Academic courses and workshops

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AniBioThreat

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TASK 6.1

ACADEMIC COURSES AND WORKSHOPS

With the financial support from the Prevention of and Fight against Crime Programme of the European Union

European Commission – Directorate – General Home Affairs

WP6

TASK 6.1
ACADEMIC COURSES AND WORKSHOPS

TASK LEADER

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The AniBioThreat project was in 2010 awarded a grant by Directorate General Home Affairs under the programme "Prevention of and Fight Against Crime". One issue stated in the call text in 2009 under this programme was animal bioterrorism threats. The focus of AniBioThreat is therefore based on threats to living animals, animal feed and food of animal origin. As part of this, it is foreseen that the project will enhance international cooperation and promote networking for bridging security with animal and public health.

The objectives are furthermore based upon some of the identified actions in the EU Chemical, Biological, Radiological and Nuclear (CBRN) Action Plan (2009), the recommendations of the CBRN Task Force Report (2009) and especially the work that took place in the Biosubgroup threats to animal, and food and feed for animals (2008), and the Biosubgroup detection and diagnosis (2008, June).

The project is divided into the following six work packages (WPs); WP1 the establishment of a network between law enforcement, forensic institutes, first responders, intelligence, veterinary institutes, public health agencies and universities, WP2 threat assessment, WP3 early warning/detection, WP4 European Laboratory Response Network for animal bio-terrorism threats, WP5 detection and diagnostics and WP6 dissemination.

SPECIFIC OBJECTIVES OF THE WPS ARE AS FOLLOWS:

- To facilitate effective international cooperation, improve training and establish a network between law enforcement, forensic institutes, first responders, intelligence agencies, veterinary institutes, public health agencies and universities (WP1).
- To improve monitoring and threat assessments (WP2).
- To investigate early warning and rapid alert for animal disease outbreaks caused by criminal acts (WP3).
- To establish a European Laboratory Response Network approach to counter animal bio-terrorism threats (WP4).
- To enhance research and development of detection methods of animal diseases, such as anthrax, botulism and viral diseases caused by criminal acts (WP5).
- To disseminate the outcome of the project to relevant stakeholders through exercises, workshops, publications, and academic courses and to strengthen research through existing EU projects (WP6).

The overall objective of AniBioThreat is to improve the EU's capacity to counter biological animal bioterrorism threats in terms of awareness, prevention and contingency.

CAPACITY AND CAPABILITY

The overall goal of the EU CBRN Action Plan is an all-hazards approach to reduce the threat of damage from CBRN incidents of accidental, natural or intentional origin, including acts of terrorism.

This deliverable has improved EU's capacity and capability to counter biological animal bioterrorism threats in terms of awareness, prevention and contingency in following areas:

- ■ **Education and training capacity and capability**
- ■ **Research capability**
- ☐ Risk assessment capability
- ☐ Cooperation/interoperability capability
- ☐ Surveillance and rapid alert capability
- ■ **Diagnostic and laboratory response network capacity and capability**
- ■ **Forensic awareness capability**
- ☐ Contingency planning capability
- ☐ Joint exercise capacity
- ☐ Readiness assessment and medical countermeasure capacity
- ☐ Communication and information sharing capability
- ☐ Strategic, tactical and operational decision making capability

ABSTRACT

Three academic courses related to biothreats were developed and arranged within AniBioThreat, forming an informal research school for the PhD students in the project. The courses were entitled (i) DNA amplification technology, (ii) diagnostic preparedness in an outbreak situation, and (iii) rapid detection, characterization and enumeration of foodborne pathogens. Additionally, two other courses, (iv) biorisk assessment and (v) Bayesian networks, were developed. The AniBioThreat courses were established by experts of various scientific disciplines, and covered biological, mathematical and forensic issues of handling biothreats. The cross-disciplinary approach served to give the students a broad knowledge base in biorisk management. We conclude that one efficient way of educating future experts in bioterrorism preparedness and simultaneously enabling cross-boarder networks between them is to form an international research school for PhD students. We propose that the EC takes the initiative to fund such an education program.

DELIVERABLE ACCORDING TO GRANT AGREEMENT

Academic courses in (i) DNA amplification technology and (ii) diagnostic preparedness in an outbreak situation.

DESCRIPTION OF DELIVERABLE

This deliverable contains descriptions of academic courses developed and organised within AniBioThreat. The aim, focus, content and outcome of each course is described.

CONTENTS

BRIDGING STATEMENT

There are eight PhD students participating in the AniBioThreat project, and their projects are based on the following traditional scientific disciplines: veterinary medicine, food safety, forensic science, and mathematics and computing science. By offering a suite of academic courses (and the accompanying ECTS credits), AniBioThreat can stimulate collaboration between the aforementioned scientific disciplines and improve the education of PhD students as well as cooperation between partners.

By infusing these PhD students with a cross-disciplinary vision, AniBioThreat is forming the basis for the next generation of experts in the field of CBRN and biopreparedness. By developing the research cooperation within the project and identifying the courses and expertise available at various institutes within the project, the EU's capacity to prevent and respond to bio-crimes and bioterrorism will improve.

LINK TO EU CBRN ACTION PLAN

B.15 (second bullet point)
Member States together with the Commission should identify and spread:

- good practices on academic training on biosafety, potential misuse of information and biological agents and toxins, and bio-ethics for undergraduate, graduate and postgraduate students.

OTHER RELEVANT ACTIONS

None

CONTRIBUTION TOWARDS OVERALL OBJECTIVE OF ANIBIOTHREAT

This task contributes to the overall objective of AniBioThreat by providing relevant, tailor-made academic courses for biosafety students and personnel. It will also contribute to the determination of basic training requirements, training good practices, and an overall curriculum for biosafety personnel throughout the EU. Additionally, the courses serve as a platform for networking between scientific disciplines, governmental bodies and countries.

TASK LEADER

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AIM

To provide academic courses that focus on biosafety and biosecurity rules, transportation rules, import and export control, diagnostic analysis of biothreat agents, biosafety and biosecurity in animal by-products, feed and food industry and biosecurity on the farm level, thus meeting the educational needs for the next generation of experts within biosafety.

BACKGROUND

As identified in the relevant actions in the EU CBRN Action Plan[1] and the relevant recommendations in the CBRN Task Force Report[2], this task provides relevant academic courses that determine good practices and minimum requirements on academic training for biosafety issues. The courses offered in this task will begin the development of a code of conduct for professionals working on bio-issues, define requirements for training, and define good practices for relevant training.

