

From specific-to-general at university courses: Reinforcing and connecting the dots to see the bigger picture

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Introduction

Our brains are programmed to forget. Forgetting helps to reduce outdated information, preventing overfitting and promoting generalization (Richards & Frankland, 2017). Both forgetting and remembering occur simultaneously in order to facilitate learning. However, for a number of students at the University, retaining specific concepts of the curriculum might be a challenge. For others, the burden might be on the generalization across concepts.

Dealing with that specific-to-general tradeoff is particularly challenging in sequential courses, as they build knowledge upon previous knowledge. Pedagogic activities aim to consolidate the nodes of information in a logical order. Teachers, as knowledge facilitators, deliver specific instances during lectures and exercises that are partially stored across student's neural networks. Without reinforcements, synaptic connections are likely to be pruned (Murre & Dros, 2015). What was taught at the beginning might be forgotten at the end of the course, breaking the links of interconnected dots and thus risking the visualization and understanding of the bigger picture.

During examinations, teachers and external examiners ask from specific-to-general questions and vice versa, testing for the full understanding on the subject. In our course, every year a number of students do not reach a good performance during the examination, failing to retrieve specific and/or general learning outcomes from the curriculum.

In order to improve student learning and exam performance, a number of strategies have been proved to facilitate reinforcement and thus retention of information, including:

- **Peer learning:** The use of learning strategies in which students learn from each other increases retention and promotes active learning (Boud et al., 1999)
- **Repetition and spacing effect:** Having reinforcements, spaced out over time, generally leads to superior learning than having the reinforcement immediately after information acquisition (Kang, 2016)
- **Self-evaluations and testing:** Practicing the retrieval of something learned (e.g. by using quizzes) is likely to boost learning (Anderson et al., 2013; Benjamin & Pashler, 2015)
- **Visualization of concepts:** Linking concepts to an image or diagram facilitates a deeper understanding on the matter, regardless of the structure-building ability of the person (Bui & McDaniel, 2015; Glensberg & Langston, 1992)
- **Immediate feedback:** For students, being able to know the right answer immediately when doubts arise, improves learning (Kehrer et al., 2013)
- **Class discussions:** Conversations and debates among students –with or without teacher participation– improve student learning (Hollander, 2002)
- **Formative assessment:** Gathering immediate data and information during lectures leads to informed teacher decisions, who can adapt their instructions in order to meet students' needs and advancing their learning (Trumbull & Lash, 2013)
- **Others:** Problem-based learning, changing learning environments (e.g. teaching and learning outside) or using analogies and metaphors among others, might improve learning (Biggs & Tang, 2011)

The aim of this study was to design, implement and assess activities –combining the strategies mentioned above– in order to improve learning across scales –from specific to general content knowledge– and thus exam performance.

Methodology

The course: Environmental Impact Assessment

In spring 2019, I taught the course Environmental Impact Assessment at the Faculty of Science, University of Copenhagen (LNAK10010U). Every year, the course is eligible for six different MSc Programs, indicating its interdisciplinary nature. Its objective is to introduce the components and the structure of an Environmental Impact Assessment (EIA) –a tool developed to minimize negative social and environmental impacts of human activities– as well as discuss how national guidelines and requirements for EIAs influence the outcome. The course includes a comprehensive overview and thorough knowledge of EIA procedures and methodologies. The course follows the steps or stages of an EIA process. These are sequential, taught in lectures and exercises, one after the other, building the knowledge to understand a whole-EIA process. The steps are the following: (1) Initial work; (2) Screening; (3) Scoping; (4) Assessing; (5) Mitigation and impact management; (6) Reporting; (7) Reviewing; (8) Decision making; and (9) Monitoring/implementing/auditing.

As a result of more than 20 years of iterations on the course –aiming for a constructive alignment (Biggs & Tang, 2011)– the course curriculum is well lined up with lectures, exercises and assessments. Lectures include a combination of teaching followed by case studies, role games, group work and individual preparation. The assessment consists out of written mandatory group reports (40%) and a 20 minute individual oral exam (60%). For the current edition, I designed, implemented and assessed two pedagogic activities –a poster session and a quiz session– which together include the strategies mentioned in the introduction (peer learning, repetition and space effect, self-evaluations, visualization of concepts, immediate feedback, class discussions and formative assessments among others), aiming to improve students' learning and exam performance.

