Evaluation of different teaching interventions to motivate agricultural students in the lecture of animal health

Alexander Grahofer[1]

Animal Physiology, Department of Environmental Systems Science, ETH Zurich
8092 Zurich, Switzerland

Clinic for Swine, Vetsuisse Faculty, University of Bern
3001 Bern, Switzerland

Roman Suter[2]

Educational Development Unit, University of Bern
3001 Bern, Switzerland

Abstract

Student motivation is an important factor for successful learning. The aim of this study was to describe and evaluate specific teaching interventions used in teaching animal health to students of agronomy. For evaluating the motivation of students, the MUSIC® Model from Jones rated on a 6-point Likert type scale was used. By means of the MUSIC® inventory and open questions at the end of the semester, students were asked about their perception of different interventions during the course. The caring component of the lecturer was evaluated at highest (5.7), followed by success (5.1), interest (4.8), usefulness (4.6) and empowerment (4.5) of the topics in this class. Furthermore, usefulness and interest seem to be the main driver for motivation among students in this study. Therefore, interventions, which activate these components such as field trips with exercises and group discussions, should be regularly used in teaching to improve the motivation of students.

1 Introduction

Intrinsic motivation plays a crucial role for academic learning and achievement. Therefore, teachers should try to engage students' motivation patterns during lectures, because students with motivation work more actively during lectures and therefore tend to learn more effectively. However, it is a big challenge to motivate all students, because they are coming from different backgrounds, with different interests and different experiences. In particular, during the past few decades the population of students in agricultural sciences has shifted. Nowadays, the students in this field have little or no background in agriculture, resulting in a high diversity of previous knowledge. These changes in student demographics require several new teaching strategies to motivate the individual student in the lecture. Consequently, current knowledge about human motivation is necessary to fulfill the needs of every individual student. Self-determination theory represents a broad framework for the study of human motivation and personality (Deci & Ryan 2008). In their basic theoretical framework, the authors distinguish different types of motivation that underlie and shape human behaviour. These are extrinsic motivation, intrinsic motivation and amotivation. Extrinsic motivation refers to behaviours carried out to gain some type of external reward, whereas intrinsic motivation refers to behaviours performed out of interest and enjoyment (Deci & Ryan 2008). The most effective extrinsic motivation for students is the probability of finding a job after the study program

[1] alexander.grahofer@usys.ethz.ch, alexander.grahofer@vetsuisse.unibe.ch
[2] roman.suter@zuw.unibe.ch

(Celikoz 2010). However, students who were motivated externally were at a greater risk of lower academic performance than intrinsically motivated students. Intrinsic motivation refers to behaviour that is driven by internal rewards. It is further driven by several factors, such as the reason for preferring the school, future expectations, and the desire to complete a Masters' degree (Vero & Puka 2017). In addition to extrinsic and intrinsic motivation, amotivation is the third construct necessary to fully understand human behaviour. Amotivation occurs when students do not perceive contingencies between outcomes and their own actions. In literature, it is hypothesised that these students may stop participating in the academic field.
According to self-determination theory, the development of intrinsic motivation depends on three basic psychological needs (Deci & Ryan 2008): the need for self-determination, the need for competence and the need for social belonging. Self-determination means that one's own actions are perceived as being in accordance with one's own values and goals. The need for competence is about subjective perceptions based on personal experiences of success. In the absence of such experiences of success, intrinsic motivation is reduced to passivity. The need for social belonging depends on the extent to which someone has the feeling of being embedded in a network of meaningful social relationships. When these three needs are met in a learning task, students find the associated activities rewarding and are intrinsically motivated for the task. These three basic psychological needs can be used to foster intrinsic motivation of students in higher education.

Several tools are available to evaluate motivation in students. The MUSIC® Model of Motivation is an often-used tool to examine students' motivation at the university. The basic principles of the MUSIC® Model are to investigate the motivation of students in courses, and therefore develop and improve the course program at the university (Jones 2009). To evaluate the motivation of students, the MUSIC® Model measures five primary components of motivation, which are empowerment, usefulness, success, interest, and caring. Most of these components can be related to the self-determination theory. Whereas empowerment, usefulness and interest are closely related to the basic psychological need for self-determination, success is an expression of the basic need for competence experience. Caring, in turn, is related to the need for social belonging. The key principle of empowerment is that individuals enjoy activities when they have the ability to make choices (Deci & Ryan 1985 und 1991, Ryan & Deci 2000). It is known from literature that students of autonomy-supportive teachers acquire greater academic and social competence, are more creative, prefer challenging tasks, increase class attendance and have better grades (Filak & Sheldon 2008, Vallerand & Bissonnette 1992).

