the lecture structure.
TAKE A RISK [Pedagogical Patterns Editorial Board 2012]	If you decide to take a risk and try something new, then it's in some cases hard to judge how long that will take. It's also possible that the new approach is not working and you need to go back to the old one. The lecture structure should provide this flexibility.
THINK..PAIR..SHARE [Larson et al. 2008]	Applying this pattern requires a sufficient time slot in the lecture structure.

Table XI. : Patterns that, when chosen for their application as delivery form, are of impact on the LECTURE STRUCTURING, most often because they require some time or a special moment in the lecture.

Pattern Name and origin	Remarks
ABSTRACTION GRAVITY AND FROM HIGH TO LOW [Pedagogical Patterns Editorial Board 2012]	Applicable if a concept must be understood at different abstraction levels. The high abstraction should be covered first in a lecture (or lecture series).
ACTIVE STUDENT [Pedagogical Patterns Editorial Board 2012]	A lecture should be structured in a way that offers enough opportunities for students to be actively engaged.
BREAKS [Fricke and Völter 2000]	In lectures that last long (more than one hour) the attention span decreases towards the end of the lecture, so it becomes even harder to REGAIN ATTENTION REGULARLY. A (not too long) break could help to freshen the minds of the students and to increase the attention span again. It therefore is a valid possible element in a lecture structure.
BUFFERS [Fricke and Völter 2000]	If you plan your lecture too tightly, then you won't be able to flexibly react on probably important questions, additional examples or relevant sidesteps. Buffers should be added so that you have time for these important activities.
CHANGE MEDIA [Fricke and Völter 2000]	The content of a lecture might be presented using different media, the lecture structure should include regular changes of these.
DIGESTIBLE PACKETS [Pedagogical Patterns Editorial Board 2012], also [Fricke and Völter 2000]	This should be respected when structuring lectures, as it helps to REGAIN ATTENTION REGULARLY. It works good together with DIFFERENT APPROACHES or CHANGE MEDIA.
GENERAL CONCEPTS FIRST [Fricke and Völter 2000]	A good help when structuring a lecture.
ITERATIVE COURSE DEVELOPMENT [Anthony 1996]	You should take your experience with earlier version of the course (and the chosen lecture content) into account.
REFERENCE THE PLAN [Fricke and Völter 2000]	In many cases the lecture structure should also be known to the students in order to provide some guidance. At many moments there should be a reference to that structure (or plan) so that the students are aware of where they are content-wise. The lecture structure is input for this pattern.
REPEAT YOURSELF [Pedagogical Patterns Editorial Board 2012], also [Fricke and Völter 2000]	Repetitions of important topics are part of the lecture structure.
SEPARATE SIMILAR CONTENT [Fricke and Völter 2000]	A question of lecture structuring.
SET THE STAGE [Pedagogical Patterns Editorial Board 2012]	This should be applied at the beginning of a lecture.
SEVEN PARTS [Anthony 1996]	Related to structuring a lecture, but there is not much evidence that this really works. No known uses.

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**Table XII – continued from previous page**

Pattern Name and origin	Remarks
SPIRAL [Pedagogical Patterns Editorial Board 2012]	A pattern that helps with structuring a lecture or a series of lectures.

Table XII. : Patterns that help with implementing LECTURE STRUCTURING.

Pattern Name and origin	Remarks
MANUSCRIPT [Fricke and Völter 2000]	A manuscript could also be influenced by the lecture structure, if this is determined before. Ideally they are complementing in structure.
LET THE PLAN GO [Fricke and Völter 2000]	Even though a good structure for a lecture is essential, it shouldn't be seen as a law to follow. In the end, the lecture should support the learning of the students, and if that means that you better could do something else than following the plan: do it!

Table XIII. : Patterns that make use of the result of implementing LECTURE STRUCTURING, they are follow-ups on this pattern.

## IMAGINATION STIMULATION

Pattern Name and origin	Remarks
DIFFERENT APPROACHES [Pedagogical Patterns Editorial Board 2012], also [Fricke and Völter 2000]	To stimulate imagination is one of the possible approaches.
NEW PEDAGOGY FOR NEW PARADIGMS [Pedagogical Patterns Editorial Board 2012]	To stimulate the imagination could be one reason for choosing another pedagogy.

Table XIV. : IMAGINATION STIMULATION helps to implement or improve the efficiency of the following patterns.