Poster session

Inspired by Scientific Conferences, the poster session aimed to reinforce all the stages –and interactions among stages– of the EIA process. I hypothesized that activity would help the students to acquire the general, bigger picture of the whole-EIA process. The session took place after all the course lectures. Students, in groups of 4, had 45 min to prepare and summarize

–visually when possible– one of the eight EIA stages. A poster template was provided to the groups and the steps were previously assigned during the instructions (Appendix A). Furthermore, the group had to write two single-choice questions on their EIA stage for the quiz session. When all the posters were ready, we had a poster session outdoors where each of the groups delivered a 3 min presentation of their poster. The poster presentation was followed by 2 min of questions from the other groups (figure 1). All posters were uploaded afterwards to the course platform.



Figure 1. On the left, a group of students working in their poster. On the right, a group presenting their poster.

Quiz session

The quiz session, as the last activity of the course, aimed to promote student self-evaluation and formative assessment on specific content before examination. I hypothesized that students would be able to identify their weaknesses and clear doubts before the exam preparation. The quiz was built and implemented using Socrative, a licensed electronic voting system (EVS), which can be accessed from smartphones and computers. The quiz consisted in 10 single-choice questions –some of them selected from the ones that the groups wrote during the poster session– and 10 open questions designed to promote discussion (see Appendix B). Discussions followed the questions when there was no agreement among students on the right answer. Teaching was implemented when there was a need for clarification

or a lack of consensus. Corrections on the student's submitted answers was uploaded to the course platform after the session.

Assessment of the sessions

Using Google Forms, I distributed an online questionnaire among the students. The questionnaire consisted of 10 questions, five similar questions for each session.

Two of them gathered the student feedback on the sessions' appropriateness for providing the general overview on the EIA process and identifying weaknesses in their understanding, by answering within a rating scale from [(1) strongly disagree; (2) disagree; (3) neither agree nor disagree; (4) agree; to (5) strongly agree].

- *Did the poster/quiz session help you to get a good overview of the EIA process?*
- *Did the poster/quiz session help you to identify weaknesses in your understanding of the whole-EIA process?*

The third question aimed to assess the success of the sessions on the clarification of doubts, by answering [yes/no/or other answer question].

- *Did you clear your doubts (if any) during the session?*

Last, two open questions assessed the learning outcomes behind the sessions and what could be improved for coming years.

- *What was the most useful thing from the poster/quiz session?*
- *What could be improved in the poster/quiz session from a learning perspective?*

Besides the questionnaire, the oral examination was also indicative of students' performance.

Results, discussion and reflections

Poster session

The poster session reinforced the general knowledge content of the course, by providing a visual summary and linking all steps of the EIA process.

Twelve students gave feedback on the exercise (figure 2). Although some of them mentioned that they were representing their whole group, they were counted as individuals. In the scale from 1 (Strongly disagree) to 5 (Strongly agree), 83% of the students acknowledged the poster session enabled a good overview of the EIA process (scores of 4 and 5). As an activity to identify weaknesses in their understanding, only 50% found the poster session helpful, 33% did not agree or disagree, and 16% did not find it helpful. However, most of the students (91%) considered that the poster exercise cleared their doubts.

When the students were asked the open question *what was the most useful thing from the poster exercise*, most of them referred to the clear overview on the whole process (figure 3). The exercise provided a visualization and an explanation of each of the eight steps of the EIA process in one session, refreshing and reinforcing what was learnt during the course. Other answers pointed at peer learning directly and indirectly, recognizing the benefits not only of learning from other students, but also the active learning by being part of the poster design and explanations (Boud et al., 1999). Some others appreciated the possibility of asking questions and receive immediate feedback on their doubts, during the two minutes reserved for questions. Immediacy is likely to improve learning when compared to other delayed forms of feedback (Kehrer et al., 2013). These were some of the student reflections related to the strategies for improving learning, that the poster session succeeded to bring together.