Another important component of motivation is usefulness. Students are more motivated when they can refer to existing knowledge and learn things for their future lives (Kauffman & Husman 2004, Tabachnick, Miller & Relyea 2008). Several studies showed that students who perceived a course to contain topics that are needed for their entire careers had better learning outcomes and were more motivated compared to a course with fewer practical applications (Wigfield & Eccles 1992 and 2000; Simons et al. 2004).

Success also plays a major role in the motivation of students. Competence and success are inherent psychological human needs (Elliot & Dweck 2005). To motivate students with success, it is important to match the activity with the ability level of the students (Csikszentmihalyi 1990).

In addition, interest is a major component for motivation in students. There are several definitions of interest described in literature. In general, it can be stated that interest is liking and displaying wilful engagement in a cognitive activity (Schraw & Lehman 2001). Interest positively influences measures of attention, memory, comprehension, deeper cognitive engagement, thinking, learning strategies and achievement (Hidi & Renninger 2006, Schunk et al. 2008). Teachers have to be careful in stimulating interest in students, because too many interesting details can reduce the cognitive capacity of students and therefore decrease the learning outcome (Mayer et al. 2008).

The last component of the MUSIC® model is caring. All humans have a need to establish and receive caring interpersonal relationships (Baumeister & Leary 1995, Ryan & Deci 2000). Caring relationships with teachers have a positive effect on intrinsic motivation, engagement at the university, and performance of the students (Freeman et al. 2007, Furrer & Skinner 2003, Osterman 2000, Walker & Greene 2009). Furthermore, it is known that students feel more comfortable, and therefore are more active during lectures, when caring relationships are established (Stipek 1998).

Although general information about motivation in students is known, there is still a lack of knowledge about the effect of specific teaching interventions in the classroom on the motivation of students. Therefore, this study was conducted to evaluate the overall level of motivation in the class, as well as the effect of different teaching interventions on the motivation of agriculture bachelor students. The objectives were to examine students' motivation with the MUSIC® Inventory at the end of the lecture of animal health, rank the used teaching interventions according the preferences of the students and summarize the different opinions of the students on motivation. The overall goal of this study was to understand student motivation in the field of agriculture, and use that to improve teaching and learning. The results of the present study should help to engage the interest and the enthusiasm of the students on the topic, but also motivate the students for long-term learning. All of these aspects will lead to better academic performance of students.

2 Teaching concept

This study was conducted throughout the spring semester 2019 in the class of animal health, which belongs to the bachelor program in agricultural science at ETH Zurich. A total of 48 students, 38 female and 10 male, were enrolled in the course. The mother tongue of the participants varied, with German (n=44), French (n=2) and Italian (n=2) represented. During the semester, five interventions were implemented in the class to foster student's intrinsic motivation:

a) Identify topics for class
In the first lecture, the students were put into groups of five. They had to identify three different topics that they wanted to discuss during this particular class. The task of this group activity can be found in Appendix I. The topics of the groups were then presented by the students and clustered by the lecturer on the board (Appendix I). This intervention was chosen to increase the empowerment and self-determination of the students, as well as to promote the students' interest and competence in class. With this intervention, the basic psychological need for self-determination was addressed to increase the intrinsic motivation of the students.

b) Group work activities
Throughout the semester, students performed several group work activities in class, such as group discussion, poster presentation and worksheets with problem-based exercises. Some examples of the activities are shown in Appendix II. With the group work activities, components of the MUSIC® model and self-determination theory were initiated, which supported the fulfilment of the basic needs for self-determination and competence experience. These were empowerment, success and usefulness, as well as self-determination, social relationship, and competence.

