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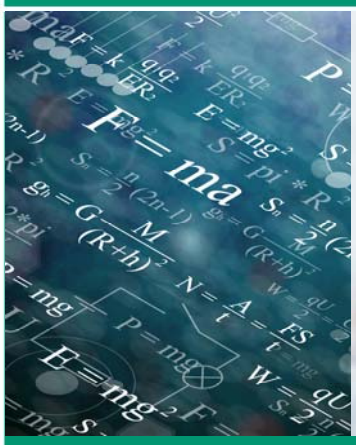
NATURWISSENSCHAFTLICHE
FAKULTÄT

Guidelines for formulating skills-orientated learning objectives for modules

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Contents

1 Skills as a measurable target in teaching

Acquisition of skills has been at the heart of teaching and learning at universities. The skills which should be acquired in higher education are documented in various sets of regulations, such as the Qualification Framework for German Higher Education Qualifications – DQR-- (c.f. Resolution of 21/04/2005 in the respective version in effect, HRK, KMK and BMBF). This framework makes it clear that it most important that students should be able to effectively find solutions to relevant problems in their lives and especially their careers. It serves as a general basis for the conception of our study program modules. These conceptions include – e.g. in the module handbook – detailed descriptions of the learning objectives and skills to be obtained through the respective modules.

For lecturers, skills are therefore a key starting point and a measurable target when considering content and methods in teaching. The skills which are to be acquired in the context of teaching and learning are described and planned in learning objectives. Skills-orientated learning objectives help students to evaluate their own learning and take on responsibility for their own learning.

When the focus is on skills, the crucial matter is what the student is able to do in the end, not what has been dealt with during the course.

Accordingly, the bottom line of skills-oriented teaching is not which topics are covered in a course, but which skills the students acquired.

Furthermore, examinations cannot be designed adequately without skills-orientated learning objectives. Accreditation is also an important consideration, as the new structure of degree programmes has led to increased significance for achievements obtained at other universities.Skills-orientated learning objectives clarify the level desired at the university and therefore contribute significantly to controlling accreditation processes.

The guidelines presented here are designed to help formulate skills-orientated learning objectives.

2 Skills and learning objectives – An introduction to key terms

2.1 Skills

Skills are understood as the willingness and ability of an individual to behave appropriately and in a way which is well thought out and individually and socially responsible in professional, social and private situations (Kultusministerkonferenz [KMK], 2007).

The ability to sketch curves in mathematics is completely different from the ability to communicate clearly and respectfully in social contexts, such as in a management position in a company. The first example is usually considered a subject-specific skill while the second is categorised as a social skill.

Skills models are a useful aid which illustrate the different kinds of skills (Table 1). They divide up different types of skills into sub-categories. We make a distinction between four types of skills.

2.2 Skills model

Below is a simple skills model with examples of how such skills can be formulated. It is based on the model in the German Qualifications Framework for Lifelong Learning (Arbeitskreis Deutscher Qualifikationsrahmen, 2011) and the Qualification Framework for German Higher Education Qualifications (KMK, 2005). A more detailed version of the model, including a distinction between the levels required for each skill for Bachelor's and Master's degree programmes can be found in Table 2.

Skill category	Description	Example
Subject-specific skills	The ability and willingness to process tasks and problems independently, as appropriate to the subject, and to evaluate the result.	Students are able to apply the basic priniciples of inorganic chemistry to virtual chemical problems, and are able to critically reflect on the interaction between measure and problem.
Learning and methodological skills	The ability and willingness to use specific learning and working methods that are required in order to develop other skills, especially subject-specific skills.	Students answer research questions in the field of cell and molecular biology independently by planning, carrying out and evaluating analyses of documents and relevant experiments. They source information for this purpose independently via the internet.
Personal skills	The ability and willingness to develop and to shape one's own life independently and responsibly in social, cultural and professional contexts.	Students evaluate their own strengths and weaknesses in relation to their field of study and develop a picture of how they can develop their abilities as a future graduate of their study program.
Social skills	The ability and willingness to work together with others in pursuit of a goal, to take into account their interests and social situations, to hold discussions and come to agreements with them rationally and responsibly, and to contribute to the working and living environment.	Students organise themselves indpendently in working groups and approach virtual scientific problems in a cooperative and work-sharing way. They delop a understanding of their role in the group and accept responsibilitiy for themselves as well as the group.
		Please note: It has become standard to leave out 'can' in the description of skills, i.e. to say 'explain' instead of 'can explain'. This is succinct and focuses on the result. However, these formulations may lead to misunderstanding in certain situations or make the syntax unnecessarily complicated. In these cases, it is acceptable to use 'can'. Such formulations are also used in the skills model (pp. 6–7) in these guidelines.

