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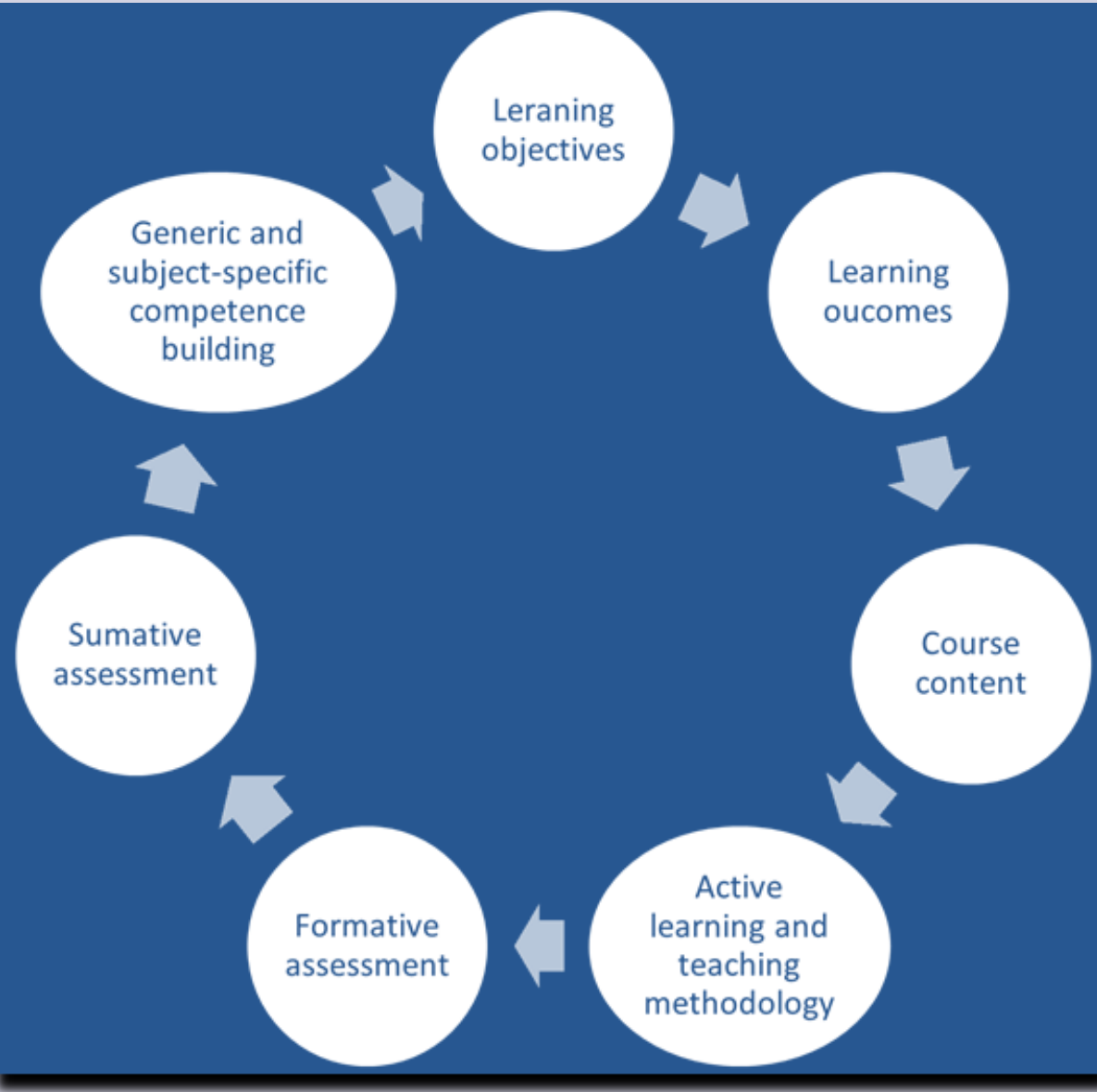
Constructive alignment that includes learning outcomes (LOs), competencies (COs) and formative assessment (FA) and summative assessment (SA) of student learning is very important for the successful teaching by educators and for the acquisition of student competencies.