c) Field trips
In addition, two field trips were organized during the semester. One was a herd examination on a swine farm. It was conducted in groups of six students to practice the evaluation of the general health condition of the animals. In the next lecture, the findings on the farm were concluded. Pictures from the farm and further details on swine production were provided (Appendix III). The main focus of this intervention was that students could practice their

knowledge and competence in the field and gain more self-confidence. Three components of the MUSIC® model, success, interest and usefulness as well as self-determination and competence from the self-determination theory were initiated, which supported the basic needs for self-determination and competence experience. The second field trip was an excursion to the Federal Food Safety and Veterinary Office in Bern. It was implemented in the lecture to provide the students with information about the One Health Concept, disease prevention, eradication and epidemiology. This intervention was conducted to show the students the usefulness of their broad education in agricultural science and to address the basic need for competence experience and social belonging.

d) Mock exam
At the end of the semester, the students were able to participate in a mock exam. The aim of the mock exam was that the students become familiar with the question types (Kprim question, Short and long answer question) and know how the defined learning outcomes, e.g. Evaluation of the general health status of an animal, Analysis of risk factors in herds, Define specific terms from animal health, are evaluated (Appendix IV). The results were discussed in class and open questions were answered. This intervention mainly focused on the success of the students and served the basic need for competence experience. During the whole semester the teacher tried to have a caring relationship with the students, which has a strong influence on the need for social belonging.

3 Analysis of student motivation

After the final written exam, a questionnaire was sent via email to the students of the class. The questionnaire contained the college student version of the MUSIC® Model including 26 items that comprise five scales (i.e., empowerment, usefulness, success, interest, and caring). Each item was rated using a 6-point Likert-format scale that ranges from 1 (strongly disagree) to 6 (strongly agree). In addition, the students had to rank the five interventions (identify topics, group work, herd examination, excursion Federal Food Safety and Veterinary Office and mock exam) from 1 (best intervention) to 5 (unnecessary). Furthermore, the students were asked to describe pros and cons of the five interventions in an open question. In addition, in an open question students were asked how they can best be motivated. All collected data were entered into a spreadsheet program (Microsoft Office Excel 2010). Statistical analysis was performed in NCSS 12 Data.

Although the questionnaire was sent after the exam, the response rate of the students was 56%. This method was chosen to give the students the possibility to compare the different interventions of the class. In total, 36 students opened the link to the questionnaire; 27 completed the whole survey. All variables of the MUSIC® Model were rated highly by the students, with a mean of more than 4.5 on a 6-point Likert-type scale. The caring component was evaluated highest by the students, followed by success, interest and usefulness in this class. Empowerment had the lowest value in the MUSIC ® Model. All details are presented in table 1.

MUSIC® model component	Mean (SD)	Students believe that:
Empowerment	4.55 ± 1.04	• they have the freedom to complete the coursework their own way. • they have options in how to achieve the goals of the course. • they have control over how they learn the course content. • they have flexibility in what they are allowed to do in this course.
Usefulness	4.61 ± 1.07	• in general, the coursework is useful to them. • the coursework is beneficial to them.

		• the coursework is relevant to their future. • the knowledge they gain in this course is important for their future.
Success	5.15 ± 0.69	• they are confident that they can succeed in the coursework. • they can be successful in meeting the academic challenges in this course. • they are capable of getting a high grade in this course. • throughout the course, they could be successful on the coursework.
Interest	4.83 ± 1.04	• the instructional methods used in this course hold their attention. • they enjoy the instructional methods used in this course. • they enjoy completing the coursework. • the coursework is interesting.
Caring	5.68 ± 0.46	• The teacher is willing to assist them if they need help in the course. • The teacher cares about how well they do in this course. • The teacher is respectful of them. • The teacher is friendly.

Table 1: Overview of students' rating of the class animal health with the described components of the MUSIC ®model.

The ranking of the different teaching interventions are presented in table 2.

Rank	Teaching interventions	Median (SD)
1	Mock exam	2.38± 1.10
2	Excursion Federal Food Safety and Veterinary Office	2.62± 1.30
3	Group work during class	3.04± 1.18
4	Herd examination swine	3.23± 1.48
5	Identify topics for class	3.73± 1.66

Table 2: Ranking of the conducted teaching interventions in the class of animal health.