METHODOLOGY

Three academic courses were developed and organised within AniBioThreat. Two of the courses were defined when the project was initiated, i.e. DNA amplification technology (ULUND) and Diagnostic preparedness in an outbreak situation (SLU). The third one, i.e. Rapid detection, characterization and enumeration of foodborne pathogens, was developed during the project to meet an expressed need from the PhD students within AniBioThreat. To meet the interest from participating organisations, DNA amplification technology was organised three times, i.e. once more than what was initially planned. Additionally, syllabuses were prepared and course organisations formed for two other courses, entitled Biorisk assessment and Bayesian networks. These two courses complement the three other courses described above in giving the next generation of experts a broad understanding of the biological, mathematical and forensic issues of handling an outbreak situation. *Figure 1* shows how the five courses are related to each other, and how they connect to the work process in biorisk management. Due to time and budget limitations, Biorisk assessment and Bayesian networks were not offered within the three years of AniBioThreat, but could easily be executed should there be an interest from a funding body. The courses organised together form an informal AniBioThreat research school.

Course evaluations were performed after completing each course *(see Appendices 1–5)*, and the outcome was fed back to the course organisers in order to continuously improve the quality of the courses.

Additionally, workshops focused on evaluating the courses and planning for coming courses were held at the first AniBioThreat annual meeting and subsequent Work package 6 meetings, with participation from both students and senior scientists including course organisers.

The academic courses within AniBioThreat were tailor-made to give young researchers and practitioners a broad knowledge base for working in CBRN/ bioterrorism preparedness, extensive training in relevant diagnostic methods as well as a deep understanding for the overall process of handling complex bioterrorism cases *(Table 1)*. The courses also served to initiate networking by bridging professionals from different governmental agencies and countries, and to enable inter-disciplinary learning by bridging researchers from different scientific fields. The individual courses are presented and described on the following pages.

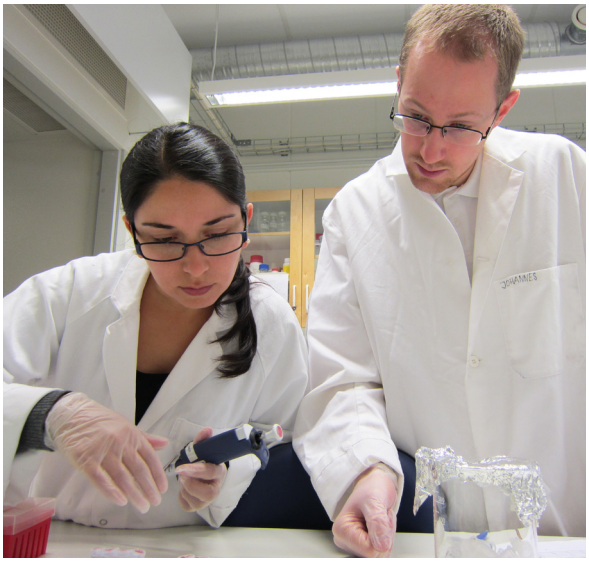
Overview of courses

Given courses:	Planned courses:	Additional course support:
DNA amplification technology (3 ECTS)	Biorisk assessment (3 ECTS)	Workshop on Classical and Molecular Veterinary Virology
Diagnostic preparedness in an outbreak situation (2 ECTS)	Bayesian networks (3 ECTS)	Early warning and strategic analysis
Rapid detection, characterization and enumeration of foodborne pathogens (2.5 ECTS)		

Table 1. Overview of a tentative outline of a future EU biopreparedness syllabus.

DNA amplification technology (3 ECTS)
– Course given on three separate occasions

- **Course venue:** Division of Applied Microbiology, ULUND.
- **Course leader:** Johannes Hedman.
- **Dates:** 10–14 October 2011 (#1); 15–19 October 2012 (#2); 19–23 August 2013 (#3).
- **Organisation:** One week, full-time.
- **Participants:** In total 24 participants, i.e. eight participants during each course week. The participants came from seven organisations in four countries: Chalmers Institute of Technology, Göteborg, Sweden; Directorate of Veterinary Medicinal Products, Hungary; DTU; Norwegian Institute of Public Health, Oslo, Norway; SKL; SLU; and SVA. Seven of the participants were PhD students within AniBioThreat.
- **Aim:** After completing the course the students should have a deep understanding of the biochemical and physical processes that constitute the polymerase chain reaction (PCR), thus giving them the tools for using, designing, optimising, troubleshooting and evaluating PCR/qPCR assays in a scientifically and forensically sound way.
- **Description:** Real-time quantitative PCR (qPCR) has tremendous potential for accurate and sensitive detection and quantification of biothreat agents. However, careful considerations regarding sampling, sample preparation and reagent optimisation are required to enhance the analytical level of detection and minimise the risk of false-negative and false-positive results. The course covered real-time qPCR analysis from sampling to evaluation of results, applying an integrative pre-PCR processing approach. Included topics were (i) absolute and relative quantification of DNA/RNA, (ii) conventional PCR vs. qPCR, (iii) reverse transcription qPCR, (iv) optimisation and kinetics of qPCR (v) primer/probe design, (vi) sample preparation (DNA/RNA), (vii) understanding and relieving PCR inhibition, and (viii) quality assessment of qPCR results. Laboratory exercises were integrated with the lectures and served to illustrate essential theoretical aspects of PCR design and kinetics. The obtained results were thoroughly discussed within the course. Additionally, various applications of PCR/qPCR, such as diagnostic PCR, digital PCR, forensic DNA analysis, gene expression, and high resolution melting, were presented and discussed.
- **Examination:** Active participation in practical laboratory work including oral presentations of results and discussions was required for a passing grade. The students were examined through preparing and giving oral literature presentations on chosen topics related to biosafety and PCR-based analysis. All students served as opponents, critically evaluating the individual presentations.
- **Course evaluation:** *See Appendices 1, 2 and 3.*



Participants in the DNA amplification technology course performing practical laboratory work. The practicals serve to illustrate theoretical aspects of PCR-based DNA analysis, and are an important part of the AniBio Threat PhD student course.

Diagnostic preparedness in an outbreak situation (2 ECTS)

- **Course venue:** Swedish University of Agricultural Sciences (SLU) in Uppsala, Sweden. Course given in collaboration with SVA.
- **Course leader:** Anne-Lie Blomström, SLU
- **Dates:** 21–25 May 2012.
- **Organisation:** One week, full-time.
- **Participants:** 14 PhD students from seven organisations in three countries: DTU, SLU, SVA, SKL, Uppsala University, Sweden, and Instituto de Investigación en Recursos Cinegéticos (IREC) and Makerere University in Uganda. Six of the students were members of the AniBioThreat project. The course was announced within the AniBioThreat network as well as registered and announced as a 2 ECTS PhD course at the Swedish University of Agricultural Sciences.
- **Aim:** The objective of the course is to give the students an overview of the steps taken in a disease outbreak situation, including how to work in the field, safety and security issues, facts about significant bioterrorism agents and diseases, and knowledge about modern diagnostic methods.