OBJECTIVES

The aim of the paper is to analyze relationships between LOs, COs and FA and SA of student learning in Farm Animals Biosecurity (FAB) courses and their constructive alignment.

MATERIAL AND METHODS

RESULTS



The authors focus group analyzed 51 references to identify issues related to the definition of LOs, COs, FA and SA related to FAB courses, and tables were created, illustrating relationships between LOs, COs and FA and SA for FAB courses. Tables 1 - 6 were generated and modified by the focus group composed of authors of the poster based on the issues that arose from the review of the references presented in this poster.

FAB courses should equip students with theoretical knowledge, practical skills, and professional attitudes for implementing biosecurity measures in various farm settings. The literature analysis identifies three core competency groups: generic (instrumental, interpersonal, systemic), 21st-century skills, and program-specific competencies. Beyond generic competencies, students must develop a strong foundation in biosecurity principles, including risk analysis, disease transmission pathways, and preventive strategies. This knowledge enables them to perform risk assessments and execute biosecurity protocols effectively. Decision-making competencies at strategic, tactical, and operational levels are also crucial for adapting to evolving biosecurity challenges. Additionally, biosecurity expertise extends beyond technical proficiency to include sociocultural awareness, effective communication, and problem-solving skills.

Assessment methods should integrate formative and summative approaches. FA provides ongoing feedback, while SA evaluates final competency achievement. Traditional written exams assess theoretical knowledge retention, while practical assessments, such as risk analysis exercises, case studies, and simulations, gauge students’ ability to apply knowledge in real-world scenarios.

Scheme 1. Constructive alignment (Hristov et al., 2023)

Tables 1-6. Relationship between Learning Outcomes, Competencies and Formative and Summative Assessment of Student Learning In Farm Animals Biosecurity Courses

| Table 1. Structural Framework for Aligning Learning Outcomes and Competencies |   |
|---|---|
| Component   | Definition in Farm Biosecurity Context  |
| Learning Outcomes   | What students should know, understand, and be able to do upon successful completion of the course?  |
| Competencies  | What the combination of knowledge, skills, values and attitudes should students develop to perform biosecurity-related tasks effectively?                 |
| Assessment Methods  | What are the tools and techniques used to evaluate whether students have achieved the intended learning outcomes and acquired the necessary competencies? |

| Table 2. Learning Outcomes and Their Direct Connection to Competencies and Assessment |   |   |
|---|---|---|
| Learning Outcomes   | Related Competencies  | Assessment Methods  |
| 1. Understanding the principles and importance of farm biosecurity                    | Instrumental: Knowledge of epidemiology, pathogen transmission, and risk factors<br>Systemic: Ability to integrate biosecurity measures into sustainable farm management  | Written exams (Multiple Choice Questions (MCQs), case studies)<br>Oral presentations on biosecurity principles          |
| 2. Identifying and assessing farm biosecurity risks                                   | Instrumental: Risk assessment skills, problem-solving<br>Professional: Application of risk analysis frameworks<br>21st-Century Competencies: Digital biosecurity risk analysis tools  | Practical risk assessment report on a farm<br>AI-based risk assessment simulation                                       |
| 3. Implementing biosecurity protocols in farm settings                                | Professional: Proper use of Personal Protective Equipment (PPE), disinfection methods, animal movement control<br>Interpersonal: Communication with farm staff<br>Systemic: Decision-making in emergency situations           | Practical skills test on biosecurity implementation<br>Farm biosecurity audit report                                    |
| 4. Applying One Health principles in farm biosecurity                                 | Systemic: Understanding zoonotic risks, antimicrobial resistance<br>21st-Century Competencies: Use of data-driven disease prevention strategies<br>Interpersonal: Collaboration with public health and veterinary authorities | Group discussions on One Health case studies<br>Reflective essay on the global impact of farm biosecurity               |
| 5. Using digital tools for farm biosecurity monitoring                                | 21st-Century Competencies: AI, IoT, blockchain applications in biosecurity<br>Professional: Technology-assisted surveillance and data interpretation<br>Interpersonal: Communication, leadership, training skills             | Digital farm biosecurity monitoring project<br>Interactive simulations of disease outbreak scenarios                    |
| 6. Educating farm workers on biosecurity measures                                     | Professional: Ability to translate technical knowledge into practical instructions<br>Systemic: Ethical responsibility for disease prevention   | Recorded training session or workshop for farm workers<br>Peer-reviewed biosecurity education campaign                  |
| 7. Develop and implement farm biosecurity improvement plans                           | Professional: Ability to design evidence-based biosecurity programs<br>Systemic: Long-term strategic thinking<br>Instrumental: Policy and regulatory knowledge  | Farm biosecurity plan project with policy recommendations<br>Presentation to stakeholders on improving farm biosecurity |
| 8. Respond to biosecurity breaches and disease outbreaks effectively                  | Professional: Crisis management skills, emergency response<br>Systemic: Adaptability in changing disease scenarios<br>21st-Century Competencies: Data-driven outbreak management  | Role-playing emergency outbreak response<br>Case study analysis of a real-world biosecurity failure                     |