The pros and cons of the different teaching interventions are summarised in tables 3-7. The frequency of nomination is indicated by the numbers in brackets. The different answers of the students were coded and grouped by the authors. Results of the prime importance for the students will be described with some examples. Due to the small sample size the quantity of the answers have to be judged carefully.

Identifying some topics of the lecture together with the students engaged the students' motivation but also included students in the decision-making process. Two students mentioned that this process is too time consuming.

Identify topic	
Pros	**Cons**
Engaged motivation (n=2)	Time consuming (n=2)
Participation in decision-making (n=2)	Less time for important topics
Link to previous knowledge	Prioritisation of some suggestions
Activation of students	
Greater immersion of topics	
Enjoyable	

Table 3: Pros and Cons of the intervention "Identify topic" in the class animal health.

The group activities in class helped the students to actively participate in the class and also gain deeper knowledge of the topic. Although a higher number of students appreciated these

interventions, for some it was too time-consuming and should not be used in a lecture, because the goal of a lecture is to impart knowledge.

Group activities	
Pros	**Cons**
Greater immersion of topics (n=2)	Time consuming (n=2)
Activation of students (n=2)	Should not be used in a lecture. The goal of a lecture is to impart knowledge.
Interactivity	Sometimes too easy
Engaged motivation	Reasonable assignment
Self-assessment	Improve motivation of students
Enjoyable	Inadequate efficacy
Activation of previous knowledge	
Interaction with other students	
Interesting topics	

Table 4: Pros and Cons of the intervention "Group activities" in the class animal health.

The students gave positive feedback for the intervention "herd examination", because it was application-oriented and a good link to the lecture. Due to several topics one student mentioned that an unequal knowledge acquisition remained a problem of this intervention.

Herd examination	
Pros	**Cons**
Application-oriented (n=8)	Time consuming
Activation of students (n=3)	Unequal knowledge acquisition
Link to lecture (n=2)	
Engaged motivation	
Great enrichment	
Greater immersion of topics	
Enjoyable	
Established understanding of topics	

Table 5: Pros and Cons of the intervention "Herd examination" in the class animal health.

Diverse feedback on the excursion was given by the students. Some students liked the application-oriented topic that was also linked to the lecture. The negative aspects of this intervention were its instructor-centred teaching style and long lecture duration. Furthermore, it would have been better to invite the speakers to the university.

Excursion	
Pros	**Cons**
Application-oriented (n=5)	Teacher-centred teaching (n=3)
Link to lecture (n=2)	Too long (n=2)
Activation of students (n=2)	No additional benefit to lecture (n=2)
Engaged motivation	Wealth of information
Great enrichment	Missing link to lecture
Greater immersion of topics	Time consuming
Enjoyable	Expenditure of time
Expert knowledge	

Table 6: Pros and Cons of the intervention "Excursion" in the class animal health.

Most students evaluated the mock exam as useful, because it helped to prepare for the exam, but it is essential that the mock exam has the same difficulty level as the final exam.

Mock exam	
Pros	**Cons**
Preparation for the exam (n=8)	Not same level as real exam (n=3)
Activation of students	
Enjoyable	

Table 7: Pros and Cons of the intervention "Mock exam" in the class animal health.

The different answers to the open question on how students can be motivated are presented in table 8. The answers were coded and grouped to the MUSIC® inventory by the authors. Due to the frequency of nomination (n=27), usefulness seems to be the best motivation for students, followed by interest with 12 nominations. Empowerment and success were only mentioned twice.

MUSIC® model component	Students opinions for motivation
Empowerment	• Identify topics • Balance between lecture and discussion
Usefulness	• Applications-oriented (n=8) • Activating interventions (n=5) • Practical examples (n=2) • Good structure of lecture (n=2) • Different interventions (Herd exam, excursion, mock exam, group work) (n=2) • Good oral presentations
Success	• Repetition of knowledge helpful • Enough learning materials
Interest	• Interesting topics (n=5) • Activating interventions (n=5) • Teacher is motivated about the topics (n=4) • Different interventions (Herd exam, excursion, group work) • Current topics
Caring	• The teacher gives feedback. (n=2) • The teacher cares about the students. • The teacher is respectful to the students. • The teacher is willing to help students. • The teacher is friendly. • The teacher is open for discussions.