Among other benefits, designing the posters provided an opportunity to visually, summarize content. Though some groups might be more creative than others in their diagrams, the sole exercise of summarizing one of the components of an EIA in a limited space already provided a learning outcome. During the 3 min presentation, students had to organize ideas and generalize them in order to explain the key points of their EIA process. Furthermore, the whole exercise served as a formative assessment, identifying general misconceptions and the need of further teaching (Trumbull & Lash, 2013). The change of environment, teaching outside of the class, was positively valued by most of the students.

There were a number of things that can be improved for future poster sessions, according to the students (table 1). Among them, the lack of time was commonly mentioned. While it is true that there was a limited time (and space in the poster), it also promoted –as a learning outcome– the need of summarizing content to reduce the cognitive load and thus provide the general perspective. Although keeping the time along the session was

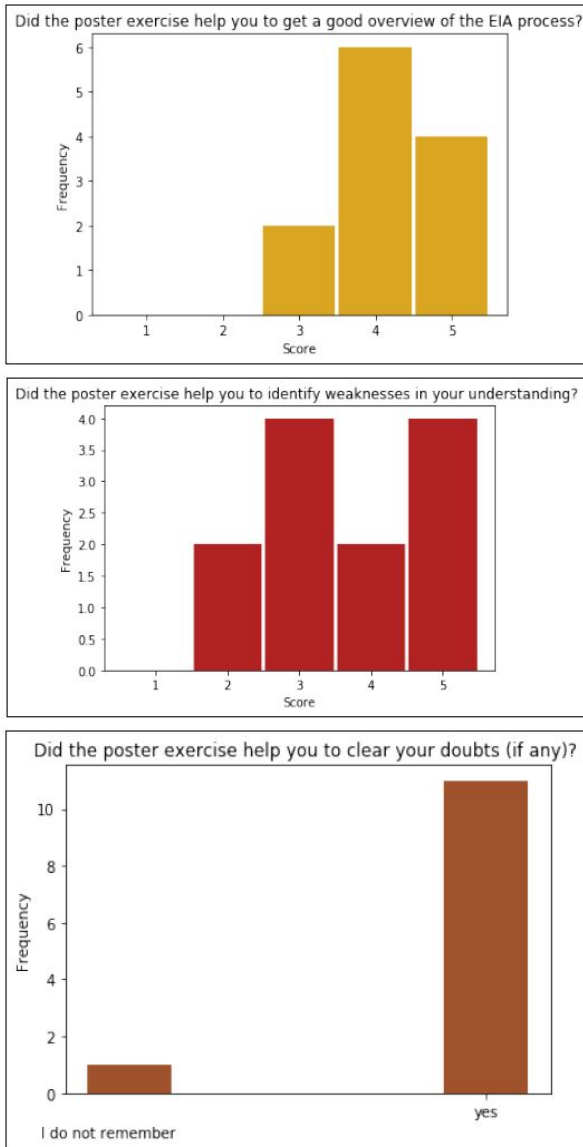


Figure 2. Responses to the questionnaire assessing the poster exercise. Scores range from (1) strongly disagree; (2) disagree; (3) neither agree nor disagree; (4) agree; (5) strongly agree.

my main concern before the session, it worked out and I succeeded with the Scientific Conference format of 3 min presentation + 2 min questions. I also asked the students to write a couple of questions for the quiz from their specific EIA step, which added some extra pressure. The questions generated were simple and general, not aligned with the aim of the quiz, so this question task could be removed.

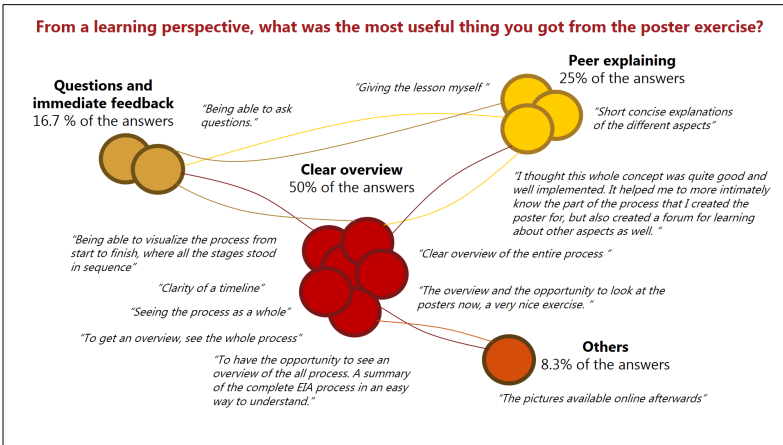


Figure 3. Representation of the student’s answers to the question: From a learning perspective, what was the most useful thing you got from the poster exercise? The student’s answers are clustered in four categories: 1) Questions and immediate feedback; 2) Clear overview; 3) Peer explaining; 4) Others.