Table 1: Simple skills model

2.3 Learning objectives

Learning objectives and skills should be provided in module handbooks. But what exactly is a learning objective? And what is the relationship between learning objectives and skills? Without going into the details of the complicated theoretical discussion which may arise in this context, this relationship can be described by the following three aspects:

Aspect 1: Learning objectives are skills which are consciously aimed for within the context of teaching and learning.

When a person can carry out Convex Analysis, i.e. accomplishes the appropriate tasks properly and successfully in a professional context, the question of where they learnt how to do so is no longer relevant. We then only speak of a **skill**, and no longer of a **learning objective**. However, if a course is offered on this topic and aims for students to acquire the appropriate skills, we speak of a learning objective.

Aspect 2: Learning objectives are operationalised skills.

The fact that students should acquire subject-specific skills is not specific enough to give a module or course direction. The fact that students should understand Convex Analysis leaves us to wonder how it is possible to recognise and verify that they have understood. A skill can only be demonstrated through actions carried out by the person in question. A learning objective must therefore be formulated in such a way that it is specific, related to action and able to be verified. Suitable examination methods must be chosen accordingly at a later date in order to evaluate the skills acquired.

How should learning objectives be formulated? This question brings us to the third aspect:

Aspect 3: Learning objectives always include two components: content and action.

The **content** is conveyed by a noun and describes the subject-specific or interdisciplinary content to which the learning process relates. The **action** is conveyed by a verb and indicates what the students should do with the content. In the learning objective

Example:

„Students are able to apply methods of Analysis to deal with elementary functions, compute limits , derivate and integrate resp. recognise divergence“

Content: **„Methods of analysis to deal with elementary functions, compute limits, derivate and integrate resp. recognise divergence “**

Action: **„apply“**

additional example:

„Employing geoscientific basics students analyse structure and composition of rock mass in the field and the laboratory“

Content: **„ structure and composition of rock mass” “geoscientific basics “**
Action: **„ analyse“**

The actions in both examples make it clear that there are different levels of skills (see chapter 2.4 and Table 3 for the learning objective levels).

The desired level of a learning objective results from the requirements that arise due to the nature of the action (e.g. should students simply reproduce content or be able to evaluate it?) and the complexity of the content. For example, for certain content, to 'explain' is easier to achieve than to 'apply'.

2.4 A taxonomy for structuring learning objectives

There are recognised models which have been developed to enable learning achievements to be better evaluated and systematised. One of the most well-known models is the model by Bloom (1956), adapted by Anderson and Krathwohl (2001). In their model, Anderson and Krathwohl describe the various hierarchical levels for thought processes according to their complexity. The assumption here is this: the intellectual demands on the cognitive abilities increase hierarchically from, 'remember' at the bottom with the lowest demands to 'create' with the highest.

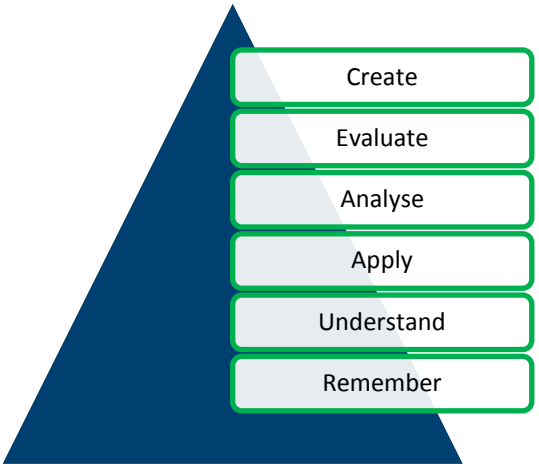

Figure 2: Taxonomy for structuring learning objectives by Bloom (1956), adapted by Anderson and Krathwohl (2001)

More advanced cognitive functions include each of the functions on the lower levels, meaning that these are a prerequisite. For example, in order to apply knowledge, the theoretical background or certain rules must first be understood.

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Each action within a learning objective can be allocated to one of the levels in the hierarchy. In doing so, the level of the learning objective becomes clear. However, this does not take into account the demands of the content itself. These may vary greatly depending on its complexity and level of difficulty.