Computer work for the participants.

- **Description:** A fast and accurate diagnosis is crucial in a disease outbreak. Knowledge of the present and future technologies used for pathogen detection and identification is important for staff in various disciplines within biosafety as it allows a better understanding of the results and statements given by the laboratories in an outbreak situation. The course was composed of lectures and practical laboratory training. The course covered (i) introduction to infectious agents, (ii) tools and strategies for controlling the outbreak of a disease, (iii) laboratory preparedness, (iv) risk assessment, (v) pathology, and (vi) development and validation of methods for pathogen detection and characterisation. The following analysis techniques/methods were thoroughly described: qPCR, Luminex, Plex-ID, metagenomics, and sequencing. Biosecurity issues and GLP rules were also handled. The practical training consisted of a wet-lab with DNA extraction and qPCR, illustrating the importance of choosing an efficient sample treatment method, and a hands-on computer exercise on bioinformatics, showing how the open access EMBOSS software package can be used to handle and analyse sequence data. Through lectures and practical training, the course provided the students with training in biosecurity, pathogen identification and raised awareness of intentional spread of infectious agents.
- **Examination:** Group assignment on risk assessment for a particular scenario. Individual preparation of a written report describing a strategy of how to deal with a specified disease outbreak.
- **Course evaluation:** See *Appendix 4*.

Rapid detection, characterization and enumeration of foodborne pathogens (2.5 ECTS)

- **Course organiser:** DTU, Copenhagen, Denmark.
- **Course leader:** Jeffrey Hoorfar
- **Dates:** August 2012.
- **Organisation:** Online course.
- **Participants:** 12 PhD students from five institutes in five countries: DTU; Freie University of Berlin, Germany; Lithuanian University of Health Sciences; SLU; and Wageningen University, The Netherlands. Four of the students were members of the AniBioThreat project.
- **Aim:** To provide students with a thorough overview of important issues in the response to an outbreak of foodborne illnesses, with specific focus on the following themes: (i) critical considerations in setting up rapid analysis methods, (ii) current detection and typing methods, (iii) fresh produce, water and seafood testing for pathogens, and (iv) future of advanced laboratory methods.
- **Description:** Traceability of microorganisms and their toxins along the entire food production chain and the use of advanced methods to trace and track these are essential to ensure the safety/security of the food chain. This course reviewed the most important food-borne pathogens that can be transmitted through the food chains to humans. It provided a thorough introduction to advanced molecular methods for detection, enumeration and characterization. It presented a structured and detailed description of main pathogens and their specific detection from the point of sampling through sample preparation, analysis and data analysis. The following book was used in the course: Rapid Detection, Characterization and Enumeration of Foodborne Pathogens (2011). Hoorfar J. (ed.). American Society for Microbiology. Washington, D.C., USA. ISBN 978-1-55581-542-4.
- **Examination:** The students were examined through four web-based writing assignments.
- **Course evaluation:** See *Appendix 5*.

Planned course: Biorisk assessment (3 ECTS)

- **Course venue:** Swedish University of Agricultural Sciences (SLU) in Uppsala, Sweden.
- **Organisation:** One week, full-time.
- **Course leader:** Fredrik Granberg, SLU.
- **Aim:** After finishing the course the student should (i) be able to communicate biorisk information with a preparedness perspective, (ii) be able to make a risk assessment for given situations in a lab environment, the transportation chain, and farm environment, (iii) have knowledge of the major informatic resources for managing outbreaks as well as be familiar with their use in practice (e.g. selected agents list and outbreak watch), (iv) be able to formulate their own thoughts about possible dual-use issues connected to their field of science, and (v) given a set premise be able to formulate an action plan for assessing possible biorisk and suitable actions for minimising that risk.
- **Description:** The course aims at integrating the major control factors of a possible biorisk incident thereby providing deeper understanding of prerequisite needs in training and logistics needed for managing a biorisk incident. The course integrates with the previous course Diagnostic preparedness in an outbreak situation, however, that course is not a prerequisite for taking the course. The course combines lectures and case-based

study with problem-based learning sessions, the focus is on integrating knowledge from several fields (Command, Communication and Control).

- **Examination:** Examination is performed by attendance (80% of lectures) and one short presentation about dual use of science as well as a larger hand in assignment: formulating a biorisk action plan.

Planned course: Bayesian networks (3 ECTS)

- **Course venue:** SVA, Uppsala, Sweden. Course given in collaboration with SKL.
- **Course leader:** Anders Nordgaard, SKL.
- **Organisation:** One week, full-time.
- **Aim:** Upon completion of the course, the participants should be able to (i) use knowledge about basic probability models and graphical network analysis for evaluation of various types of evidence within the fields of forensic genetics, epidemiology and chemistry, (ii) display good understanding of major principles for formulation of hypothesis and likelihood ratios and the construction of Bayesian networks, (iii) estimate likelihood ratios from empirical data and interpret their values on ordinal scales of conclusion, and (iv) use standard software for Bayesian networks.
- **Description:** Bayesian networks are graphical models for probabilistic reasoning and have wide-spread use. In particular they serve as good tools for reasoning about forensic evidence, allowing for flexibility with respect to assigning probabilities, but still avoiding intrinsic mathematical formulas. The focus of the course is the application of Bayesian networks to simple and intermediate level problems regarding forensic findings that are expected to support propositions about the state-of-nature, e.g. about the source of a biothreat agent. The course covers (i) the concept of probability and Bayes' theorem on odds form, (ii) Bayesian hypothesis testing, hierarchy of propositions and likelihood ratios, (iii) graphical models for probabilistic reasoning and Bayesian networks, (iv) different types of evidence: DNA, illicit drugs and trace evidence, (v) transfer evidence, combination of evidence and pre-assessment, (vi) sources of errors, fallacies and forensic interpretation on ordinal scales, (vii) training in a computer package for Bayesian networks, and (viii) practical cases/scenarios from the course participants. Practical exercises in class and as homework are carried out with use of the free software GeNIe. Through lectures and exercises the course provides understanding of basic concepts and teaches skills employed in the statistical evaluation of physical evidence, with special reference to technical (forensic) evidence used in the jurisdictional process. The text book used is Bayesian Networks and Probabilistic Inference in Forensic Science (2006). Taroni F., Aitken C., Garbolino P., Biedermann A. Chichester: Wiley. ISBN 0-470-09173-8.
- **Examination:** Assignments that should be worked on during the course week and the solution of which should be presented in seminar form the last day of the course.