While being outside was initially received with enthusiasm for most of the students, it was a bit warm to be outside, especially on the sun. This generated some distractions, as some of the students were uncomfortable, protecting themselves from the sun rather than paying attention to their colleagues. A shaded area would have been a better location, keeping the benefits of a change of environment (Biggs & Tang, 2011).

Last, using the oral examination as feedback on student learning, some students mentioned that “the poster exercise was key to improve their understanding of the EIA process and therefore their performance during the exam”. Also, the external examiner noticed a good performance of the stu-

dents when recalling the whole-EIA process, in comparison with previous years.

Table 1. What could be improved in the poster exercise?

<i>"Not focus solely on your part, engage more in the other parts as well"</i>
<i>"Be more time-efficient"</i>
<i>"Maybe do it inside? It was nice outside but it got a bit too warm"</i>
<i>"More time, better speeches"</i>
<i>"Maybe a bit more time?"</i>
<i>"I liked the whole thing. No complaints"</i>
<i>"Not to stand with the sun backing on the posters. Chose the shade"</i>
<i>"In a more shaded area. Having a chance to be quized (multiple choice) during or after this session, to test retention"</i>
<i>More time to do it, so it is not so much stress, also that you don't have to do the quiz questions at the same time since it adds to the stress</i>
<i>I think as a whole it was a good activity. I think it works good.</i>

Quiz session

The quiz session aimed to help the students to reinforce the specific contents, by self-evaluating and identifying weaknesses in their acquired knowledge during the course. Twelve students provided responses to the assessment and 83% of them considered that the quiz achieved the objective (scores of 4 and 5) (figure 4). Unlike the poster session, most of the students (83%) considered that the quiz exercise helped them to identify the weaknesses in their understanding. Those can be used as key points to reinforce for exam preparation. Furthermore, the quiz itself is a way to transfer knowledge, and questions tested and discussed are more unlikely to be forgotten (Anderson et al., 2013; Benjamin & Pashler, 2015). All the students considered that the quiz provided a good way to clear their doubts, though two of them could not clear all their doubts.