It is important that the learning objectives are not aimed purely at remembering and reproducing knowledge but, in the context of higher education, also aim to reach other levels of the hierarchy. In addition, a clear distinction between the levels for Bachelor's and Master's degrees should be apparent due to this systematisation of actions in connection with content (Table 4).

2.5 Guide

The following guides are designed to help formulate learning objectives. Herewith, a clear distinction between the levels for Bachelor's and Master's degrees should be apparent due to the systematisation of actions.

- Table 2: Skills model with a distinction between Bachelor and Master
- Table 3: A guide to formulating learning objectives (actions)
- Table 4: Check list for formulating learning objectives

2.5.1 Table 2: Skills model with a distinction between Bachelor's and Master's degrees

Type of skills	Description	Possible forms	Example	Level: Bachelor's degree	Level: Master's degree
Subject-specific skills	The ability and willingness to process tasks and problems independently, as appropriate to the subject, and to evaluate the result.	• Knowledge (of rules, terms, definitions), • recognising relationships, • applying knowledge and expertise acquired in a discipline in appropriate situations, • connecting knowledge and drawing on relevant opinions	**The following examples relate to business and economics and should be adapted to suit the appropriate faculty.**	**Please note: It is not always possible to make an absolute distinction between Bachelor's and Master's degree levels which is applicable in all cases. The examples suggested here are intended merely as a guide.**	
			he students are qualified to apply the essential basics of inorganic chemistry to practical chemical problems and reflect the issues critically.	• Can explain and apply basic theories and principles (in depth in certain areas).	• Can explain and apply basic theories and principles, as well as specialised and in-depth knowledge. • Can develop independent ideas and concepts to solve theoretical and professional problems. • Can explain, apply and reflect upon the theories, terminology, specialities, boundaries and different schools of thought of their discipline critically and in depth.
Learning and methodological skills	The ability and willingness to use specific learning and working methods that are required in order to develop other skills, especially subject-specific skills.	• Planning stages of work in order to solve a problem, • using qualitative and quantitative methods for distinct purposes, • interpreting and visualising results, • developing, monitoring and guiding suitable learning strategies, • applying different techniques and procedures appropriately and under consideration of the situation (forming hypotheses, working with models, working with texts, etc.), • gathering information and evaluating it in context	The students respond to research questions in the fields of cell and molecular biology independently by planning, conducting and evaluating document analyses and experiments with specific working techniques. They gather information in all available media and analyse the data independently.	• Can apply basic research methods, e.g. - collect relevant information, especially within their subject - interpret and evaluate (empirical) data and information - interpret texts • Can plan and implement stages of work in order to solve a problem in their subject and in a professional context. • Can design their own learning processes independently.	• Can carry out research projects or application-based projects largely independently using a wide range of the subject's specialist research methods. • Can also plan and implement stages of work in order to solve a problem in new and unfamiliar contexts and interdisciplinary contexts. • Can manage their own learning processes independently, reflect upon them and expand their knowledge of appropriate methods.

Type of skills	Description	Possible forms	Example	Level: Bachelor's degree	Level: Master's degree
Personal skills	The ability and willingness to develop and to shape one's own life independently and responsibly in social, cultural and professional contexts.	• Recognising and evaluating personal strengths and weaknesses, • taking responsibility and acting rationally, • setting personal goals regarding work and behaviour, • being able to deal with failure, • being willing • - to implement suggestions from others • - to cultivate self-control, self-reflection and effort	The students are able to estimate their individual skills and competences as well as their personal limitations. Also they plan their own competence profile within their course of study as a future graduate of the degree programme.	**Please note: It is especially difficult to differentiate between social and personal skills and to make an absolute distinction between Bachelor's and Master's degree levels which is applicable in all cases The examples suggested here are intended merely as a guide and may vary greatly depending on the subject.** • Can define goals for personal development, reflect upon personal strengths and weaknesses and plan personal development.	• Can define goals for personal development, reflect upon personal strengths and weaknesses and plan personal development, and reflect upon these under consideration of fundamental ethical questions and the consequences for society.
Social skills	The ability and willingness to work together with others in pursuit of a goal, to take into account their interests and social situations, to hold discussions and come to agreements with them rationally and responsibly, and to contribute to the working and living environment.	• Learning and working with others, • adhering to rules which have been agreed upon, • approaching others with an open mind, • demonstrating a positive attitude towards others, • acting appropriately depending on the person and situation, • dealing with conflict appropriately, • respecting other cultures and other people, • acting and communicating fairly and co-operatively	The students organize themselve in effective working groups and work on practical natural scientific problems in a cooperative way as good colleagues do. They develop an underständing of their own position in a team and assume responsibility for themselves as well as for the team.	• Can work co-operatively and responsibly in a group. • Can lead small groups with manageable tasks responsibly. • Can present complex, subject-specific content clearly and present arguments effectively.	• Can work co-operatively and responsibly in a group and critically reflect upon and improve their own co-operative behaviour in a group. • Can lead larger groups with complex tasks effectively and promote the development of other members of the group. • Can present complex, subject-specific content clearly and present arguments effectively, and improve their own methods of presenting arguments through critical reflection.