Table 8: Overview of motivating factors from the students opinions in the class animal health clustered within the Music® model components.

4 Lessons learnt

The overall goal of this study was to understand student motivation in the field of agriculture and use that to improve teaching and learning. The results of the present study should help to engage the interest and the enthusiasm of the students on the topic, but also motivate the students for long-term learning. All these aspects will lead to better academic performance of students. Therefore, a survey after the semester was conducted using the MUSIC® model by Jones (Jones, 2009) and open questions. The results should be taken into account by planning further studies in field of motivating behaviour.

a) Lessons learnt about student motivation

In total, student motivation in the class of animal health was assessed with high values in all five components (empowerment, usefulness, success, interest, and caring) described by the MUSIC® model. The caring component was ranked highest, although only a few students mentioned this point in the open questions. It is known from literature that the relationship between the instructor and the students has a major impact on the success of the students (Jones 2018). Therefore, it is important that the instructor allow students to believe that they can achieve a high grade if they put effort to the class (Jones 2018). By activating students in a discussion, their feelings of confidence and success can be increased.

Even though success was ranked highly in the MUSIC® questionnaire, there were not many answers concerning this component in the open questions. It can be speculated that the lecturer already met the requirements for this motivational component and therefore, students passed on mentioning this aspect in the open questions. It seems like the participants had similar opinions, because the standard deviation was low compared to the other components. Literature shows that the adaptation of teaching to students' previous knowledge is a strong motivational factor. Allowing a flexible pace of work or providing shorter activities of ill-structured problems are possible interventions to enable a feeling of success (Jones 2018).

In the questionnaire, interest was ranked in third place by the students. A teacher needs to try and get interest from the student so that they are engaging with information at a deeper level of processing (Schraw & Lehman 2001). Interest arises from a combination of situational and individual interest (Jones 2018). This component could be improved in the next class with more adequate and challenging interventions, such as video analysis of the health status of a herd or training of communication skills. Novel activities can catch the attention of the students and this can help them remember information better (Tulving & Kroll 1995). In addition, limiting distractions, such as noise from outside, helps the student to concentrate and focus on the topic of interest (Jones 2018). Furthermore, asking questions in class to random students can lead to higher interest, but also raise students' anxiety (Jones 2018). Students will be more likely to pay attention if they know that they may be called on to answer a question. In this class, the lecturer tried to challenge students with questions, and those questions raised small discussions in the class. However, it is important for the instructor not to lose leadership and to continue with topics. Further suggestions in the interventions used are described below.

Although many application-oriented problems were discussed in the class, the students evaluated usefulness and empowerment almost at the same level, which means both components could have been explained more during this class. A basic way of showing usefulness is to explicitly tell a student about the benefits of the content they are learning and how they can use the information in the real world (Jones 2018). Furthermore, students should reflect during the semester upon the usefulness of the topics (Jones 2018). In addition, guest speakers can help to show their knowledge and skills from the class that are important for their career (Jones 2018). Although this aspect was already conducted during the lecture with real case examples and guest speakers, an improvement of success can be achieved by continuously referencing the importance of the topic in the field. Empowerment is rather hard to gain, but interventions like identifying topics for the class help to improve this motivation pattern.

b) Lessons learnt about the teaching approaches used in relation to student motivation
Due to the high values of the motivation components it can be speculated that the different interventions motivated the students in class. The mock exam was ranked in first place by the students, because it was good preparation for the final exam. Nevertheless, negative feedback was assessed by the students because the mock exam was not the same difficulty level as the final exam. Next time, the lecturer will prepare the mock exam at the same level or even harder, so that the students get a real impression of the exam. Moreover, it would be a benefit for the competencies of the students to prepare some exam questions themselves. With this intervention they can reflect their current knowledge and get to know their weaknesses. The excursion to the Federal Food Safety and Veterinary Office was ranked in second place, although the students evaluated the inputs of the speaker as too long and without benefits. This intervention can be improved with a more problem-oriented learning setup. Each speaker should prepare a case problem and then the students can discuss and ask the expert questions. Alternatively, the students could be divided into groups and select a topic of their interest. Afterwards, they interview an expert of this special topic and then present the results in the class. This intervention might increase empowerment and interest. The group activities were ranked in the midrange. The students complained that some of the tasks were too easy and boring. Thus, in the next semester, the lecturer will improve the assignments by increasing the level of difficulty. Although the herd examination had good written feedback, the students