| Table 3. Assessment Model for Competency Acquisition |   |                                 |
|--|---|---------------------------------|
| Assessment Type                                      | Purpose   | Competency Evaluated            |
| Written Exams  | Test theoretical knowledge of biosecurity principles        | Instrumental (Cognitive Skills) |
| Farm Biosecurity Audit Report                        | Evaluate practical risk assessment and management skills    | Professional and Systemic       |
| Practical Lab Test                                   | Assess biosecurity measures application (PPE, disinfection) | Professional                    |
| Digital Biosecurity Project                          | Apply AI and IoT tools for monitoring farm biosecurity      | 21st-Century Competencies       |
| Training Session Presentation                        | Assess ability to educate others on biosecurity             | Interpersonal                   |
| Policy Proposal for Biosecurity Improvement          | Evaluate long-term planning and systemic thinking           | Systemic and Professional       |
| Outbreak Response Role-Play                          | Assess crisis management and adaptability                   | Professional and Systemic       |

CONCLUSION

The LOs define expected knowledge, skills, and attitudes, while the COs ensure students develop expertise in biosecurity application. Assessment methods verify achievement of these COs. A competency-based approach should blend foundational knowledge with experiential learning and rigorous assessment methods, ensuring students are well-prepared for theoretical and practical biosecurity challenges, including policy implementation, risk assessment, fieldwork, emergency response, and stakeholder communication.

| Table 4. Formative Assessment Methods and Learning Alignment |   |   |   |
|--|---|---|---|
| Formative Assessment Method                                  | Purpose   | Skills/Competencies Assessed  | Implementation  |
| Quizzes and MCQs   | Reinforce theoretical knowledge of biosecurity principles | Instrumental (cognitive understanding of risk factors, disease transmission, regulations) | Weekly online quizzes, in-class rapid polling   |
| Case Study Analysis  | Develop critical thinking and problem-solving             | Systemic (decision-making in outbreak scenarios, One Health approach)                     | Small group discussions on real-world biosecurity failures                            |
| Field Visit Reflection Reports                               | Connect theory with real-world farm biosecurity practices | Professional (risk assessment, evaluation of farm biosecurity measures)                   | Students submit reports after farm visits, analyzing observed biosecurity protocols   |
| Role-Playing Scenarios                                       | Enhance emergency response and crisis management skills   | Systemic and Professional (handling disease outbreaks, stakeholder communication)         | Students act as veterinarians, farm owners, or inspectors in simulated outbreak cases |
| Digital Risk Assessment                                      | Improve use of AI and technology in biosecurity           | 21st-Century (use of digital tools, IoT, AI in biosecurity monitoring)                    | Students analyze real-time farm biosecurity data using digital platforms              |
| Peer Teaching and Video Presentations                        | Encourage knowledge-sharing and communication skills      | Interpersonal (educating farm workers, engaging policymakers)                             | Students create short explainer videos on biosecurity best practices                  |
| Concept Mapping  | Visualize the interconnection of biosecurity measures     | Instrumental (understanding of risk management and mitigation strategies)                 | Students create biosecurity flowcharts linking different farm measures                |