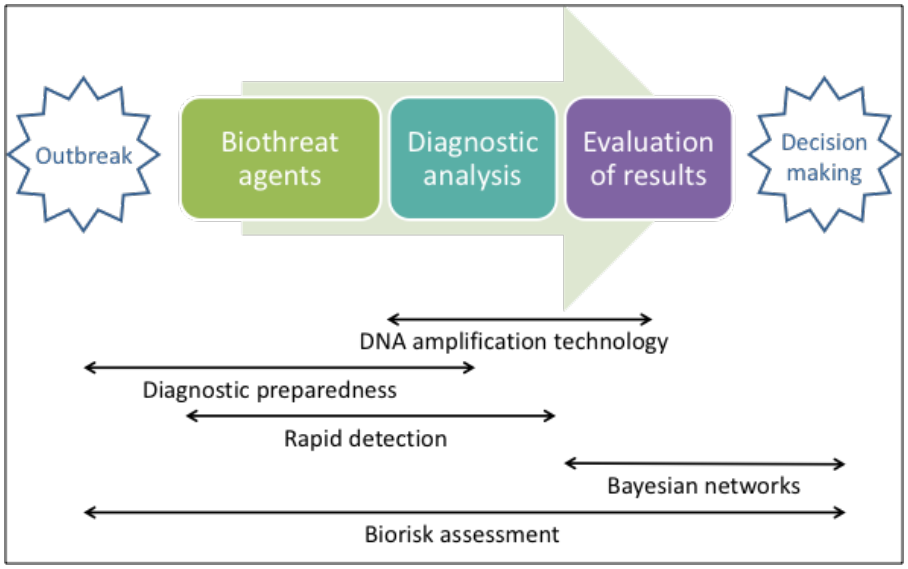


Figure 1. Overview of biorisk management and the AniBioThreat courses. Knowledge about possible biothreat agents, the ability to use and set-up diagnostic analysis methods and carefully evaluate the results, are all vital aspects in the handling of a bioterrorism event. The five academic courses within AniBioThreat (organised and planned) together span the whole process from outbreak to governmental decision making, giving the participants an overview of the different subjects as well as deeper knowledge on critical details.

Additional course support

Apart from the courses developed and organised within AniBioThreat, the consortium provided financial support for a course entitled Workshop on Classical and Molecular Veterinary Virology, organised by the International Atomic Energy Agency (IAEA) and the Food and Agriculture Organization (FAO) of the United Nations through the Joint FAO/IAEA Division of Nuclear Techniques in Food and Agriculture and the Animal Health Service (FAO-AGAH), in Vienna, Austria, 28 November to 9 December 2011. Several oganisations, other than AniBioThreat, supported the workshop; EPIZONE, ConFluTech, ESVV and the University of Veterinary Medicine Vienna. The two-week intensive course spanned the full range of molecular as well as classical methods for detection and diagnosis of viral diseases in animals. The course mixed theoretical sessions with lab work and hands-on training. The 20 participants came from 19 countries in Europe, Asia and Africa. The professions varied from PhD students to post docs to field veterinarians and epidemiologists. Oskar Karlsson participated in the course representing AniBioThreat.

Laboratory work

Presentations at the Early warning and strategic analysis course.

Another organised course was the Early Warning and Strategic Analysis Course, 21–23 of May, 2013, Stockholm, Sweden. The course was an initiative in AniBioThreat Task 3.2 and the Swedish National Defense College in cooperation with Mr Ken Knight and Mr Mark Polyak, Centra Technology Inc, Washington DC, USA. Course participants came from Sweden, Denmark, Norway and UK from various sectors such as law enforcement, public and animal health. PhD students were also invited. The 3 day course contained lectures about 3D warning and surveillance systems. The aim of the course was to infuse a collaborative culture for early warning and strategic analysis related to bio- and agroterrorism. The course pinpointed a need to educate law enforcement and public and animal health experts together concerning early warning for bio- and agroterrorism.

RESULTS AND DISCUSSION

Efficient biorisk assessment and bioterrorism management requires experts with a broad knowledge-base in microbiology, diagnostic methods and mathematical statistics. Additionally, strong networks are needed, i.e. between countries, governmental bodies and scientific disciplines. The academic courses organised within AniBioThreat have provided training and knowledge for PhD students and young practitioners, and have also formed a foundation for networking for this next generation of experts. In total, academic courses summing up to 130 ECTS were provided to young scientists within the expanded AniBioThreat network, including not only partners but also specifically invited persons from relevant organisations, e.g. within forensic science and mathematical statistics. The students came from 13 organisations in seven countries, including the EU countries Denmark, Germany, Hungary, Lithuania and Sweden, plus Norway and Uganda.

Course evaluations were performed *(see Appendices 1–5)* in order to get the students' views of the organisation and content of the courses. The outcome of the evaluations was then used to improve the quality of the courses. As an example, following the evaluation of the first DNA amplification course some work was dedicated to improving the overall planning and performance of the course, as well as the amount and quality of the literature used and other hand-out material. The course evaluations following the second and third DNA amplification course gave considerably higher ratings concering the overall quality, the planning and the handouts *(see Appendices 1, 2 and 3)*. The course evaluations were generally positive. Different evaluation forms were used for the different courses, complicating comparisons and the overall analysis of the evaluations. In the future, it would be beneficial to streamline the course evaluations, i.e. using the same set of questions.

During the AniBioThreat project, the expressed educational needs from the PhD students and senior experts lead to the development of additional courses, complementing the two that were originally defined in the proposal. A decisive factor for taking these needs and requests from ideas to organised courses were the workshops/meetings held at the first annual meeting and subsequent Work package 6 meetings. Both students and experts participated in the work-

shops/meetings, making it a good environment for collecting all viewpoints on the educational needs within biosafety, as well as finding the ideal persons and organisations for developing and organising relevant courses. The process of working with the academic courses lead to the realisation of the power that lies in combining courses from different scientific disciplines as a means to give the young researchers a solid overview of the complex handling of biological threats and events. Two of the courses were organised as one-week intense courses, giving the participants the chance to network. In the course evaluation, the networking and exchange of knowledge between different scientific fields was highlighted by the students as one of the main benefits of the courses.

CONCLUSION

This deliverable has improved EU's capacity and capability to counter biological animal bioterrorism threats by providing knowledge, training and networking oppurtunities for PhD students and other young professionals in the field of biosafety. In a greater scope, the developed courses strengthen EU's education and training capacity and capability and can be used in future education programs.