Table 2: Skills model with a distinction between Bachelor's and Master's degrees

2.5.2 Table 3: A guide to formulating learning goals (actions)

Level	Description of the taxonomy level	Verbs
Create	Learners can build a new structure or create a new meaning out of several elements, can suggest new solutions, outline new plans or develop well-substantiated hypotheses.	develop, produce, construct, plan, devise, prepare, establish, design, formulate, invent, engineer, compose, create
Evaluate	Learners can make evidence-based, qualitative and quantitative judgements about information based on criteria.	evaluate, decide, assess, determine, question, review, compare, choose, distinguish, estab-lish criteria, gauge, judge, rate, measure, categorise
Analyse	Learners can break a problem down into individual parts in order to understand the structure of the problem; they can identify contradictions and relationships, draw conclusions, and distinguish between facts and interpretations.	distinguish, identify, discover, classify, test, determine, contrast, verify, review, observe, conclude, investigate, explore, examine, structure, discuss, select
Apply	Learners can solve a new problem by transferring knowledge.	apply, order, calculate, transfer, allocate, explain, establish, classify, report, predict, distinguish, describe, compare, generalise, organise, assign, quantify, implement, demonstrate, realise, resolve, modify
Understand	Learners can explain information, give examples, interpret tasks or explain a problem in their own words.	explain, summarise, interpret, present, translate, display, report, abstract, sketch, illustrate, emphasise, compare, define, illuminate, adapt, demonstrate
Remember	Learners can reproduce information. They know specific terms, definitions, facts, dates, rules, procedures, characteristics, criteria, etc.	state, name, reproduce, describe, list, draw, depict, identify, recall, refer, specify

Table 3: A guide to formulating learning goals (actions)

Note on using verbs:

The verbs suggested are intended merely as examples. The content must always be considered in order to make statements about the demands and the level of the learning objective.

2.5.3 Table 4: Check list for formulating learning objectives

Criterion	Key questions
Prospects for students	What should students be able to do after successfully completing this module?
Actions and skills (see also 3.2)	Does the objective include an action and content? Are active verbs used to describe the actions? Are objectives actually pursued on different levels? Which subject-specific situations should students be able to control independently, successfully and responsibly (subject-specific skills)? Which (learning) situations should students be able to control independently, successfully and responsibly using suitable methods (learning and methodological skills)? Which social and communicative situations should students be able to control independently, successfully and responsibly (social skills)? Which situations of self-reflection should students be able to control independently, successfully and responsibly (personal skills)?
Clarity/precision	Is the nature of the skills formulated clearly? Are the statements detailed and specific?
Verifiability	Can the intended learning objectives be observed and identified using assessment procedures (written examinations, oral examinations, essays, etc.)? Are the chosen assessment procedures a suitable way of observing the skills acquired?
Suitability of teaching and learning concept	Is the chosen teaching and learning concept suitable for achieving the intended learning objectives? Which skills are not adequately taken into account in the course or module?
Making distinctions (Bachelor's/Master's degree)	Is a distinction made between the levels required for Bachelor's and Master's degrees (see appendix A)?
Reference to *module handbook*	Are the learning objectives in line with the overall module objectives? Which modules are taken before, at the same time as, and after this module? Can the skills which have been formulated be linked to these modules?

Table 4: Check list for formulating learning objectives

3 Advice and support for lecturers

We are happy to help you with any questions about formulating learning objectives and other related topics. Please contact the following people at FBZHL:

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Further information on teaching in higher education is available at http://www.fbzhl.de

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