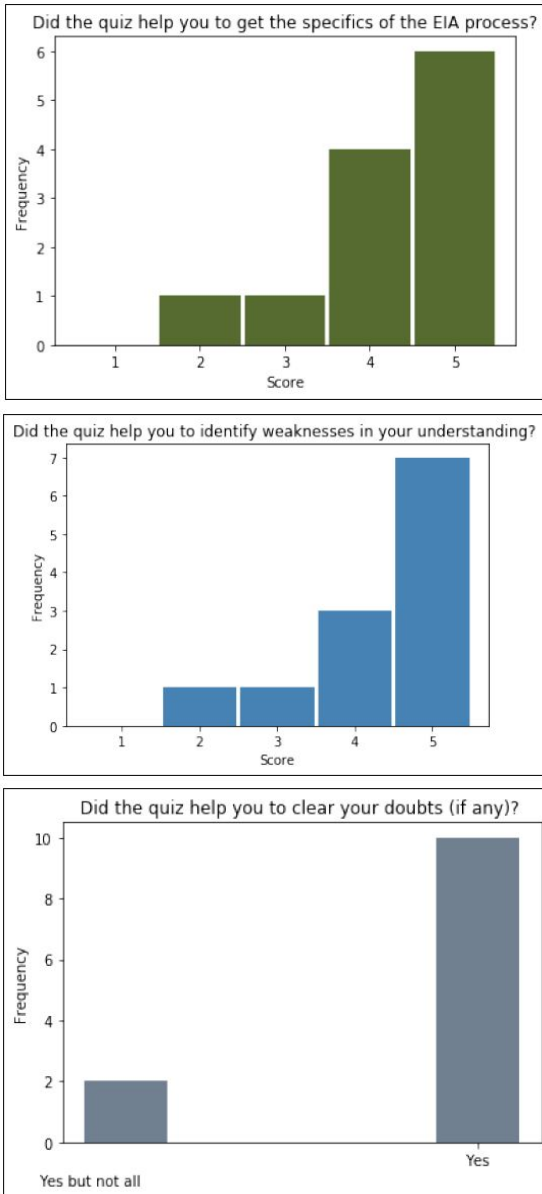


Figure 4. Responses to the questionnaire assessing the quiz exercise. Scores range from (1) strongly disagree; (2) disagree; (3) neither agree nor disagree; (4) agree; (5) strongly agree.

From a learning perspective, students found the quiz session as an appropriate tool to identify gaps in their knowledge (figure 5). The exercise facilitated the students to deepen their understanding and retrieval from memory to find the answer to the questions. When there was a disagreement among students in the answer, my role as a teacher was to moderate the discussion and provide the right answer when necessary. This was used as a formative assessment (Trumbull & Lash, 2013). If something was still not clear, then I taught, which resulted in an efficient teaching. Concepts reinforcement was also mentioned by the students, especially for those concepts that were introduced at the very beginning of the course. As an applied course, students work in specific cases, and the theory –or the why are they doing what they are doing– might be forgotten. However, in the exam, the student performance to recall these concepts is evaluated, and students valued the quiz exercise as an excellent tool for exam preparation. Among other benefits for learning, having exam questions without the pressure of an exam, with other students and the teacher providing immediate feedback, facilitated a good atmosphere for learning.

Students were asked also for improvements on the quiz session. A number of improvements should be made for future editions of the course. Time efficiency, proper formulation of the questions, more questions and more sessions like this were among the answers.

As a teacher reflection, some of the answers of the students were distant from the right, expected answers. These specific themes and concepts were obviously not reinforced during the course. The quiz session not only helps students, but also us, teachers, to identify weaknesses in our teaching.

Last, during the feedback on the oral examination, some students mentioned “*a feeling of more confidence thanks to the quiz exercise*”. Whether it was because of an improved learning, or because they got a sense of the type of exams questions, or both, will have to be asked in future editions.

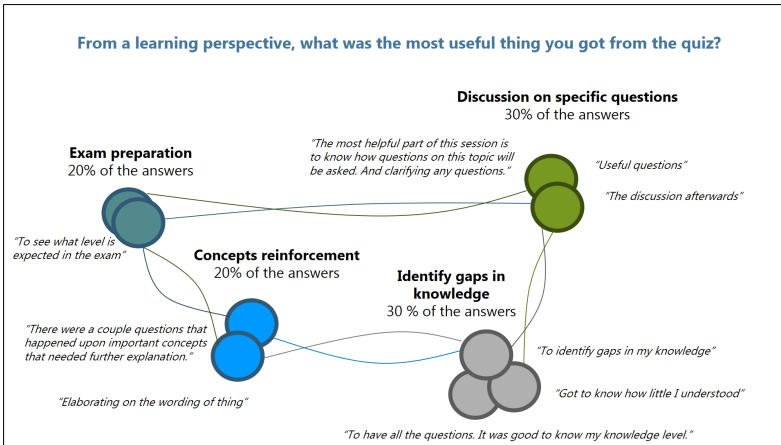


Figure 5. Representation of the student answers to the question: From a learning perspective, what was the most useful thing you got from the quiz? The student’s answers are clustered in four categories: 1) Identify gaps in knowledge; 2) Discussion on specific questions; 3) Exam preparation; 4) Concepts reinforcement.

Table 2. What could be improved in the quiz session?

<i>Be more time-efficient</i>
<i>The formulation of the questions should be more clear</i>
<i>I think it would have been better to have a quiz prepared by the examination team. This would give more confidence that these were legitimate questions, and that we were covering concepts that are actually important to know.</i>
<i>More questions, multiple choice. Or another session in the middle of the block</i>
<i>If people were more quiet, and if we got more precise answers on what was actually right, it was a bit hard to hear/know sometimes</i>
<i>Better clarity on right or wrong questions</i>
<i>I think to review the options in the multiple options choice, some of them were a bit odd, but I know the questions were formulated by the group.</i>

Conclusions and perspectives

We had the concern in our course that, every year, a number of students were not able to reach a good performance during examination. They were failing to recall specific and general content knowledge of the curriculum.