FUTURE OUTLOOK AND RECOMMENDATIONS:

Establishing a Biopreparedness Research School

To handle biological threats, events or acts of bioterrorism national experts with a broad knowledge in all aspects of biorisk management need to be connected in cross-boarder networks. It is not feasible to meet the educational needs of the next generation of experts by employing national programs and courses, due to the low number of students and experts in each specific country. Based on the experience from organising the academic courses within AniBioThreat, we conclude that one efficient way of educating future European experts in bioterrorism preparedness and simultaneously enabling networks between them is to form an international research school for PhD students. At this moment, no such research school is available within the EU.

We propose that the EC takes the initiative to fund a Biopreparedness Research School. The five courses developed within AniBioThreat, spanning from understanding of biothreat agents, issues regarding diagnostic nucleic acid analysis, evaluation of analysis results, and statistical methodology, can serve as a model for the research school. The establishment of a Biopreparedness Research School based on these courses will stimulate collaboration between the scientific disciplines involved in biothreat situations, i.e. crisis management, food safety, forensic science, veterinary medicine, and mathematics and computing sciences *(Table 1)*. Additionally, it will improve the education and supervision of PhD students and collaboration between different governmental bodies and countries. The formation of a course syllabus in the field of biopreparedness will contribute to a better planning of relevant graduate courses. Also, the Research School will provide new European PhDs forming the basis for the next generation of experts in the field of CBRN and biopreprepredness.

The international network of experts that was established through AniBioThreat provides a strong foundation for meeting the future education needs within biosafety and bioterrorism preparedness in Europe. Following the implementation of a Biopreparedness Research School, similar EC funded programs can be developed within the other branches of CBRN.

ACKNOWLEDGEMENTS

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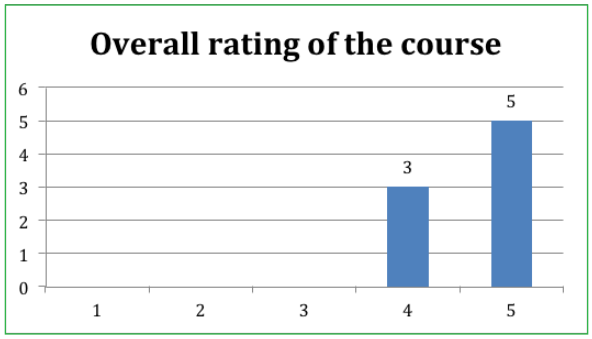
REFERENCES

1. Council of the European Union. EU CBRN Action Plan2009. Available from: http://register.consilium.europa.eu/pdf/en/09/st15/st15505-re01.en09.pdf.
2. EU CBRN Task Force. Report of the CBRN Task Force2009. Available from: http://www.ebsaweb.eu/GGTSPU-argusgate02.bfr.bund.de-25391-3642556-NGrXC2DO2OxJ1pJL-DAT/ebsa_media/Downloads/EBSAActivities/Biosecurity+and+Bio_preparedness-p-877/CBRNupdate02_02_2009-p-1180/CBRN+TF+Report_20_01_2009.doc.

APPENDIX

Appendix 1: Course evaluation, DNA amplification technology #1, 10-14 October 2011

The evaluation form consists of five questions/statements, where 1 is the lowest rating and 5 is the highest. The course had 8 participants and all of them completed the evaluation form.

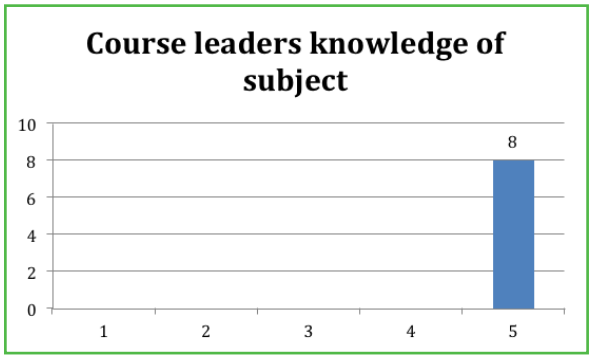


1: Overall rating of the course – Would you recommend the course to others?

(8 answers)

Average rating: 4.6

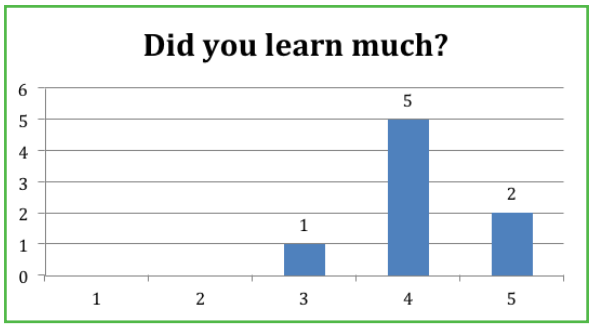
Comment: "Good course with interesting discussions. Perfect number of participants"



3: The course leaders knowledge of the topic of this course *(8 answers)*

Average rating: 5.0

Comment: "They knew it all"

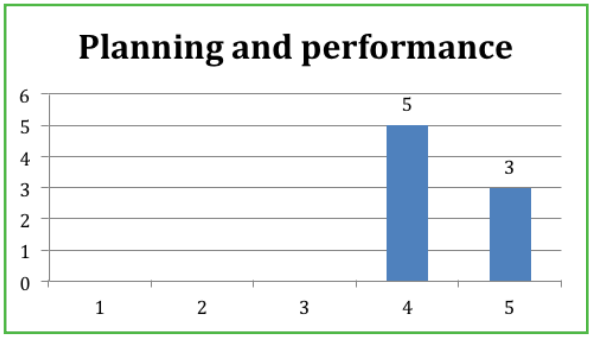


2: Did you learn much or not? *(8 answers)*

Average rating: 4.1

Comments: "I, like many others, thought that I understood PCR, but now it feels like I really understand"

"In some areas I expanded my knowledge, some things I already knew"



4: The course leaders planning and performance in this course *(8 answers)*

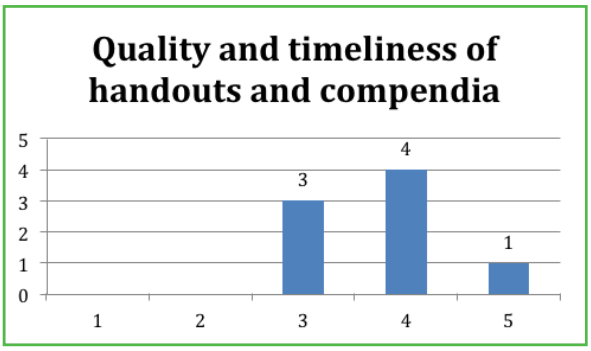
Average rating: 4.4

Comments: "I would have wanted some more time to prepare the literature assignment"

"The structure was good"

"Mixing lectures and lab exercises worked really well"

"Very well prepared lab exercises which gave interesting results for the discussions"



5: Quality and timeliness of handouts and compendia received during the course *(8 answers)*

Average rating: 3.8

Comments: "Well explained laboratory manuals"

"Would have been good to get handouts before the lectures"

"Would have wanted more reference material to bring home"

What was best with this course?