Pattern Name and origin	Remarks
CAREFULLY CRAFTED QUESTIONS [Larson et al. 2008]	Good questions can be used for motivating students to think about things in a different way and therefore to stimulate their imagination.
COLORFUL ANALOGY [Anthony 1996]	Analogies provide a good way of presenting concepts in different ways and to stimulate the imagination of the students.
CONSISTENT METAPHOR (AKA ANALOGY) [Pedagogical Patterns Editorial Board 2012]	see COLORFUL ANALOGY.
EXPAND THE KNOWN WORLD [Pedagogical Patterns Editorial Board 2012]	Showing or presenting something that the students already know, and using this as starting point for exploring new topics and content might help to stimulate the imagination of the students.
EXPOSE THE PROCESS [Pedagogical Patterns Editorial Board 2012]	Showing the process offers opportunities for side-steps and alternatives. By exposing these to the students they can imagine other possibilities.
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Table XV – continued from previous page

Pattern Name and origin	Remarks
FEEDBACK [Pedagogical Patterns Editorial Board 2012], also [Fricke and Völter 2000]	If different student solutions are used for giving feedback instead of one teacher-defined solution, then the students are exposed to a variety of possible ways of solving a problem. This might help with stimulating their imagination in the sense that there often is not only one possible good solution.
LAY OF THE LAND [Pedagogical Patterns Editorial Board 2012]	Presenting an example in the beginning of a course or lecture that covers all major topics might help students to get a feeling of the bigger picture. As this feeling is fuzzy (they don't know the details yet, as these are covered during the course), their imagination is stimulated to fill in the details by themselves.
LINKING OLD TO NEW [Pedagogical Patterns Editorial Board 2012]	similar to EXPAND THE KNOWN WORLD.
MAKE IT THEIR PROBLEM [Schmolitzky 2007]	This puts some necessity of being creative on the students, and therefore helps to stimulate their imagination.
MAKE THEM MAKE IT THEIR PROBLEM [Schmolitzky 2007]	If the way the students have to present their problem and solution is not fixed, then will need their imagination for determining how to best present the content. This can lead to some unexpected, but also interesting presentations. It can motivating for students to have a certain degree of freedom regarding the presentation style.
MIX NEW AND OLD [Anthony 1996]	Old knowledge can be used to stimulate the imaginative thinking of the students by making them looking for ways of using this knowledge to discover new content.
MODULE'S STORY [Anthony 1996]	If the module's story has some properties of a real story, like characters, problems, conflicts etc., then also the imagination of the students might be triggered.
MULTI PRONGED ATTACK [Pedagogical Patterns Editorial Board 2012]	Examples that cover many topics or ideas show the students what can be done with combinations of all the single topics covered in a lecture. They hereby help with stimulating the imagination of the students.
NAME IS LAST [Fricke and Völter 2000]	Not giving some topic or concept a name in advance might require the students to think about it how to name it themselves, which requires their imagination.
ONE CONCEPT AND SEVERAL IMPLEMENTATIONS [Pedagogical Patterns Editorial Board 2012]	This pattern can also be used for stimulating imagination, as it contains some search for the essence — the concept — done by the students.
OPEN ENDED QUESTIONS [Larson et al. 2008]	These are a very good way of stimulating the imagination of the students.
PHYSICAL ANALOGY [Pedagogical Patterns Editorial Board 2012]	See COLORFUL ANALOGY.
PREGNANT PAUSE [Larson et al. 2008]	Asking questions and giving students enough time to think about an answer is likely to stimulate imagination in a better way than answering the question yourself if no student immediately comes up with an answer.
PROBLEM ORIENTATION [Fricke and Völter 2000]	Using a problem as starting point can trigger the imagination of the students (how to solve this problem?).
RELEVANT EXAMPLES [Fricke and Völter 2000]	If the chosen examples are relevant for the students, then they can make the connection to their own experience much easier and it also helps them to see the value and importance of the content better.
SEE BEFORE HEAR [Pedagogical Patterns Editorial Board 2012]	This could help to stimulate imagination, if the shown examples trigger questions like "How can I do that myself?" or "Why does this work well?".
SHOW IT RUNNING [Schmolitzky 2007]	Most often the tools, or the parts of the tool shown, are not ones the students are already familiar with. Therefore it helps them to get an idea of what can be done with the tool and how it can be used, which stimulates their imagination.
SHOW PROGRAMMING [Schmolitzky 2007]	Showing a subset of how an IDE can be used for programming gives the students an idea about other possibilities. They might come up with questions based on some imaginations.
SIMULATION GAMES [Anthony 1996]	Doing something physically or simulating some complex activity helps the students to imagine what the complex concept is about.
SOLUTION BEFORE ABSTRACTION [Pedagogical Patterns Editorial Board 2012]	Presenting problems first when introducing a new topic stimulates the imagination of the students (how can we solve the problem) and is therefore a good motivator.

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**Table XV – continued from previous page**

Pattern Name and origin	Remarks
TAKE A RISK [Pedagogical Patterns Editorial Board 2012]	Some new pedagogical approaches can be especially helpful with stimulating imagination.
TEACHER ENTHUSIASM [Olson 2008]	Teachers who are enthusiastic about the topic and can provide examples of their own experience seem to be good motivators for the students. They trigger them to think themselves about possibilities and show them that the topic is interesting and fun.
WIDER PERSPECTIVE [Pedagogical Patterns Editorial Board 2012]	Placing a topic in a broader context shows the students a part of the bigger picture and stimulates them to think further.

Table XV. : Patterns that help with implementing IMAGINATION STIMULATION.