only ranked it in fourth place. The reason for this rank remains unclear. Next time, the herd examination will be conducted with smaller groups and better interaction with the lecturer. The students ranked the intervention “Identifying the topic” in the last position. Interestingly, this intervention had the highest standard deviation. Some students really enjoyed their empowerment and interest of this intervention, whereas others explained that not all topics were treated equally. In the beginning of the semester this intervention was enjoyed by the students. It might be that some students were overstrained with this intervention, because they lacked enough knowledge on this topic. Furthermore, this intervention is rarely used in the university.

c) Lessons learnt about teaching in higher education
Overall, every different intervention can be improved to gain more motivation for the students. Problem-based learning, as well as practice-oriented teaching, seems to be crucial in order to strengthen intrinsic motivation of students. Serving the three basic psychological needs of self-determination, competence experience and social belonging through the teaching interventions has proven to be effective.

In conclusion, the students’ motivation in the class of animal health was assessed with high values in all five components. Each of the implemented interventions increased the motivation of the students in class. Usefulness and interest seem to be the main drivers for motivation among students in this study. Therefore, interventions which activate these two components should be regularly used in teaching at the university to improve the success of students.

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References

Baumeister, R., & Leary, M. (1995). The need to belong: Desire for interpersonal attachments as a fundamental human motivation. *Psychological Bulletin*, 117, 497-529.

Celikoz, N. (2010). Basic Factors that Affect General Academic Motivation Levels of Candidate Preschool Teachers. *Education*, 131(1), 113-127.

Csikszentmihalyi, M. (1990). Flow: The psychology of optimal experience. New York: Harper Perennial.

Deci, E. L., & Ryan, R. M. (1985). Intrinsic motivation and self-determination in human behavior. New York: Plenum.

Deci, E. L., & Ryan, R. M. (1991). A motivational approach to self: Integration in personality. R. Dienstbier (Ed.). *Nebraska symposium on motivation*, Vol. 38. Lincoln: University of Nebraska Press.

Deci, E. L., & Ryan, R. M. (2008). Self-determination theory: A macrotheory of human motivation, development, and health. *Canadian Psychology/Psychologie canadienne*, 49(3), 182-185.

Elliot, A. J., & Dweck, C. S. (2005). Competence and motivation. A. J. Elliot, & C. S. Dweck (Eds.), *Handbook of competence and motivation*, pp. 312. New York: Guilford.

Filak, V. F., & Sheldon, K. M. (2008). Teacher support, student motivation, student need satisfaction, and college teacher course evaluations: Testing a sequential path model. *Educational Psychology*, 28(6), 711-724

Freeman, T. M., Anderman, L. H., & Jenson, J. M. (2007). Sense of belonging in college freshmen at the classroom and campus level. *The Journal of Experimental Education*, 75(3), 203-220.

Furrer, C., & Skinner, E. (2003). Sense of relatedness as a factor in children's academic engagement and performance. *Journal of Educational Psychology*, 95(1), 148-162.

Hidi, S., & Renninger, K. A. (2006). The four-phase model of interest development. *Educational Psychologist*, 41(2), 111-127.

Jones, B. D. (2009). Motivating students to engage in learning: The MUSIC Model of Academic Motivation. *International Journal of Teaching and Learning in Higher Education*, 21(2), 272-285.

Jones, B.D. (2018). Motivating students by design: Practical strategies for professors. 2nd ed., Academic Press.

Kauffman, D. F., & Husman, J. (2004). Effects of time perspective on student motivation: Introduction to a special issue. *Educational Psychology Review*, 16(1), 1-7.

Mayer, R. E., Griffith, E., Jurkowitz, I. T. N., & Rothman, D. (2008). Increasing interestingness of extraneous details in multimedia science presentation leads to decreased learning. *Journal of Experimental Psychology: Applied*, 14(4), 329-339

Osterman, K. F. (2000). Students' need for belonging in the school community. *Review of Educational Research*, 70(3), 323–367.