There was a need to facilitate the learning process through different teaching strategies. The poster session was able to gather together peer learning, repetition and spacing-effect, visualization of concepts, immediate feedback and change of environment (teaching outdoors) among others, mimicking –and using the analogy– of a Scientific Conference. It succeeded to assist the students to get the bigger picture –the whole-EIA process and the interactions among stages– under the hypothesis that it would be easier to remember a sequence that has been previously reinforced and visualized. On the other hand, the quiz session combined self-testing and formative assessment, which were key for students to identify their own knowledge gaps, always relevant for exam preparation. The quiz aimed for the specifics, the dots that are necessary to be reinforced and connected to see the bigger picture. Fomenting the discussion among students, clearing doubts and teaching when necessary, were also the ingredients of a successful session. A number of improvements on the activities were identified –from timing to questions formulation– providing the roadmap for the coming editions. This is part of an iteration process –edition after edition, through evaluations and aiming for a constructive alignment with the course curriculum– which will yield a more effective teaching while fostering student engagement and learning.

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A

Recap of the whole-EIA process

Poster session

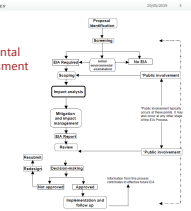


Today


- Recap of the whole EIA process through a poster session (preparation + presentation + questions)
- 45 min to prepare the posters
- 3 min presentation per poster
- 2 min questions per poster

International Conference on Environmental Impact Assessment (EIA)

Copenhagen
20/05/2019



Keynote speaker



https://youtu.be/PWAMP_jnK0T

Poster Session



3 min presentation + 2 min questions

Poster TEMPLATE

TITLE (EIA STAGE) RATIONALE (FOR THIS EIA STAGE)
RESPONSABILITIES (IF ANY)
METHODS (e.g. EXERCISES YOU DID IN CLASS)
RESULTS (OUTPUTS OF THIS EIA STAGE)
LIMITATIONS (e.g. BARRIERS, SHORTCOMINGS)

Poster distribution

- Strategic Environmental Assessment (SEA) Group F
- Public involvement Group F
- Screening Group E
- Scoping Group E
- Assessing Group D
- Mitigation Group C
- Reporting Group B
- Reviewing and decision making Group B
- Monitoring and auditing Group A

For the exam quiz

Write two questions about your EIA stage for the exam quiz

The answer should be multiple choice with 4 options

e.g. When is public involvement taking place in the EIA process?

- Screening
- Mitigation
- Scoping
- Scoping and review

Environmental Impact Assessment (EIA) ... Total Questions: 20
Most Correct Answer: #8 Least Correct Answer: #5

9. Who is responsible for conducting the Strategic Environmental Assessment (SEA)?

12/18 Parliament
0/18 Local authorities
17/18 The government
0/18 NGOs

2. What are the expected results of SEA?

20/18 Information
20/18 Information to policies, programs and budgets
0/18 Decide whether an EA is needed
0/18 Register public opinions

3. What does the screening determine?

25/13 An EA is needed
0/18 If the project should happen or not
0/18 If the project will be ready problem or negative
1/18 If the needs of the project justify money cost
4/18 If the project is worth the money cost

4. What is the outcome of the scoping phase?

27/18 The terms of reference
0/18 The feasibility study
0/18 The EA
0/18 The bid

12. What is the function of the 0-alternative?

The alternative highlights the impacts on the project location in the **absence of the project location** which is what occurs in the location if the review goes in alternative.

Complete the sentence when you do not do the project:

To assess the severity of the impacts, establishing the **project versus no intervention**.

Application of the 0-alternative helps you to **eliminate the impact of doing nothing** it is a way to view the contribution of the baseline.

13. What is a baseline study in an EA and why do we need it?

A baseline study is the **starting point** of the assessment where the project will take place. It is necessary to ensure **comprehensive understanding of the project** can be compared for severity, and mitigate effects have a clear idea of the baseline.

A baseline study reviews the **pre-existing conditions of the project area**. **Baseline of the environment** A baseline study is necessary to identify what are the project's impacts on the area.