| Table 5. Summative Assessment Methods and Learning Alignment |   |   |  |
|--|---|---|--|
| Summative Assessment Method                                  | Purpose   | Skills/Competencies Assessed  | Implementation   |
| Final Exam (MCQs + Case Studies)                             | Assess theoretical knowledge and application skills           | Instrumental (biosecurity principles, regulations, risk assessment) | Written or online exam with scenario-based questions                           |
| Farm Biosecurity Audit Report                                | Evaluate ability to assess and improve farm biosecurity       | Professional (identifying risks, implementing improvement plans)    | Students conduct a full biosecurity audit of a farm, providing recommendations |
| Practical Biosecurity Simulation                             | Test hands-on skills in biosecurity implementation            | Professional (PPE use, disinfection, quarantine protocols)          | Students participate in a controlled farm biosecurity exercise                 |
| Biosecurity Policy Proposal                                  | Assess ability to develop long-term strategies                | Systemic (policy development, stakeholder engagement)               | Students submit a research-based biosecurity policy proposal for farm settings |
| Outbreak Response Scenario (Viva Voce)                       | Test real-time problem-solving and teamwork                   | Systemic and Professional (crisis management, communication)        | Students respond to a simulated farm outbreak in an oral defense format        |
| Digital Biosecurity Risk Assessment Project                  | Measure competency in using modern technology for biosecurity | 21st-Century (AI, IoT, data-driven disease prevention)              | Students create a digital model assessing farm biosecurity risks               |

| Table 6. Linking Learning Outcomes, Competencies and Assessment Methods |  |  |   |
|---|--|--|---|
| Learning Outcomes (LOs)   | Related Competencies   | Formative Assessment Methods (Continuous Feedback)                   | Summative Assessment Methods (Final Evaluation)                   |
| 1. Explaining the principles and importance of farm biosecurity         | Instrumental: Understanding pathogen transmission and risk factors     | Quizzes and Flashcards on biosecurity terms and principles           | Final Exam (MCQs + Case Studies) on biosecurity principles        |
| 2. Identifying biosecurity risks and conducting farm biosecurity audits | Professional: Risk assessment, evaluation of farm management practices | Case Study Analysis on past farm outbreaks                           | Farm Biosecurity Audit Report evaluating a real or simulated farm |
| 3. Implementing and monitoring biosecurity protocols in farm settings   | Professional: Proper use of PPE, hygiene measures, disinfection        | Practical PPE and Disinfection Demonstration                         | Practical Skills Test on farm biosecurity application             |
| 4. Applying One Health principles in biosecurity planning               | Systemic: Understanding zoonotic risks and antimicrobial resistance    | Debate or Group Discussion on One Health implications in biosecurity | Reflective Essay on global biosecurity strategies                 |
| 5. Using digital tools and AI for biosecurity monitoring                | 21st-Century: Application of technology in disease prevention          | Digital Biosecurity Risk Assessment Simulation                       | AI-based Farm Biosecurity Monitoring Project                      |
| 6. Educating farm workers and stakeholders on biosecurity               | Interpersonal: Communication, leadership, teamwork                     | Peer Teaching Session on biosecurity best practices                  | Recorded Training Workshop for farm workers                       |
| 7. Developing and implementing a farm biosecurity improvement plan      | Systemic and Professional: Strategic planning, policymaking            | Biosecurity Plan Draft + Peer Feedback                               | Final Biosecurity Plan Submission with Policy Recommendations     |
| 8. Responding effectively to biosecurity breaches and outbreaks         | Professional and Systemic: Crisis management, decision-making          | Emergency Outbreak Role-Playing Exercise                             | Oral Defense of Outbreak Response Plan                            |

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