Ryan, R. M., & Deci, E. L. (2000). Self-determination theory and facilitation of intrinsic motivation, social development, and well-being. *American Psychologist*, 55(1), 68-78.

Schraw and Lehman, (2001). Situational Interest: A Review of the Literature and Directions for Future Research. *Educational Psychology Review*, 13, (1).

Schunk, D. H., Pintrich, P. R., & Meece, J. L. (2008). Motivation in education: Theory, research, and applications. Upper Saddle River, NJ: Pearson.

Simons, J., Vansteenkiste, M., Lens, W., & Lacante, M. (2004). Placing motivation and future time perspective theory in a temporal perspective. *Educational Psychology Review*, 16(2), 121-139.

Stipek, D. J. (1998). Motivation to learn: From theory to practice. Boston: Allyn & Bacon.

Tabachnick, S. E., Miller, R. B., & Telyea, G. E. (2008). The relationships among students' futureoriented goals and subgoals, perceived task instrumentality, and task-oriented self-regulation strategies in an academic environment. *Journal of Educational Psychology*, 100(3), 629-642.

Tulving, E., & Kroll, N. (1995). Novelty assessment in the brain and long-term memory encoding. *Psychonomic Bulletin and Review*, 2(3), 387-390.

Vallerand, R. J., & Bissonnette, R. (1992). Intrinsic, extrinsic, and amotivational styles as predictors of behavior: A prospective study. *Journal of Personality*, 60, 599-620.

Vero, E. & Puka, E. (2017). The importance of motivation in an educational environment. *Formazione & Insegnamento XV*, 15 (1), 57-66.

Walker, C. O., & Greene, B. A. (2009). The relations between student motivational beliefs and cognitive engagement in high school. *Journal of Educational Research*, 102(6), 463-472.

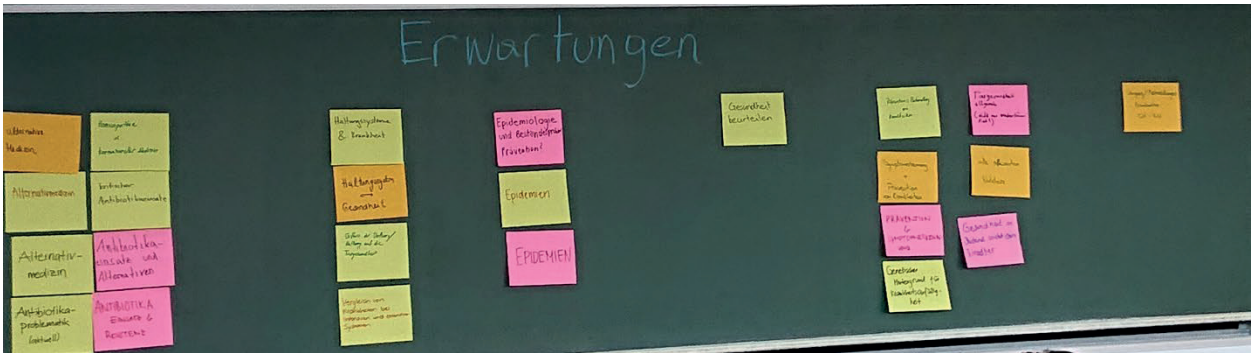
Wigfield, A., & Eccles, J. S. (1992). The development of achievement task values: A theoretical analysis. *Developmental Review*, 12, 265-310.

Wigfield, A., & Eccles, J. S. (2000). Expectancy-value theory of achievement motivation. *Contemporary Educational Psychology*, 25, 68-81.