"The combination of lectures, lab exercises and discussions"

"The mix between theory and practise"

"The discussione of lab results. The lab exercises were well connected to the theory lectures"

"Very nice student group, we complemented each other"

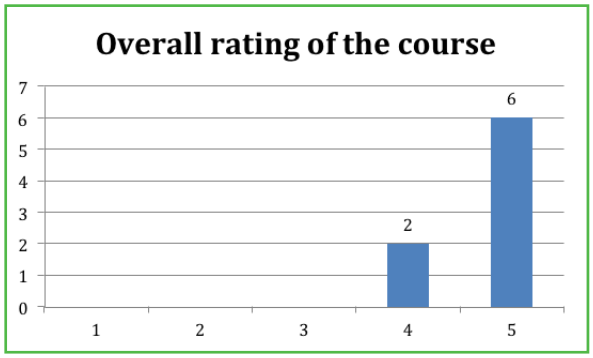
"Networking with other students, and the high activity of the students in the lectures"

"Good that the lecturers stopped to explain some things when all students were not following"

"A lot of time for questions and discussions instead of "old-fashioned" lectures"

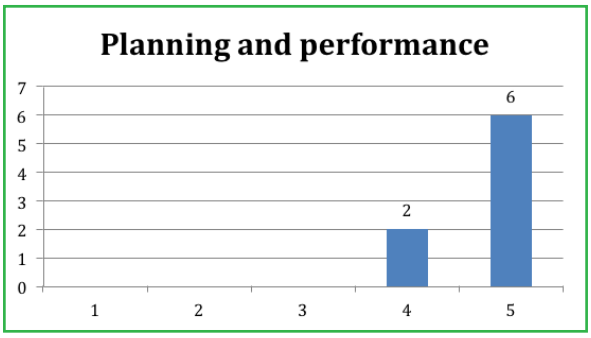
Appendix 2: Course evaluation, DNA amplification technology #2, 15-19 October 2012

The evaluation form consists of five questions/statements, where 1 is the lowest rating and 5 is the highest. The course had 8 participants and all of them completed the evaluation form.



1: Overall rating of the course – Would you recommend the course to others? *(8 answers)*

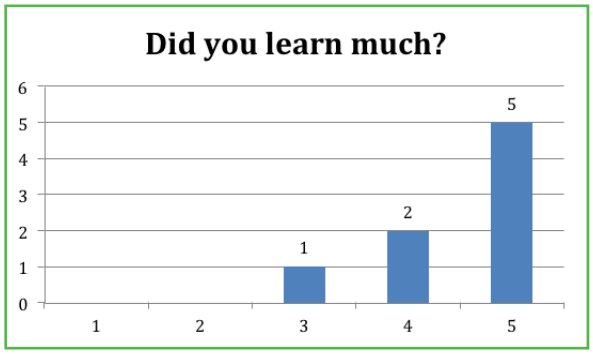
Average rating: 4.8



4: The course leaders planning and performance in this course *(8 answers)*

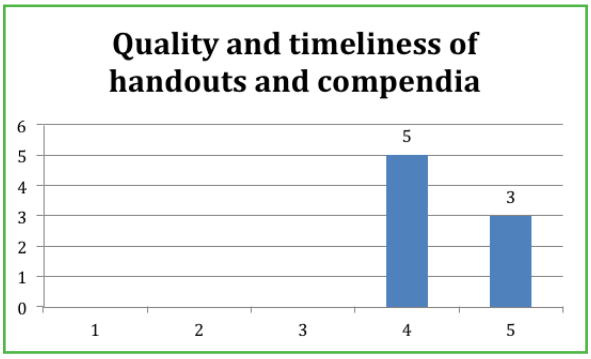
Average rating: 4.8

Comments: "The theoretical sessions were long sometimes (too few breaks)"



2: Did you learn much or not? *(8 answers)*

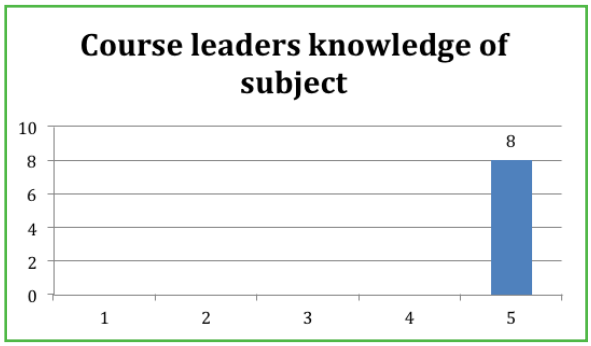
Average rating: 4.5



5: Quality and timeliness of handouts and compendia received during the course *(8 answers)*

Average rating: 4.4

Comments: "It was good that we got handouts before the lectures"



3: The course leaders knowledge of the topic of this course *(8 answers)*

Average rating: 5.0

What was best with this course?

"Great discussions and nice mood"
"The practicals and the discussions!"
"Good group composition."
"Good balance between theory and practise. Good group size for discussions etc"
"Good disucssions, good networkinng"
"People attending the course had different backgrounds. Learned a lot from each other. Fantastiska lärare!"
"Mix of people. Experiment 3 (Optimisation of PCR)"

Suggestions for improvements of course

"Setting up qPCR from the start in theory"
"Higher level on theory"
"Change some experiments slightly (eg. reagent concentrations in experiment 3)"

Appendix 3: Course evaluation, DNA Amplification Technology #3, 19-23 August 2013

The evaluation form consists of five questions/statements, where 1 is the lowest rating and 5 is the highest. The course had 8 participants and all of them completed the evaluation form.

1: Overall rating of the course – Would you recommend the course to others?

Average rating: 5.0
Comments: "A lot of very useful information, not only in theory but also in practise"
"Excellent mix of lectures, discussions and lab"
"I felt that I learnt everything that is worth learning about PCR"

2: Did you learn much or not?

Average rating: 5.0
Comments: "Sometimes even too much :)"
"Better than I ever could expect!"