Describe the steps of the assessment before the project. Executive, **agencies of baseline and** **and to measure the medium term.**

A baseline study **determines the current state of the area** (physical, ecological, hydrogeological, socio-economic) **at the start of the project**. The project's impact is compared to the baseline to determine the project's effects on the environment.

16. At which stage in the EA process are the alternatives considered and why? or when?

Proposed in the scoping phase. Because of the EA, considered before decision-making to assess if there is a more feasible, viable, realistic project alternative.

17. Who is responsible for the monitoring?

Project proponent and relevant authorities.

Projector

Projector of the project

Whoever is **responsible for the EA** e.g. a proponent, government, subcontractor

5. What do you need to do during the scoping phase?

9/18 Involve the public, with workshops for example
0/18 Assess the impacts
5/18 Gather the data and establish baseline data
7/18 Write a detailed report explaining the major impacts

6. What is most often required for mitigation?

27/18 Awareness
1/18 Interest of the project
1/18 Awareness
0/18 Total community

7. What is NOT included in an Environmental Management Plan (EMPP)?

0/18 Accountability
1/18 Mitigation measures
16/18 Funding of impacts
12/18 Costs of mitigation

8. When do you mitigate in the EA report?

0/18 After scoping
3/18 After reporting
0/18 After decision-making
20/18 After assessment

9. When does the monitoring phase take place in the EA process?

1/18 Before scoping
5/18 After scoping
18/18 After decision-making
4/18 Subject of the EA

14. What are the purposes of the Environmental Management Plan (EMPP)?

Identify mitigation measures to be implemented
Establish a system and procedures for the project
Monitor the effectiveness of mitigation measures
Set action when unforeseen impacts occur

The EMPP is the practical backbone of the EA as it covers the **how** (people involved, time constraints), **responsibility** (environmental responsibility), **assessment** (environmental responsibility).

To outline the measures that need to be taken for avoiding, minimizing or offsetting significant adverse impacts from your plan to the project and what the monitoring, review and checking as well as **reporting** of the progress. It also includes detailed notes for mitigation.

18. Can the decision-maker ignore the EA report?

No. The decision-maker has to take into account all the relevant documents regarding the project.

Not they cannot ignore the EA

15. What are the differences between an Environmental Management Plan and an Environmental Monitoring Plan?

The **management plan is used to describe mitigation measures** while the **monitoring plan describes** a system for **Measuring of the mitigation measures**

10. Auditing involves:

2/18 The scope of the processes for establishing terms of Reference (TOR) and boundaries for the TOR
24/18 Reporting impacts predicted with those that actually occur
3/18 Identify the risks and establish costs in the EA
6/18 Decide whether a project requires EA or not

11. At which stages is the public the public involvement required and why? (required as mandatory)

During **scoping** the public interests are identified, the public is encouraged to understand the project and its compatibility with their values.
During the **scoping** the public can evaluate the acceptability of the project and its impacts.

The public involvement takes place over the course of **EA stages**

EA stages

The public must be included because they are one of the primary stakeholders and need to have an **opinion** before the **development plan** can be used for **decision-making**. Furthermore, they may need to be consulted.

During scoping, before we need to include the opinion of the public, it will bring more clarity to the report because we need to know for the public agree with the location of the project

11. What is a cumulative impact? (Give an example)

Cumulative effects, also referred to as cumulative environmental effects and cumulative impacts, can be defined as changes to the environment caused by the combined impact of past, present and future human activities and natural processes. **Cumulative effects of environmental and development activities should be taken into account in significant environmental effects.**

Cumulative impact results from the given project will impact the area alongside other existing projects.

Cumulative impacts: When you have the same impact in different projects, but in the same area as both such as noise, higher impact. Example: A new road going to take more noise from the same area.

When an area might be a risk of water over-exploitation due to increased water demand.

When multiple projects impact on the same environmental components in such a way that the partial impacts could be **additive** or **synergistic** in some way or severely deteriorate the environment.

In a project that is not so significant but when placed with added pressure of the same or other impacts becomes significant. An example: using farm in an, using farm in the same area as a problem (noise, smell, etc.)

20. Who is usually undertaking the review of the EA report?

Auditing team and **Independent experts**

The **responsible authority**