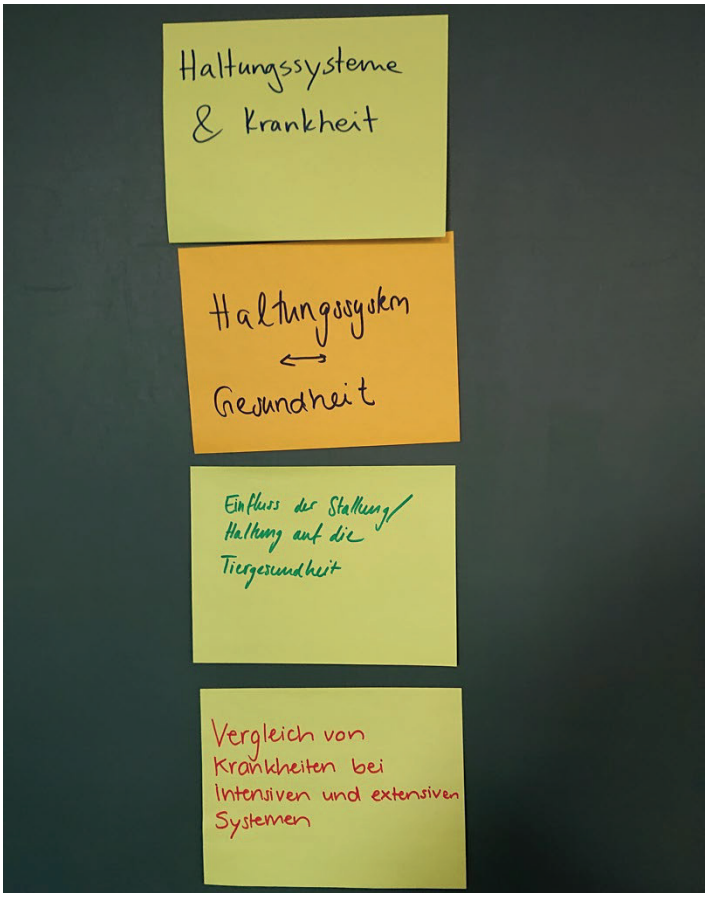
Appendix I – Identification of topics

Task for Identification of topics:

Overview of the different topics in the class:



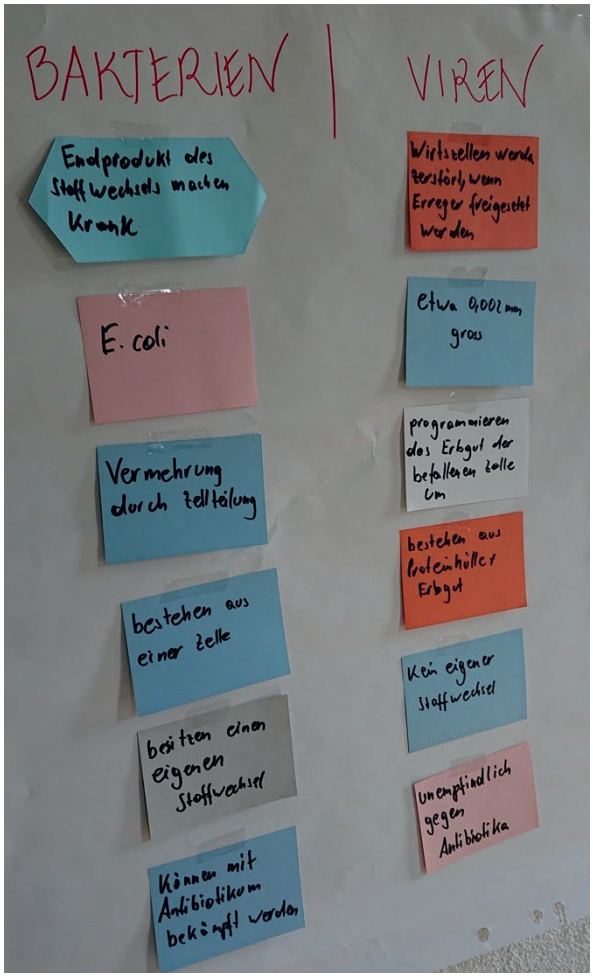
One cluster of the presented topics:



Appendix II – Group activities in class

Example of a group discussion focusing on the different between single animals vs. herd management

Task and results on the differences between bacteria and virus:



ETH zürich

Gruppenarbeit

Bitte ordnet in der Gruppe die erhaltenen Statements zu und klebt es auf ein Flipchart

Bakterien	Viren

Appendix III – Excursion pig farm and Wrap- up

Questionnaire of the excursion and discussion of questions:

Appendix IV – Mock exam

Example short answer question

Auf einem Milchviehbestand in der Schweiz fällt Ihnen diese Veränderung bei 35% der Tiere auf. Nennen Sie bitte die Veränderung und beschreiben Sie drei Ursachen die dieser zu Grunde liegen.