3: The course leaders knowledge of the topic of this course

Average rating: 5.0
Comment: "Brilliant course leaders"

4: The course leaders planning and performance in this course

Average rating: 4.9

5: Quality and timeliness of handouts and compendia received during the course

Average rating: 5.0

What was best with the course?

"The focus of understanding the PCR!"
"Lecture regarding forensic medicine was a very nice idea"
"A lot of practicals and further discussions based on obtained results"
"That I learned a lot of new things that I can use in my daily work"
"I learned a lot and cleared many questions marks! :)"
"The discussions and the comprehensive descriptions"
"Very good structure and pedagogic experiments"
"The course covered my expectations 100%"
"Planning and prework by the leaders was excelent. Perfect balance between theory and practicals"
"The combination between practicals, theory and discussion"

Suggestions for improvements of course:

"Maybe a social event/dinner to start networking?"
"No suggestions. Thank you for a great course!"
"Keep it as it is!"

Appendix 4: Course evaluation, Diagnostic preparedness in an outbreak situation, 2 ECTS (SLU-P0073)

The evaluation form consists of ten questions/statements. The course had 14 participants and all of them completed the evaluation form. The outcome is presented through the students' statements, and a summary of all student comments.

Course evaluation form with students´ answers

The main objective with this course is to give a general overview of the steps taken in a disease outbreak situation. The focus is on modern technologies and methods used for pathogen identification. The course includes lectures on different technologies, such as PCR, Luminex, metagenomics and sequencing, used to identify the agent in an outbreak situation. Introduction to significant agents and diseases is also included as well as lectures describing real outbreak situations. The course also has a practical lab part including wet lab and sequence analysis through bioinformatics.

1. How do you think that these learning outcomes of the course have been accomplished?

"I think that this course have given me a nice introduction to diagnostic preparedness and even some tools that I can use in my Ph.D project."

"Very well! I am very happy with the course. There could have been a little bit more extensive information of "infectious agents and relevant diseases"

"I think they have been accomplished perfectly"

"Very good"

"On my part they were accomplished to a great extent"

2. What was your impression of the course as a whole?

"I thought it was a good course."

"Very good."

"Very complete, as I didn't have a background in biomolecular technics some of the talks were difficult to me but I feel that know I have new tools to use in case I need them."

"It was very good, nice with so many different areas of work."

"I liked the course, but more time for more hands on."

"Well coordinated."

3. What was the best thing with the course?

"The movie-night
Coffee and tea (it keeps the students awake)"

"The mix between how to handle an outbreak in the field (sampling etc) and in the lab. And the connection to risk assessment and disease control (those two parts were really good)."

"The best thing of the course was that it was very dynamic and treated lots of different subjects so it was impossible to get bored"

"The combination of theory and case stories"

"Lots of new information"

"Committed and highly knowledgably presenters"

4. What was bad?

"Some of the lectures lasted longer than planned."

"Unfortunately a little bit too much focus on the work at SVA at some times."

"The talks that were too technical"

"Can not think of anything"

"It was to theoretical"

"A lot of things covered in a short time and only one practical session"

5. What do you think about the practical lab part?

"I liked it because I got to try out the forensic cards, but there was not much to do – Maybe you could consider expanding the lab-work a bit."

"Very well chosen pratical lab. "

"I didn't know that technique and I think it can be useful for me with the lab part I came to know it and now I have a better view of it "

"It was good to try the extraction methods, maybe some more technology demonstration"

"Was good but in the future you could target participants who may have nerver been exposed to PCRs"

"Well conducted"

6. What do you think about the computer exercise?

"It did not work on all the computers (apparently some problem with Internet Explorer) and it was maybe a bit too easy. – There was a lot of things to read, maybe next time, you could hand out the material the day before and make the exercises a bit more specific to a case. Also very well balanced, enough to get people started and interested I think."

"It was very interesting but I am still not using those programs, anyway it is good to know "free" programs otherwise you ended up using the most popular ones."

"It was good but it would have been good with some in-depth sequence work"

"It was good. We were given time to practise"

"Very good but needs more time/sessions"

7. Suggestions for improvements

"More focus on case-studies. "

"Don´t have it. It would have been nice to do some "outbreak training"."

"It would have been good with more case stories and technologies on bacteria."

"More time for the course. More hands on training."

"Increase the number of practical lab exercises to 2."

8. The course gives 2 credits in the PhD education, which should correspond to 1 week and approximately 2 days of work. Do you think that this corresponds well to the time you spent/the work you have done?

"Yes"

"That is about correct I think"

"Absolutely"

"Its fits good"

"Yes"

"Yes but tending to 3c course"

9. What is your opinion about the number of participants in this type of course (e.g. minimum/ideal/maximum)

"12 is fine"

"Ideal. Especially the mix of the participants, from different countries, different background was very good."

"Around 20 is perfect"

"Ideal for the presentations can probably be twice (i.e., 30 or more) the number we were. This might also promote discussions. But for the lab part 13-15 people is probably ideal. Minimum should be 8 or so."

"The number of participants were ideal, specifically of the broad background of the participants"

"That was ideal"

"Ideal"

10. Other comments

"It was a nice course"

"The assignment given was a bit unwelcome since some of us are very busy to get it done"

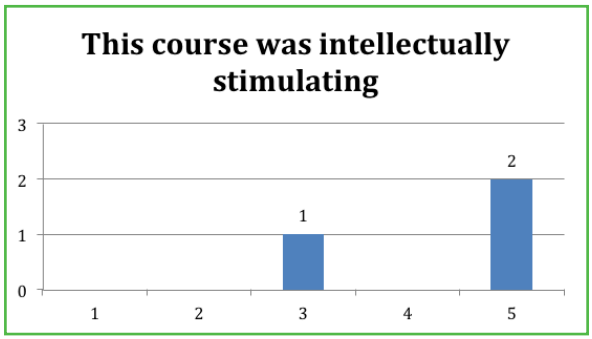
Course evaluation summary

At the end of the course, the students were given a course evaluation consisting of nine questions regarding the content of the course, the different exercises and so on. All participants thought that the intended learning outcomes described in the course syllabus were well accomplished. Their general impression of the course was very good; they felt it covered different areas and that it was well coordinated. One comment was, however, that it could have been more time for hands-on work. Describing what they liked best with the course many participants mentioned that they appreciated that the course covered many different subjects. It was also mentioned that the presenters were good, there was a good combination between theory and cases, and the movie night was also appreciated. Regarding what did not work well in the course, it was mentioned that some lectures were too technical, that the course was a bit too theoretical and that

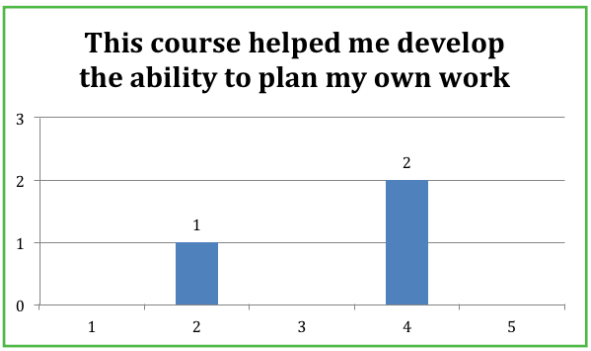
there was only one practical session. Also one comment was that because of a lot of different lecturers, the connection between the different parts of the course was not as strong as it could have been. The practical, wet lab part got a good response, and the students found it well conducted and interesting because many had not previously tried that particular lab method. It was also commented that maybe the lab work could be expanded a bit. Regarding the computer exercise, many of the students found it to be a good introduction to the EMBOSS-package, making them familiar with the different programs. It was suggested to have a case connected to a disease outbreak that the exercise is built around, and that the hand out material could have been distributed more in advance. The students were also asked to make suggestions for improvements and here more focus on case-studies, "outbreak training", more bacteria- related cases and more hands on training was mentioned. A short introduction of the course participants in the beginning of the course was also suggested. All students felt that the 2 ECTS corresponded to the work spent on the course. Regarding the number of participants, many felt that the number – 14 – that participated at this occasion, were ideal and that it was good that the participants had different backgrounds. Some felt it could have been 20–30 persons (if it would have worked in the practical parts) and that maybe that would also promote discussions.

Appendix 5: Course evaluation, Rapid detection, characterization and enumeration of foodborne pathogens (2.5 ECTS)

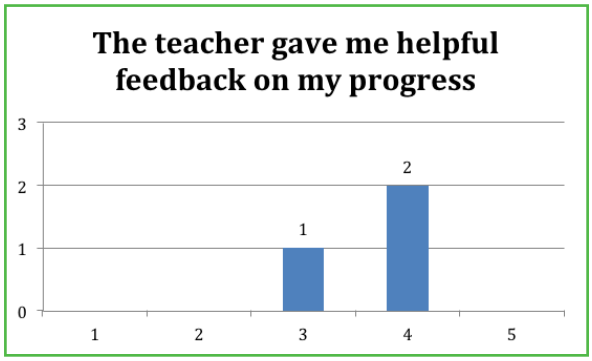
The evaluation form consists of statements, and the students state on what level they agree.
The course had 12 participants, of which 3 completed the evaluation form.
The outcome is presented below.



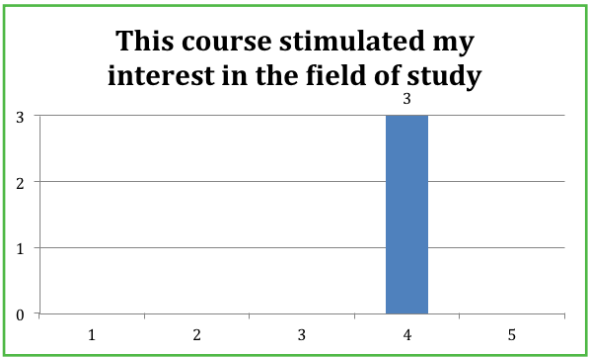
1: This course was intellectually stimulating *(3 answers)*



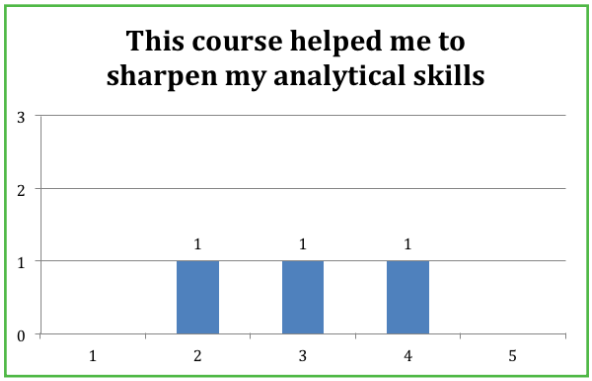
4: This course helped me develop the ability to plan my own work *(3 answers)*



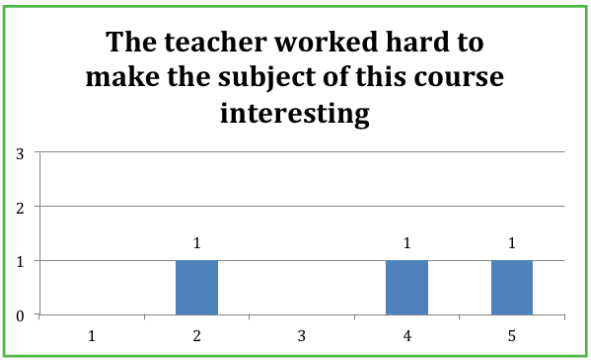
2: The teacher gave me helpful feedback on my progress *(3 answers)*



5: This course stimulated my interest in the field of study *(3 answers)*



3: This course helped me to sharpen my analytical skills *(3 answers)*



6: The teacher worked hard to make the subject of this course interesting *(3 answers)*

What worked well with the course?

"The weekly assignments worked really well in order to sum up the content of each weeks curriculum. I also found it useful to read answers from the other students in the compiled file every week."

What did not work so well in the course?

"I think it was too little actual teaching in the course. The teacher was a bit too anonymous."

Do you have any suggestions for improving the course?

"For each week a presentation (either oral or as powerpoint) could be prepared by the teacher in order to line up the most important issues in the curriculum. The presentation could then catalyze a more active discussion among the students online."

TITLE
"Bio-preparedness measures concerning prevention, detection and response to animal bioterrorism threats"

ACRONYM
AniBioThreat

TOTAL COST
€7.003.992,26

FINANCES
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START DATE OF THE PROJECT
1 October 2010

DURATION
3 years

COORDINATOR
National Veterinary Institute
SVA, Sweden

AniBioThreat

www.anibiothreat.com

BRIDGING SECURITY, SAFETY AND RESEARCH

The aim of the project AniBioThreat is to improve the EU's capacity to counter biological animal bioterrorism threats in terms of awareness, prevention and contingency.

The project will contribute to create a safer and more secure world. To succeed, we need to carry on a borderless dialogue.

AniBioThreat builds bridges across boundaries dividing countries, competencies, and disciplines.

In our work, we strive to be Collaborative, Learning, Efficient, and Alert, to be a Robust organization. Keep it CLEAR!

With the financial support from the Prevention of and Fight against Crime Programme of the European Union
European Commission – Directorate – General Home Affairs